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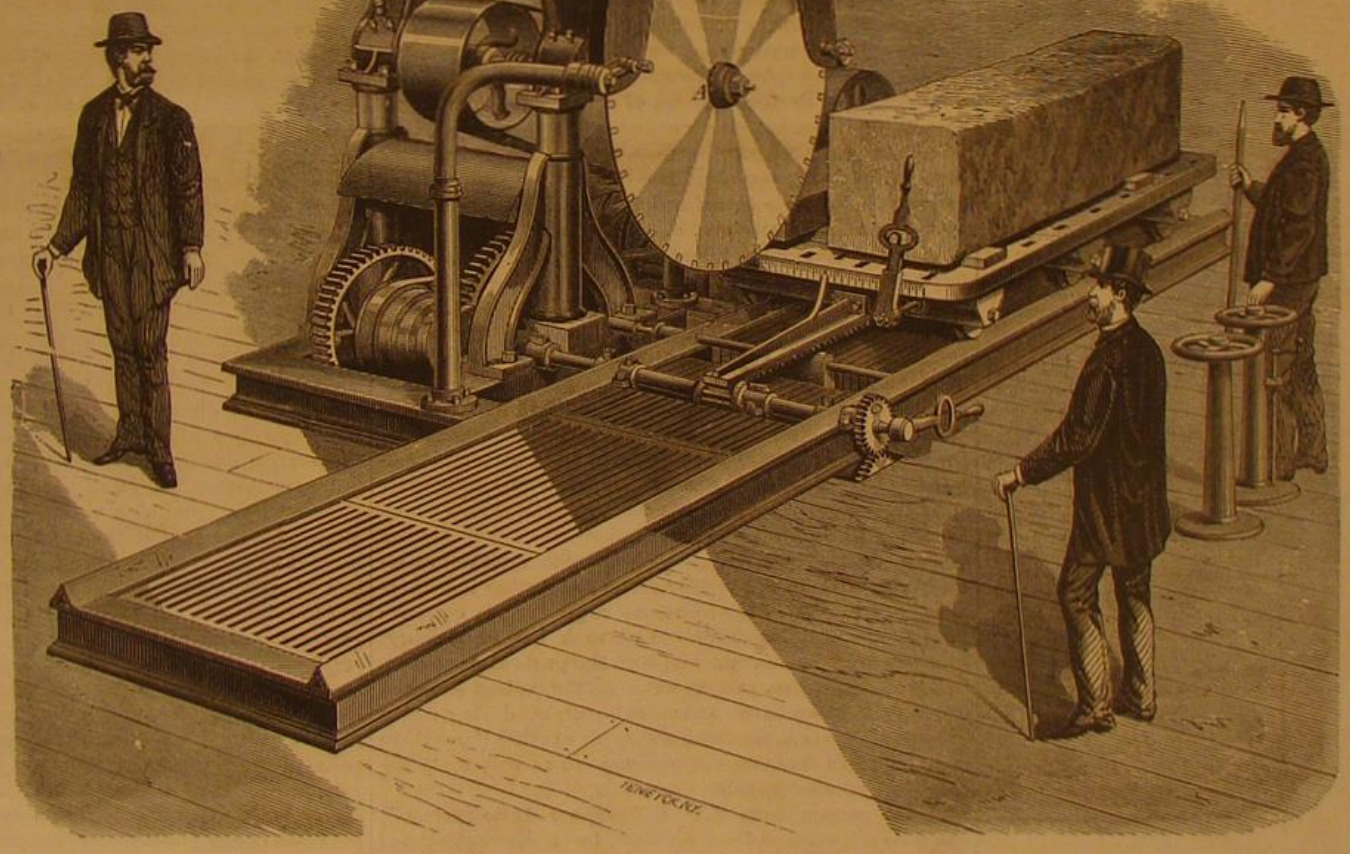
IMPROVED STONE-SAWING MACHINERY.

Since the discovery of the bort carbon, or black diamond, much skill and a vast amount of energy and capital have been expended to render it of practical value to manufacturing industries. It has long been known to scientists as one of the hardest substances in Nature; and it has been, and is still, used by lapidaries in cutting and polishing other precious stones, even the white diamond. It has also given aid to industrial science in improving the diamond drill, and more recently to the mechanic arts, in giving us new cutting tools for use on substances on which iron and steel were useless. But while its value for cutting hard substances, especially stones of various texture and density, has been known and appreciated, its practical utility has been impaired by a difficulty in harnessing it, that is, holding it securely for effective use. A large amount of inventive skill, time, and money has been expended in the attempt to accomplish this, with more or less success; but the attempts were generally entire failures, especially the attempts to saw and work stone The records of the Patent Office, within the last ten years, show the various modes and appliances to this end; and the invention of Mr. Branch has been one of the most practical successes among all such machines

Fig. 2

The circular saw, taking into consideration its unlimited capacity in sawing lumber, was considered by most inventors as the one to which the diamond could best be applied for sawing stone. Mr. Branch's first patent, dated June 8, 1869, was for the insertion of the diamond into a steel or iron holder made in two parts, with recesses for the diamond, and provided with soft metal cushions for the diamond to rest in. These holders were then dovetailed into the edge of the saw disk, and compressed, by a wedging device, the diamond into the soft metal. This saw was a success so far as the cutting was concerned, but the diamond could not be held securely for practical work, and the project was abandoned. Others have attempted improvements on this by brazing the diamonds into iron or steel holders; but the results were no better. The soft metal cushions would yield to the pressure of the work, and the centrifugal velocity of the saw would throw the diamond away. Some inventors, seeing these apparently unconquerable difficulties, regarded the circular saw as impracticable; and attempts were made to apply the diamond teeth to the sash or reciprocating saw, claiming for it greater capacity in the sawing of large blocks. While this merit may be conceded to a limited extent, the reciprocating saw is not equal to the circular saw, either in quantity or quality of work performed; while the risk of losing the diamond was in no wise lessened, except by the use of a sieve or cage to catch the recreant diamond, so that it might be again reset, to be again, as before, thrown out.



BRANCH'S DIAMOND STONE-SAWING MACHINE

Mr. J. W. Branch, the inventor of the machine herewith illustrated, claims to have achieved the secure holding of the diamond in steel or iron holders, without the dubious aid of soft metals, and his Stone Monarch, as he calls this sawing machine, gives the circular saw the same prominence in relation to the stone-working industry as in that of wood-working.

The peculiar manner of inserting the diamond into holders, and these holders into the saw disks, is fully described n letters patent dated August 31, 1875; and the chief merit of this invention is the perfect security given to the diamond under any velocity whatever. The diamond holders are simple in construction (Fig. 2), and are furnished either in the saws completed, or in duplicate, so that any that may become faulty, by undue pressure or otherwise, may be renewed or replaced. They can be inserted into the saw by any practical mechanic, if the saw in other respects be perfect, without his having the skill to set the diamond.

The mode of applying water for lubricating the saws in work, and washing away the grit and dirt, is novel, and is peculiar to these machines. The water is conducted through the center of the mandrel into chambers, and through radial orifices, A, in the saw collars on each side of the saw, causing the water to impinge upon the saw blade, and to be, by the centrifugal force, conducted to the cut. This effects three results: 1. Keeping the journals of the mandrel cool. 2. Keeping the saw cool and even in temperature, preventing all undue expansion. 3. Cleansing the saw from all grit and dirt produced in sawing.

The machinery for conveying the stone is perfectly under the control of the attendant, and is provided with a simple feeding device, adjustable to accommodate the variable texture or density of the stone to be sawn. The saws are also made adjustable relatively to the depth of cut, either entirely or partially through the block, preserving a straight line at the bottom of the cut, but allowing for moldings, rebates, etc.

The table to carry the stone is placed on a series of rollers set in the carriage, which provides for the easy adjustment of the stone at right angles with the saw, so as to cut off any thickness required. The carriages upon which the table is placed is also provided with rollers, fitted upon parallel V ways, and with a feed rack working upon a feed pinion.

It will be observed that there are no slides, and that the roller bearings and journals are all covered, so that the working parts are not impaired by any accumulation of grit or dirt. The saws are used either over or under the work, but preferably over for sawing large blocks and ashlar, and under for edging, crosscutting, and sawing small dimension stone. This range of use is due to the central application of water; as, by the centrifugal velocity of the saw, the water is always conveyed to the cut. In short, these machines are adapted to meet all the requirements of straight line work, without complication; and a large proportion of work required for building can be finished, ready for erection, without the aid of the rubber or hand labor. The saws, moreover, run at the periphery at an average velocity of 10,000 feet per minute, which effects great rapidity and perfection in cutting stone: the difference being due to the variable density of the stone to be cut, varying from 1 to 36 inches per minute, or per 10,000 feet run of the saw. The ordinary freestones and sandstones are sawn by these machines at the rate of from 6 to 36 inches per minute, and marble and limestones at from 3 to 18 inches per minute, or an average from 200 to 800 feet per day, making due allowance for handling of stone.

The manufacturers, Messrs. Branch, Crookes & Co., have on exhibition at the Centennial (section A 16 and 17, saw mill), two of their diamond circular saw stone machines, with the necessary traveling crane and facilities for handling stone. The two machines have 66 and 20 inch saws respectively. The 66 inch saw contains 84 diamonds, and the 20 inch saw 60 diamonds. These machines are kept in operation, practically illustrating what we have already described; and they attract a great deal of attention from visitors to the Exhibition.

Patented to Joseph W. Branch, under dates June 8, 1869, May 27, 1873, and August 31, 1875. For further particulars and for descriptive circulars, address Branch, Crookes & Co., 114 and 116 Vine street, St. Louis, Mo.

Melon Sugar.

Andros Island, in the long delta between the rivers Sacramento and San Joaquin, California, belongs to a group of low islands that are submerged at high water, and therefore not fit for culture. But when reclaimed by embankments they are exceptionally productive Melons are a crop that never fails in this climate, and the factory on Andros Island can get melon juice from a vast area of melon country at small expense for transport. Water melons with white pulp are preferred. They are planted twelve feet apart one way, and the other way six feet apart. The leaves of the plants cover the ground and kill the weeds before they interfere. Besides, they make an impenetrable mulching, which keeps the soil moist and prevents baking. The melon juice is free from impurities, which make chemistry costly in beet sugar, is much less expensive, and the sirup is delicious. The seeds make oil, and the refuse is good for cattle. Taking account of so many advantages, sugar from melons, though rated at 7 per cent of the weight of the fruit, instead of 8 per cent allowed for beets, costs less to make. The difference may be set down as 5¼ cents for melon sugar to 7 cents a pound for beet sugar. In regard to quality, melon sugar is superior. Unless extra care be used, beet sugar is apt to have an unpleasant buggy flavor.

Let it be understood that beets can only succeed in moist, bottom lands. Melons strike deep root, and they grow everywhere on our uplands. No doubt they would thrive luxuriantly in Jersey, Delaware, and Maryland. In the sandy soil of States South, no crop can be more certain, and Baltimore would make a convenient center for supplies of melon sugar works. Our California correspondent states that San Francisco sympathises with Baltimore, and will keep her advised as to the success of the melon sugar-making industry.—*Baltimore Sun*

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With 40 Illustrations.

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TWO PERSONALITIES IN ONE PERSON.

The record books of the medical profession contain not a few reports of patients living double lives: cases in which there is a periodical loss of one phase of mental life and the assumption or resumption of another very different one. For example, an hysterical subject will have a fit, and on coming out of it will be found to have lost all memory of the past. The mental faculties remain unimpaired, but so far as knowledge goes the patient's mind is that of an infant. With more or less delay she will learn to talk, and to read and work, practically beginning life again at the beginning, and sometimes developing a character quite unlike her first one. The physical basis appears to be the same; but the personality is entirely different, with different temperament, different habits, different tastes, and so on.

Matters will continue after this fashion for an indefinite period; and then the patient will go into another fit, emerging just as she was originally. All the life she has lived since the first fit is suddenly wiped out. She can recal none of it; for the time her second life, and it may have lasted years, is annihilated, and the current of her original life flows on as serenely and naturally as if it had never been broken—until another fit sets her back to the end of her second life, which she takes up again in utter unconsciousness of a break in it. And so her existence alternates between two lives entirely distinct and independent of each other, save that the same body serves for both.

Formerly such alternations of consciousness were explained by spiritual or demoniac possession. The body was supposed to be tenanted by two independent spirits; or the patient's soul was from time to time ousted by some other malignant or benevolent soul, as the tempter might indicate. In our more scientific and materialistic days, the spiritual hypothesis has few retainers: the phenomena in question being much more satisfactorily explanable by supposing that the patient's mental life has been carried on wholly or chiefly by one side of her double brain, and that, when the action of that side is arrested by disease, the unused side takes up the intellectual function and continues until another paroxysm shifts the responsibility to the first used side. So the two lives alternate with the alternating functional activity of the two brains: the reason that such lives are always double and never triple or manifold lying in the fact that we have only two independent brain lobes and no more.

The latest case reported of this sort is exceedingly interesting, and peculiar in that there is a loss of continuity in the life only when the state recurs in which the patient's life began. The case is reported at length in the *Revue Scientifique*, by Professor Azam, of Bordeaux, where the patient lives. The patient is a married woman, now about thirty-four years old, and has been living a double life since she was fourteen years old. For brevity, we will call her first state of consciousness and its repetitions, A, and the second state and repetitions, B.

At first B came on at intervals of days, and lasted for a few hours only. Twice it was absent for three years at a time, from the age of 17½ to 20½, and again from 24 to 27. Latterly she has lived the life of B most of the time, A recurring at intervals of two or three months, and remaining but for a few hours. Formerly the transition occurred during some minutes of unconscious sleep following violent pain in the temples; now it is almost instantaneous. In A, the patient has always been quiescent and somewhat morose in disposition; in B, she has always been bright, gay, and affectionate. In A, she has no memory of events which happen in B; but in B, she has a full recollection of her life in both states—a remarkable peculiarity in her case, as already observed. In B, her distress, on discovering that there have been blanks in her conscious experience, is extreme; but the practical inconvenience of such loss of memory, formerly great, has become less with the predominance of B. On rare occasions on passing out of B, the patient suffers a brief period of agitation and extreme terror, during which her knowledge is somewhat disordered; at other times there is no apparent derangement except such as commonly appears in hysterical patients.

In her passage from B to A (Professor Azam remarks), she does not emerge from a dream, for a dream, however incoherent, is always something. She emerges from nothing. The time elapsed may be an hour, or it may be months, it is all the same to her; an entire section of her conscious life has dropped out. "To compare her existence to a book from which some pages have been torn is not enough. An intelligent reader might fill the blank, but she can have absolutely no notion of anything that happened in her secondary state."

A world of curious problems and complications, social, theological, and other, are suggested by such a case as this. Fancy a person on trial for a crime committed in a previous state of which no recollection remains, with no one aware of the criminal's peculiarity: or a woman to find herself suddenly (to her) surrounded by a family of children, owning her as a mother, yet utterly unknown to her! There is a splendid chance for a sensational novelist. And we should like to hear a convention of clergymen discuss this proposition: Suppose a victim of double consciousness to be a saint in A, and a wretched sinner in B. Her earthly existence terminates in B. Will the two states of consciousness be united by the destruction of the conflicting organs of consciousness? Or will two souls remain, to go to their diverse ways? Again, if there is one, and only one, soul to survive, will it be damned for the sins of B, or saved by the faith that illuminated A?

THERMO-DIFFUSION---A NEW PHYSICAL PHENOMENON

It is a well known fact that gases dilate when heated, unless enclosed in space of invariable volume, in which case the action of the heat is manifested by an augmentation of pressure which increases with the temperature. If the space in which the gas is contained communicates with the air, the heat determines the escape of the gas through the orifice, more or less rapidly, but so that, at a certain instant, if the temperature remain constant, equilibrium will re-establish itself, at which time the pressure of the gas within will be precisely equal to the atmospheric pressure without.

This is easily verified in the following manner: In a block of any porous body (Fig. 1), plaster, for example, a cylindrical cavity is made, in which is introduced and fastened the extremity of an open tube, *a b*. The outer end of the tube communicates with a manometer. On the block being heated, equilibrium of pressure will maintained constant, the mercury remaining at a level in the branches of the instrument. A modification of this experiment may be made by substituting for the plaster block a vase of porous earth, such as is used in many galvanic batteries (Fig. 2), which is closed by a pierced cork, through which passes the tube, *a b*, connecting with the manometer; or instead of using the cork, the tube may be sealed in position by a little plaster. The vessel may remain empty or be filled with pulverulent material; and whatever the form of the apparatus, the results above described will always be the same, provided dry material be always used.

Fig. 1.

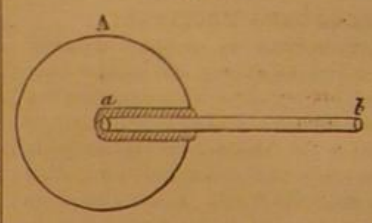
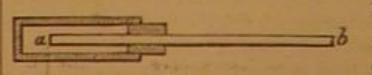


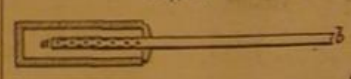
Fig. 2.



If, however, on the contrary, the material be moist, a new phenomenon presents itself, which, as *La Nature* states, M. Merget, of Lyons, has recently discovered, and to which he gives the name of "thermo-diffusion." This apparatus is the same as already described, with the difference, however that the porous vase or block is previously saturated with any volatile liquid. If the device is then submitted to the action of heat, the manometer at once indicates a difference of interior pressure, the augmentation of which depends on the volatility of the liquid, and the temperature reached. By employing a thermo-diffuser, 4½ inches long by 1½ inches in diameter, the interior pressure at the limit of dark red heat has been caused to attain that of 3 atmospheres, or 45 lbs. per square inch. This exists as long as the liquid is not entirely evaporated, but ceases as soon as the evaporation is complete, the mercury at once returning to a level in the manometer, regardless of the temperature present. The conditions described as occurring in the dry vase then resume.

This novel phenomenon may be exhibited in still another way (Fig. 3). The manometer being disconnected from the tube, the end of the latter is plunged in water. As soon as heat is applied, bubbles of gas are disengaged more or less rapidly. This disengagement is ultimately connected with the evaporation of the liquid, and is uniform as long as the evaporation continues regularly, but stops as soon as the latter terminates. M. Merget indicates, as follows, the conditions which determine variation in quantity of the gas given off. For similar thermo-diffusers, unequally moistened, the volume of gas disengaged varies with the proportion of water absorbed; and for different thermo-diffusers, wet to saturation, the volumes obtained have varied around an average of about 40 times the volume of the apparatus employed. The velocity of disengagement, which augments as the heat increases, depends on the extent of thermo-diffusive surface, and varies in like manner. It has reached several hundred cubic inches per minute with large porous battery vases.

Fig. 3.



M. Merget has likewise established that, in thermo-diffusion, it is the moist porous periphery which is the necessary condition of the phenomenon, and not the difference in hygrometric states of the gases. Two saturated thermo-diffusers were placed under entirely dissimular conditions, one being located in a thoroughly dry exterior atmosphere, and a wet sponge being placed in the interior of the apparatus, the other having highly heated quicklime within, so that in such a case its interior air might be completely dry. Both, being submitted to a feeble calorific radiation, gave sensibly the same disengagement of gas. If the state of dryness or humidity were the cause of the observed phenomenon, it necessarily would follow in the experiment that the currents of gas would be in inverse direction, which was not the case. Still, even with this fact of the porous vase being a prime necessity established, we are yet without a satisfactory explanation of the discovery. It can only be pointed out that the circumstances may play an important part in certain natural phenomena. After studying the gaseous exchanges between vegetation and the atmosphere, M. Merget concludes that a plant should be regarded as a moist and porous system, possessing the thermo-diffusive activity proper to all similar systems under elevation of temperature.

The leaves of aquatic plants, from this point of view, have considerable activity, and the quantity of gas introduced in the plant may reach 30 cubic inches per minute. A leaf having a long petiole (that of the *nuphar*, for exam-

ple) was placed in air, while the free extremity of the petiole was placed considerably beneath the surface of water in a test tube. The apparatus being submitted to solar rays, nearly pure atmospheric air passed rapidly under the tube. This took place as if the leaf were a natural thermo-diffuser; and the phenomenon is purely physical in character. The respiration of animals may also be a similar phenomenon; but this has not been sufficiently demonstrated to warrant an affirmative assertion.

The facts of M. Merget's discovery are interesting both from a physical point of view, and in that they tend to explain effects of which the causes are as yet undetermined. They go to show, besides, the mutual interdependence of sciences, the domains of which formerly appeared absolutely distinct.

PRACTICAL INFORMATION FOR PRACTICAL MEN.

The leading article of the *Journal of the Franklin Institute* for August begins with the positive assertion that the general idea that practical information, useful to a practical man, can be made interesting or instructive to the ordinary reader is an altogether erroneous one. And after a six-page amplification of this discouraging thesis, based on the half century's experience of the *Journal*, the writer closes with the sweeping remark that there is an incompatibility, now and for all time, between practical and popular information.

Bearing in mind the warning of an American humorist: "Don't never prophesy unless you know": we would not venture to contradict the *Journal* with regard to the possibilities of "all time;" but for the time that now is, we do not hesitate to say that there is no such incompatibility. And further, an expression of thirty years in trying to meet the popular demand for practical information has given us an abiding conviction that, as in the past, so in the future, in a yearly increasing degree, practical information useful to practical men will more and more be desired by intelligent readers; and the success of periodicals devoted to Science and the arts will hinge more and more—as scientific thinking increasingly prevails—upon their presenting promptly, clearly, and sensibly the very information which the *Journal* asserts to be so essentially unpopular, that is to say, practical information really and truly considered. The impossibility of making attractive to the general reader the stuff which the *Journal* describes as alone worthy of that title, we should not think of doubting. The *Journal* has sufficiently demonstrated that it cannot be done. We doubt whether it could be done even for the ludicrously limited class of men to whom the *Journal* would apply the term practical; in its own words, a few specialists, each of whom "must have acquired, in the course of his practice in some particular direction of knowledge, enough to have compelled him to have learned its 'science,' regularly and methodically, to have investigated by his reasoning faculties and founded himself upon principles and not on half-comprehended facts."

The definition is not very grammatical nor very clear; but we gather from it, and from subsequent remarks, that the practical man must not only be a specialist in scientific investigation, but one so furnished with all that has been accomplished in his particular department that no information can be practical to him unless it is wholly original and presented along with the most thorough and elaborate reasoning and formulæ that may be required for its support and demonstration. "It is the progress and advance of the arts and sciences, not the arts and sciences themselves, that the practical man needs information about;" and the method approved for the presentation of such additions to "practical" knowledge is the dryest and most elaborate possible, albeit the investigation is "tedious," the discussion "recondite," and the concluding results "unintelligible, almost incomprehensible, to any others than practical men in an extremely limited kind of practice."

It is not surprising that the *Journal* finds an incompatibility between such information and popularity: but it *is* surprising to find an editor of intelligence coolly assuming that such information exhausts the limits of the practical, and that no man deserves to be called practical who does not delight in it. The position is sufficiently absurd to be grotesque.

WORKMEN AND THEIR INSTRUCTORS.

A hammer and a chisel are two very simple tools, and surely it seems there can be no great mystery in the use of two such implements; but a foreign language, or the groundwork of a whole science, can be learned in far less time than it takes to learn to chip a piece of metal an inch long so so smoothly upon its surface that the chipping marks cannot be felt. The reason for this difference is simple, and lies in the fact the language or science has teachers who are masters of their subjects, and who make those studies the work of a lifetime; whereas the mechanic has as a rule to work out the whole problem for himself. It is as ridiculous for a man whose ten or fifteen years' experience has included the principles of construction, mathematics, mechanical drawing, etc., to assume to teach that intricate knowledge of manipulation necessary to make an expert workman as it would be for a workman who had spent his leisure time in reading books of science for instruction to attempt to instruct the scientific world; and this would have been made apparent long ago but for the lack of education so common to expert workmen, and but that, so soon as an expert workman attains the knowledge of his trade, and the skill in the use of language which enables him to enter the arena of debate or tuition, he ceases to be a workman and becomes too often a stranger to the workmen's interests. Such a faint conception of the real value of an unusually expert workman is possessed by employers that, if he possess such a qualification only, his sphere of usefulness is limited to his practice, and he would search the wide world in vain for a means of giving to others the benefits of his skill by imparting to them the minutiæ of movements, processes, forms, time, speed, etc., which, combined, form that skill which is best known as manual dexterity. There never has been nor can there ever be a piece of expert workmanship done that was not governed by distinct principles and laws; and the misfortune is that they are to a very great extent unwritten laws. Volumes are written for the edification of the workmen that had better far never have had existence. Can the workman do aught but smile at the statement, given under assumed authority, to the effect that tools for cutting wood can be much harder than for cutting iron, or, to state it better, "tools for cutting wood are harder than those usually employed for cutting iron"? And what are we to think of the advice that "the better way to make a scraper" (for flat surfaces) "is to form it like a Venetian stiletto or a beech nut"?

Not long ago, a statement went the rounds of the mechanical press to the effect that a certain French mechanic had discovered a method of reducing the diameters of the tires of locomotive wheels by a process of partial immersion in water: whereas such was the practice twenty-five years ago, and it has been in common use ever since: principles governing the process, together with its application to wheel tires, having been published, together with an illustration, months before in the SCIENTIFIC AMERICAN. Instances of this kind are so numerous that it would take a volume to recite them, nor would the recital bring us any nearer to a solution of the question of how best to impart manual dexterity by means of instruction. Our knowledge of practical mechanics, as commonly applied in our machine shops, is crude in the extreme, and will continue to be so until we have placed within reach of the workman all the intricate knowledge that goes to the very bottom of expert workmanship, which information can only be obtained by practical experiment, made by men chosen by reason of their mechanical skill, under the directions of teachers capable of explaining and formulating the principles and rules governing the practice of the skillful artisan.

BORN SCIENTISTS.

The importance of the innate tastes of an individual being considered in determining the choice of a trade or profession is well shown in Mr. Francis Galton's recent work on the antecedents of English men of science, a volume prepared as a sequel to the treatise on "Hereditary Genius" already reviewed in these columns. Mr. Galton adopted the excellent plan of a well chosen series of questions, which every scientist was requested to answer and return to the sender. One hundred and eighty scientific men were thus questioned, and the replies which most appeal to the thoughtful are those relative to prevalent tastes. We should expect to find a taste for mechanics among the physicists, and such is the case: the same among the mechanicians and engineers. The underlying cause of scientific research may be traced in the repeated mention of the possession of a "desire to know facts," curiously coupled in some cases with a strong repugnance to works of fiction. More interesting, however, is the schedule of influences and motives which urged the various individuals to follow scientific pursuits. Out of 191 people, innate taste for their calling influenced 59; fortunate accidents (generally showing innate taste), 11; indirect opportunities and indirect motives, 19; professional influences to exertion, 24; encouragement of scientific inclinations at home, 34; influence and encouragement of friends, 20; of teachers, 13; travel in distant regions, 8; residual influences, unclassed, 3. The large plurality in favor of innate taste is striking. Now take the various callings: Out of 26 cases of physicists and mathematicians, 12 had an innate taste, 1 no natural taste at all and 7 are doubtful. Of 11 chemists, the taste of 5 was innate, 1 not, and 5 doubtful; of 8 geologists, 7 innate, 1 doubtful; of 24 zoölogists, 17 innate, 3 not, 4 doubtful; of 10 botanists, 8 innate, 1 not, 1 doubtful; of 7 medical men, 2 innate, 4 not, 1 doubtful; of 6 statisticians, 3 innate, 1 not, 2 doubtful; of 5 mechanicians, 2 innate, 3 doubtful.

It is clear from this that a strong and inborn taste for science is both a prevailing and an enduring peculiarity of the persons considered. A fair estimate for Mr. Galton's deductions is that out of every ten men of science, six were naturally gifted with a strong taste for scientific pursuits. Not one person in ten, taken indiscriminately, possessing such an instinct, it follows that its presence must add five fold to the chance of scientific success.

The possession of a special taste for any pursuit is therefore a gift of Nature not to be slighted, and it is in fact something to be seriously studied and its development advanced.

EDUCATED FARMERS.

If we were asked to point out any especial fact as denoting beyond all others our rapid progression in knowledge and in civilization, we should select the strong tendency everywhere manifest to abolish empiricism in all pursuits of life. It is not very long ago that the physician administered his remedies blindly, and knew less of the functions of the heart than does his modern descendant of the spleen and gall bladder. Meteorology, most fickle of all sciences, based as it is on the most changeable of all things, the weather, has within a very few years made marvelous strides; and we are certainly advancing to a point when it will be as easy to foretel the rain and storm of tomorrow as to remember the fine weather of yesterday. Even cookery is no longer to be the science in which unaccurately compounded ingredients, under constantly varying conditions, are supposed by some pleasant fiction to yield invariable results for has not a college been endowed, to educate our future *chefs de cuisine*? Thumb rules in every trade are now scouted by intelligent working men. The world has shaped itself into a gigantic point of interrogation; "why" is the question of the hour, and faith in things earthly is confined only to those who, like the deluded partisans of Keely and others of his ilk, mistake ignorance of that which is possible for belief in that which is not.

Of all the sciences, none within recent years has so quickly emancipated itself from the fogs of empirical conjecture as that of agriculture. Up to the end of the last century even, people believed that air, water, oil, and salts were the sources of plant nutrition. Wallerius, Bergmon, Palissy, Davy, De Saussure, and Sprengel contributed discovery after discovery, investigation after investigation, but their work was scattered and little known outside their laboratories. It was reserved for the genius of Liebig to unite all these fragments of truth; but it was not until 1840 that he produced his great work "Chemistry in its Application to Agriculture and Physiology," and thus gathered in concrete form the materials which are the basis of a now great and rapidly growing science. It is hard to realize that agricultural chemistry has found its application for but 26 years, so clearly are its benefits before us in tangible form. But on the other hand, this only serves to indicate to us how vast must be the results yet to come, when agriculture, through the instrumentality of its knowledge, shall have become in its turn as exact as its sister sciences, and as susceptible of being taught and learnt in the same manner as they. And to attain this much desired end, our schools and colleges, under the guidance of far-seeing men, are doing splendid work.

The youngest of our universities, Cornell, established an agricultural department three years ago, under the charge of Professor Roberts, the farm consisting of 150 acres, in not over good condition. Upon this tract of land the whole science of raising crops, as well as the business of managing a farm, is taught with a thoroughness which we doubt has ever been exceeded. Eighteen square rods of clover, for instance, are set apart for eighteen different modes of treatment with fertilizers. In the experiments with corn, three rows of each kind, or of each mode of manuring, or of the different modes of management in other respects, extend across the field. There are also experimental strips of oats and wheat; and thus every method of cultivation of all the farm products incident to our climate is practised directly before the student, who is required personally to perform the labor necessary in connection therewith. The results of the experiments are carefully recorded and stored away until sufficient shall have been gathered, over a number of seasons, to justify the determining of accurate averages.

Besides this, the students are taught a complete system of accounts. Every hour of labor hired, every product of farm sold, is minutely registered. The food which live stock consumes is recorded on one side and balanced yearly by the market value estimated by a skilled butcher. So that, in this way, the gains or losses, not only of the farm as a whole, but of every branch, are known with the utmost accuracy. Every student is required to become proficient in this account keeping. Each keeps his books separately, and determines estimated values; and as he may sell his own labor to the farm, outside the time required of him, which is but two hours and a half for two days of the week, he is directly interested in the task. Besides the farm, there is a garden of six acres, conducted under the same admirable system; and in addition, lectures on practical agriculture are given four times weekly by Professor Roberts. The *Country Gentleman*, to which we are indebted for these facts, states that the number of agricultural students is still too small, so that there seems to be abundant opportunity for all who may desire to acquire a thorough and most valuable education. Certain it is that such instruction is most urgently needed in this country. It has become too much the fashion for young men to crowd into the great cities, and there to eke out lives behind desks and counters which should be spent in developing the vast resources of the thousands of square miles wherein the richest soil on earth awaits the plowshare. In the Centennial Exposition are exhibited actual glass-enclosed sections of prairie soil with the black unctuous loam extending downwards far below the reach of the deepest furrow. Go look at that superb exhibit in Agricultural Hall, and think of the possibilities which educated farmers cultivating such land might accomplish. Think of it, stalwart young men, who meditate coming into the city after the present harvest is garnered, to find work where there is none to be had. Expend your labor and means at Cornell, Amherst, Dartmouth, and other like colleges, and obtain such an education as we have described then; "go West," pre-empt your land, and start on the high road to independence and ultimate fortune.

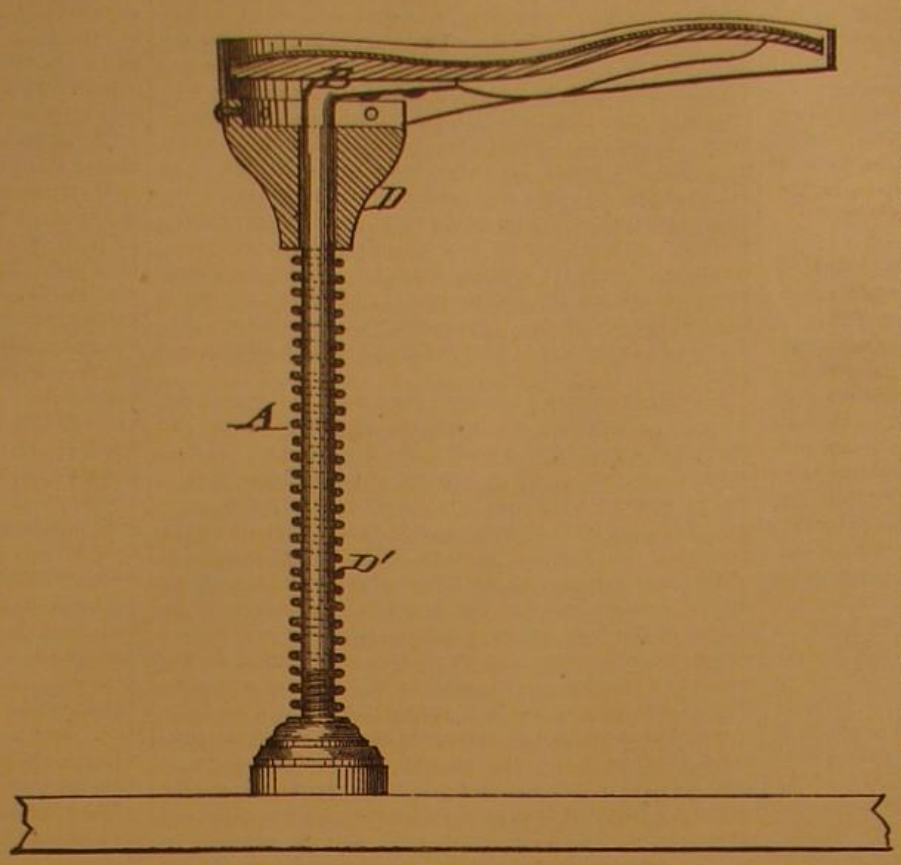
Crystallized Glycerin.

Dr. Armstrong recently exhibited, at a meeting of the Chemical Society, London, a specimen of pure crystallized glycerin. The solidification took place while the glycerin was being agitated on a railroad journey in cold weather last winter. Dr. Odling mentioned the curious fact that hydrocyanic or prussic acid is an excellent test for the purity of glycerin, the slightest admixture of any foreign substance causing the glycerin to turn yellow in a short time if a little hydrocyanic acid be stirred into the liquid.

IMPROVED APPARATUS FOR LINING INSOLES OF BOOTS.

Mr. Charles Monahan, of St. John, N. B., proposes to apply the linings of boots and shoes in a quick and perfect manner by an improved machine, which we illustrate herewith.

There is an upright post, to the top part of which the last, B, is securely attached. A metallic guard, C, extends around the last, and is attached to a support, D, that slides on the upright stand. The support, D, and guard, C, are forced in upward direction, to project above the last, by a strong spiral spring, D'. The pasted lining is placed bottom upward on the last, and prevented from sticking to the boot by the guard, while the boot is drawn over the last. The guard is kept in position by its spring until the boot is in position to be pressed on the last. The boot forces the guard down, and presses the lining firmly on the insole of the sole, so that it sticks to the same in an even manner. The boot is then taken off, a new lining placed on the last, and the next boot brought down. This invention was patented through the Scientific American Patent Agency, July 4, 1876.



APPARATUS FOR LINING INSOLES OF BOOTS.

Powder for Producing Ozone.

"In order to produce artificial ozone, Mr. Lender makes use of equal parts of peroxide of manganese, permanganate of potassium, and oxalic acid. When this mixture is placed in contact with water, ozone is quickly generated. For a room of medium size, two teaspoonfuls of this powder, placed in a dish and occasionally diluted with water, would be sufficient. The ozone develops itself; it disinfects the surrounding air without producing cough."

The attention of the writer was called to the above article as it appeared in the Philadelphia *Medical and Surgical Journal*, under date of May 20, 1876. For the purpose intended, it is certainly one of the best of the published formulæ, but, on account of the danger attending its manipulation, should be used with extreme caution. A prescription with these proportions was taken to an apothecary, who inadvertantly used a mortar in mixing it, with the result of an immediate explosion, which would have been attended with disastrous consequences except for the smallness of the quantity employed.

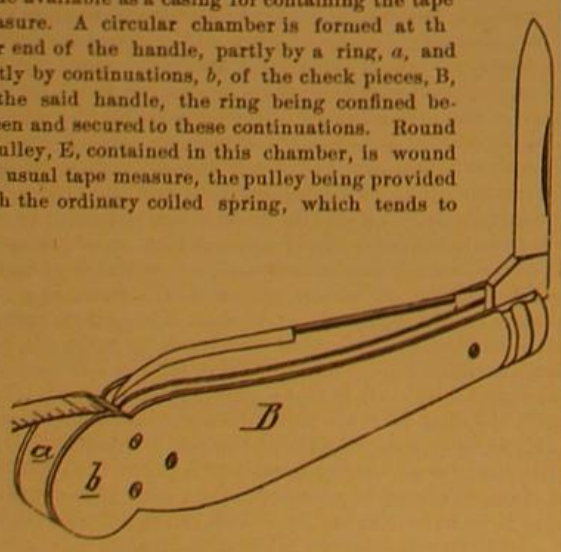
In mixing these ingredients, trituration should not be used at all, but they should be cautiously mixed with a spatula in small quantities; and even then, if they should have been reduced to a fine powder, they cannot be mixed without danger, as the mixture is liable to explode at the moment of contact.

Apothecaries who are not deficient in knowledge are sometimes deficient in caution, and articles published in reliable journals are copied and used without hesitation, and the compounder or dispenser is brought into unlooked-for and unexpected difficulties.

The above article is written solely with a view of placing druggists and physicians on their guard in using or dispensing a dangerous compound.—*John L. Davis, in American Journal of Pharmacy.*

COMBINED KNIFE AND TAPE LINE.

Mr. Glover S. Hastings, of Unionville, Conn., has patented (July 27, 1875), a combined pocket knife and tape measure, so constructed that the handle of the pocket knife is made available as a casing for containing the tape measure. A circular chamber is formed at th rear end of the handle, partly by a ring, *a*, and partly by continuations, *b*, of the check pieces, B, of the said handle, the ring being confined between and secured to these continuations. Round a pulley, E, contained in this chamber, is wound the usual tape measure, the pulley being provided wi h the ordinary coiled spring, which tends to



maintain the graduated tape within the chamber in a manner too well known to need description.

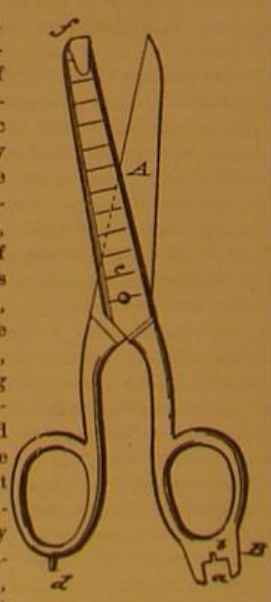
New Coal Fields in Utah.

Professor J. E. Clayton has returned from an extended visit to the coal fields in Wasatch county, Utah, and gives us some interesting and valuable information in relation thereto: "The coal mines are the first of the extensive series that stretch south through San Pete county. They are situated in Pleasant Valley, and are reached by going 40 miles due east from Spanish Fork station up the cañon to the summit, and thence south seven miles to the south end of the valley, making a total distance of about 105 miles from Salt Lake city, 58 of which are by rail. The wagon road of 47 miles is easy, there only being about two miles of up grade from the mines to Spanish Fork city. The rest of the way is down the cañon on an incline averaging 66 feet to the mile. The highest altitude on the road is the summit of the cañon, which is about 7,750 feet above the level of the sea. Pleasant Valley is at the head waters of Price's river, which ultimately flows into the Colorado, and is about four or five miles long by two or three in width. At its lower end, numerous cañons put into the valley; and at the base of the hills around these, the coal shows in a semicircle west and east around the valley for six or eight miles. Two, and in some places three, beds show one above the other; the principal one, the Hutchings, being 32 feet in thickness and lying horizontally on the east side of the valley and trending to the south east. The region is cretaceous sandstone, and the Hutchings shows a foot wall of light gray sandstone with a yellowish gray sandstone roof. In the neighborhood is but very little shale, there being no shale seams whatever in the coal bed. No iron is visible, although higher up in the mountains is seen ferruginous sandstone, which, however, indicates nothing permanent. About one half of the bed of coal is of an excellent coking variety, the specimens we saw, though made in a primitive manner, being equal to the best imported. The coal beds are at an altitude of about 7,550 feet.

The surrounding hills have fine pine timber in sufficient quantity for local purposes, while an abundance of water is close by. Considerable importance can be attached to these coal fields for their accessibility, their great extent, and the coking qualities of their product.—*Salt Lake Weekly Miner.*

NEW COMBINATION TOOL FOR SEWING MACHINES.

We illustrate herewith an ingenious arrangement of all the tools, used in the care and adjustment of sewing machines, in a single implement. It is the invention of Clara A. Rogers, of New Orleans, La., and was patented through the Scientific American Patent Agency, July 11, 1876. The tools combined are a scissors, wrench, needle straightening device, throat plate mover, screwdriver, and measure. One of the handle parts of the scissors is provided with an extension, B, that has a square recess, *a*, for the purpose of serving as a wrench, the stocks of the scissors serving as handles. The recess, *a*, is further provided with a short and narrow slot, *b*, which serves for the purpose of straightening bent needles. The other scissors handle has an extension pin, *d*, by which the throat plate of the machine, whether of glass or metal, may be readily moved without the use of a separate tool. One or both stocks of the scissors may be graduated to form an inch or other measure, *e*, which is very handy, as the scissors are at any moment available; and the end of the broader stock is made tapering to form a screwdriver. The whole forms an exceedingly convenient and useful tool.



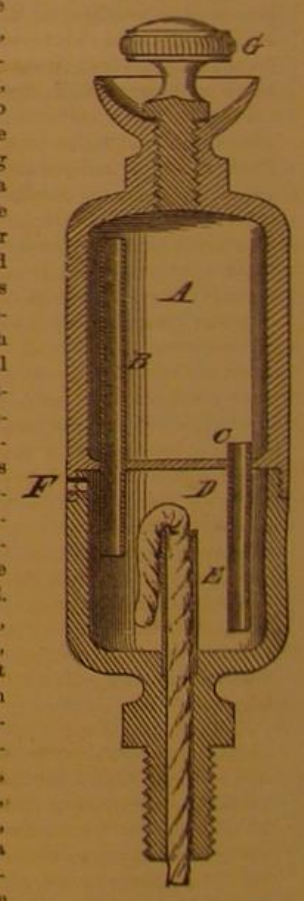
SILVER discoveries have been made in the vicinity of Arthur's Landing, on the north shore of Lake Superior, about 200 miles northeast of Duluth. A miner dropped down upon some crumbled quartz containing native silver. The rock is expected to yield $3,500 or $5,000 per tun.

What a British Centennial Judge Thinks of Us.

The London *Times*, of August 14, gives unusual prominence to a letter written by an English judge at the Centennial, which the Philadelphia *Ledger* copies, and of which it also gives the substance in an editorial as follows. Captain Galton, the judge, says that he saw enough there to convince him that American manufactures had been making remarkable strides during the past twenty years. Captain Galton is one of the engineers appointed by the British Board of Trade to survey railways and other public works before they are opened for public traffic; and he was a British judge in the group of railway appliances, and immediately upon his return home he penned this letter. He had previously visited this country twenty years ago, and during the interval we all know that American manufacturing progress has been remarkable. He speaks of the great advance in our industries as shown by the growth in the amount of coal mined, and says that our higher wages, compared with England, are counterbalanced by the use of machinery to an extent much exceeding that generally in use in England. Observing the substitution of steel for iron rails on our railways, he candidly remarks that the new rails are almost all made in the United States, and that it is not probable that England will be called upon much longer to supply us with rails. He goes further, and, speaking of general manufactures, says England can no longer expect to get a market for her manufactures in the United States, but she must be prepared to find our manufacturers competing with her in every market to which they have access. Mr. Galton bluntly tells the *Times* that England should appreciate her true position in this matter, and he closes by urging all Englishmen to visit Philadelphia, where they can see the development of American industry, and meet the leading manufacturers as well as the most prominent Americans of all classes.

A NEW OIL CUP.

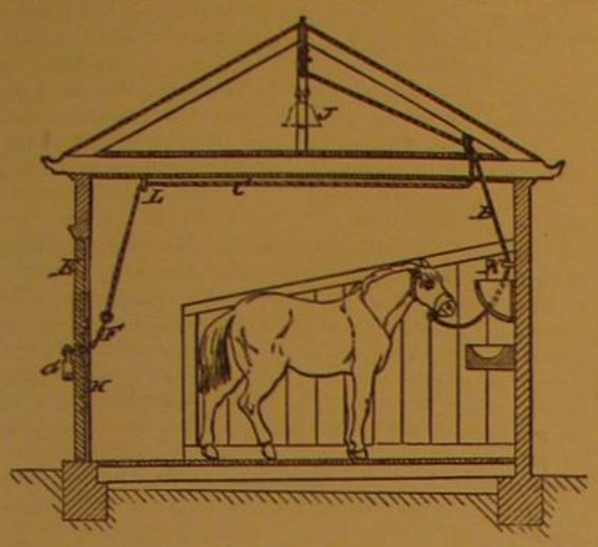
Mr. Ezra B. High, of Reading, Pa., has patented (July 4, 1876) through the Scientific American Patent Agency a novel improvement in oil cups, which we illustrate herewith. The object is to furnish a constant and uniform supply of oil to the bearing at all times. The cup is made in two parts, A D, which are screwed together. The upper part, or reservoir, A, receives a screw plug, G, so fitted as to be airtight. The lower part or distributing chamber, D, is made with a perforated screw stem, to be screwed into the journal or shaft box, and in the upper end of the perforation of which is secured a small tube, E, to receive the siphon wick by which the oil is carried to the journal to be lubricated. In the bottom of the reservoir, A, are secured two tubes, B C. The upper end of the tube, B, rises nearly to the top of the reservoir, A, and its lower end extends down into the distributing chamber, D, so far as to be below the end of the tube, E. The upper end of the tube, C, rises a little above the bottom, a^1, of the reservoir, A, so that any sediment that may be in the oil will settle upon the bottom of said reservoir, and cannot flow through the tube, C, into the distributing chamber, D. The lower end of the tube, C, may be bent up into such a position that a plug may be inserted in it through the air hole or vent, F, to prevent the oil from flowing down through the tube, C, when the reservoir, A, is being filled. With this construction the oil will flow down through the tube, C, into the distributing chamber, D, until the lower end of the tube, A, is covered, which will prevent the entrance of any more air into the reservoir, A, and will stop the flow of the oil until enough oil has been carried out by the siphon wick to again uncover the lower end of the tube, B, and allow air to again pass up through the tube, B. In this way the oil will be kept at about the same level in the distributing chamber, D, so that the siphon wick may carry it out in a uniform quantity. Air, to supply the place of the distributed oil, enters through the vent, F.



As at present worked, the gold and silver mines of Japan do not appear to be of much value. Iron ore is abundant and the mines are rich. Magnetic ore in sand and lump is most commonly used. Lead is extracted in many provinces, but in a faulty manner and in small quantities. Some of the ores are very rich. Tin is reported to be found in two localities, and the quicksilver mines are not worked

IMPROVED CONSTRUCTION OF STABLES.

Mr. Frank M. Dixon, of Jefferson City, Mo., has recently invented a contrivance for hitching a horse and fastening a stable door in such a manner that the horse will be freed and the stable door opened in case of fire in the stable, and a contrivance for sounding an alarm at the same time. The engraving shows a transverse section of a stable having the improved appliances. A cord, of cotton or other combusti-



ble material, is stretched along the space above the stable, from side to side, to which the halter of the horse is attached. A cord, C, holds the door, E, shut—say, by a chain, F, and a padlock, G—and the door has a spring, H (dotted line), to throw it open when the cord is released. There is another cord, extending along the space above the stable, from side to side, and connected to an alarm bell, J, and also having the halter and the door cord attached; so that when the cords are burned off by fire, the door will spring open, the horse will be released for escape, and the alarm bell will sound. The halter will pass down from the space above, where it is attached to the cord through guides, K, and the door cord will pass along through suitable guides. The invention was patented on July 18, 1876.

The United States Patent Association.

This society meet on September 7, 1876, at the Franklin Institute, Philadelphia, Pa , for the purpose of suggesting means for the improvement of the patent system and the formation of an international association for promoting uniformity of patent laws in all countries. Among the members present were Hon. J. M. Thacher, ex-United States Patent Commissioner ; Professor Hedrick, of the United States Patent Office; W. C. Dodge, of Washington, and John S. Perry, of Albany, N. Y., President of the Association.

President Perry called the meeting to order, and read an address, in which he took as subjects of consideration: First, the importance of the patent system in general ; and, second, that of the United States in particular, viewed both in respect to the development of original invention and as inciting inventors to persevere in the perfecting of their plans. He showed the benefits which have arisen from the patent system by a review of the condition of Europe before the patent law was recognized. So long as the laws of property were neither recognized nor properly defined, there could be little incentive to invention or the pushing forward of appliances for the better comfort of mankind. Often an individual, like Roger Bacon, would be on the eve of an invention, and often for that matter did invent; but, well knowing that his rights would be unrecognized, he failed to make it public. Indeed it is well known that several inventions and discoveries of great value, which have since been re-invented, were really made, but suffered to die with the inventor or discoverer from this cause. The first trace of patent law is,he thought, to be found in the reigns of Henry III. and Edward IV., of England, in the thirteenth and fifteenth centuries, about which periods the services of the villains or serfs gradually became less onerous and uncertain.

He furthermore said : "Patents are sometimes characterized as monopolies and even as vicious monopolies. With equal reason might the possession of wealth honestly acquired be denounced as a trespass upon the rights of others. To take money unlawfully is called stealing; to appropriate an invention is not by some considered very dishonorable. The public seem to have lost sight of the fact that the inventor has taken nothing which it had before ; that he has from his own brain brought into existence and perfected, at his own cost of labor and money, a production as new to the world, and perhaps as useful, as the gold which the miner brings forth from the hidden recesses of the mountains. The most bitter opposition the patent system meets is from the agriculturists,and they of all men are the most benefited by its provisions. With the high cost for labor that has existed during the past twelve years, the business of farming could not have been carried on without the improved machinery that inventors and progressive manufacturers have provided.

"The importance of the patent system in general is shown in that a vast number of articles have been through its instrumentality added to the means of human happiness, of which the latter must otherwise from necessity have been deprived. In reference to the importance of the patent system in the United States, the speaker argued that the history of patent protection is almost coincident with our existence as an independent nation. The law of patents, as it now stands in the United States, rests on the statutes of February 21, 1783, and April 7, 1800. These statutes have been modified several times, yet our patent law as it now stands is far from being perfect, and it is in the hope of aiding in correcting its errors, and in giving it a wider scope, that the United States Association has been formed."

REMARKS: These views are in the main sound, although tinged with a few misconceptions. Patents, the chairman assumes, are not monopolies, but inherent rights. The poor miner, who controls the gold that his industry brings from the rocks, is just as much of a monopolist, he tells us, as the wealthy patentee, who compels every poor woman to pay him forty dollars royalty, for the privilege of earning her living by means of his patent sewing machine. Such reasoning, Mr. Chairman, will not do. The people know better. They know by actual daily experience that patents are monopolies, some of them of the most oppressive kind ; and no sugar-coating by any Patent Association will alter the fact. It is because patents *are* monopolies of the vicious kind, that they are valuable, and in such great demand. Of what account would a patent be, if the patentee were not clothed with authority over his fellow creatures to enforce his private demands, in respect to his patent? Of none whatever.

According to President Perry, the miner who first discovered gold in the Rocky Mountains was the natural patentee of the entire range, as respects the precious metal. He takes nothing that the public had before; on the other hand, by his discovery, he contributes to the general supply of gold. Therefore, no one but the discoverer, or the favored few whom he permits, ought to be allowed to work at gold mining on the premises. This is poor logic for the United States Patent Association to promulgate.

Patents, as we have stated, are pure monopolies. They are only tolerated and granted for reasons of public policy. They are issued solely as rewards: for the mere purpose of stimulating people to discover, invent, and study out new forms of industry. The general weal is promoted by increasing the number and variety of industrial arts, which all the people may freely and equally enjoy. Instead of rewarding the inventor by paying him a sum in cash from the collected taxes in the treasury, the government gives him a patent, or, in other words, makes him his own tax gatherer; and authorizes him to compel the people, by force if necessary, to satisfy his demands.

The redeeming feature of our patent monopoly system is that it effects its object, it brings out new improvements, and is limited to a brief period. Our patents run for seventeen years—a short time in the life of a nation; the inventions then become public property, and everybody may enjoy them, free from the annoying whip and spur of any wealthy private corporation or patent holder. Great as are the inconveniences of our patent system, the benefits are amazing, and greatly exceed the drawbacks. So long as this continues to be the case, the patent laws will stand.

A PAPER EGG CUP.

Here is a new application of that all-useful commodity, paper, to the purposes of table furniture. Mr. R. M. Washburn, of Burlington, Iowa, has patented a paper egg cup, which, besides being a really ingenious idea, is based on sound theory, inasmuch as paper is a non-conductor of heat; it is elastic, so that one cup will hold securely an egg of any size; and it is molded in corrugated form, so that there is always a circulation of air between the egg and its vessel, which is represented in our engravings as empty in Fig. 1, and holding an egg in Fig. 2. The same cups may be used over and over again, or may be thrown away after each meal, their cheapness allowing of this latter disposition. They are handy for picnic parties or for persons traveling, and as novelties for hotels, restaraunts, and even private houses. The material may be paper, muslin, or almost any fabric. Tinted of different colors, the cups would be quite ornamental; or they might serve as a medium for advertising, so that the person using them may have food for digestion mentally as well as physically. The invention is one likely to be remunerative. It is just such cheap and simple devices which, now-a-days, are most in demand, and produce the largest profit. Those desiring to negotiate for the right to manufacture can obtain further particulars by addressing the inventor as above.

Fig. 1.

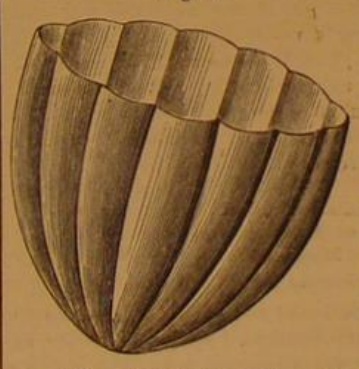
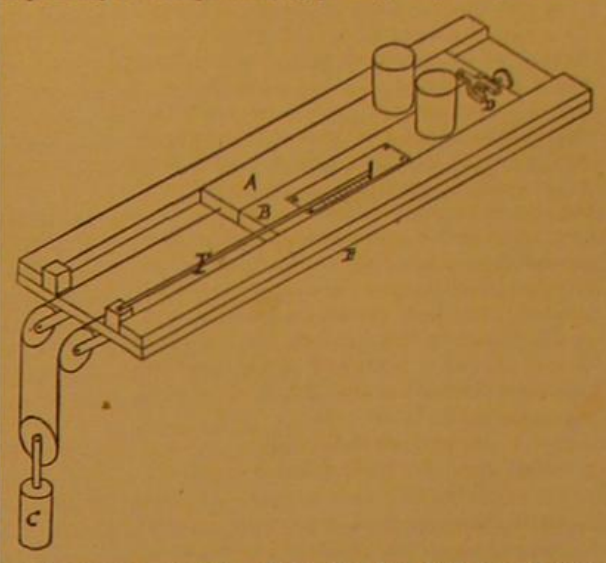


Fig. 2.

A SIMPLE DIVIDING MACHINE.

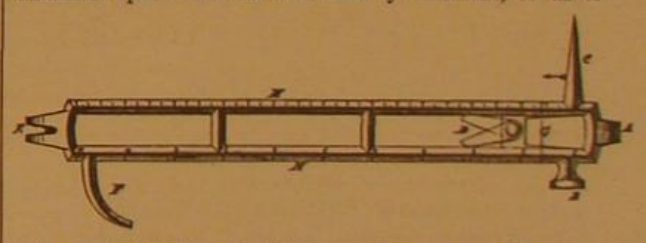
Among the exhibits of the Massachusetts Institute of Technology, at the Exposition, is a novel instrument devised by the professor of physics, to be used as a dividing machine for graduating scales of equal parts. It can be constructed for a trifling outlay by any one who understands the use of tools, and by its aid scales can be laid down with considerable accuracy. It consists of two strips of wood, A, B, which slide in a wooden frame, E. The ends of a cord are fastened to these strips, the cord being fastened, as shown in the engraving, to the weight, C, which is heavy enough to slide the strips along the frame. The slips can, however, be kept in any desired position, by placing weights upon them.



At the upper extremities of the slips is a fork-shaped piece of metal which is secured to the strip, A, by a pin, on which it can turn; and a pin on the strip, B, engages the fork, allowing a certain amount of play, which can be varied at pleasure by the adjusting screw, as shown in the engraving. An arm, F, is attached to the frame by a pin, and has a pencil at the end, this being the marker for constructing the scale on a piece of paper which is fastened to the strip, B. To show the action of the instrument, suppose the adjusting screw is turned so that the play of the fork is $\frac{1}{100}$ of an inch. A piece of paper is secured to the strip, B, and a mark made upon it with the pencil. The weight is then lifted from the strip, B, when it will be slipped along a distance equal to the play of the fork, or $\frac{1}{100}$ of an inch, and a second mark is made with the pencil. Then the weight is replaced on the strip, B, and that on the strip, A, is removed, when B will be slipped along until it is square with B, a stop preventing the fork from turning back any further. The weight is replaced on A, the other removed from B, a third mark made, and so on, alternately moving each strip through the required distance, until a sufficient number of divisions is obtained. R. H. B.

NEW COMBINATION TOOL.

Mr. Lester Beach, of Derby, Conn., is the inventor of a novel and ingenious combination tool, an engraving of which is presented herewith. The body of the tool consists of two parallel bars, connected at their ends, and at suitable distances apart between said ends by crossbars, so as to



make the tool light and at the same time strong. Upon one end of the tool is formed a screwdriver, A, near which is a hammer head, B; and upon the other edge is an ice pick, C. To one of the crossbars are attached two small steel plates, D, arranged at an angle, so that they may be used as a knife sharpener. Upon the other end of the tool is formed a notched claw, E, for pulling tacks and for lifting stove covers. Upon the edge, diagonally opposite the ice pick, C, is formed a curved finger, F, which may be used as a poker and as a pot lifter. At one end the space, G, is made slightly tapering, and the inner edges of the side bars are flattened, to adapt said space to be used as a wrench for turning various sized nuts. Upon the side bars of the tool are formed division marks of inches and parts of an inch, to adapt the tool to be used as a rule, H. Patented through the Scientific American Patent Agency, August 1, 1876.

The East River Bridge.

Chief Engineer Roebling now intends to hoist a carrier rope of 1¾ inches diameter, instead of 1½ inches, as originally intended, between the towers of the East river bridge. The increased weight will prevent the carrier rope from being hauled across by the traveler ropes now in place ; and it will have to be carried across the river in a scow and hauled taut between the towers, as was done in the case of the first traveler rope. Two 1¾ inches carrier ropes will be placed in position ; and then the cradle and foot bridge ropes will be hung on them by pulleys. The carrier ropes are of chrome steel wire, and will weigh about 22,000 lbs.

A Statue of Lafayette.

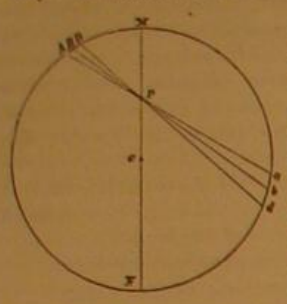
The French republic has recently sent, as a gift to the citizens of New York, a bronze statue of Lafayette, the renowned soldier whose zeal in the cause of republicanism brought him to this country 99 years ago, and enlisted him in the army which achieved our independence. The statue has been erected in Union Square, looking down Broadway; and it was unveiled on September 6, with appropriate ceremonies.

Correspondence.

The Weight of a Body inside a Hollow Sphere.

To the Editor of the Scientific American:

I am surprised at the half knowledge shown by your correspondents in their discussion of the attraction of a hollow sphere on a body within it. Can any one name a scientific man of repute who has repudiated it, or the demonstration of it, which is to be found in "Newton's Principia"? If Mr. Whitmore chooses to represent the mass which exerts the attraction on the body, P (see the illustration on page 84), by the cup-shaped fragment, B E F G C B, his position is undoubtedly correct; but the calculation of the attraction becomes so troublesome that we may well ask for a simpler way. Newton's theorem furnishes this.



In a thin shell, whose section is the circle at A M *a* N A, let a body, P, be found; draw through P in any direction the line, B P *b*, and revolve around it the line, A P *a*, which makes with it the small angle, A P B: the resulting circles, shown in section at A D, *a d*, will have the areas $\pi(A\ B)^2$, $\pi(d\ b)^2$, and the masses $= \pi\ m\ t$ $(A\ B)^2$, $\pi\ m\ t\ (d\ b)^2$, where t = the thickness of the shell, and m = the quantity of matter in the unit of volume: the attractions on P will equal these masses divided by the squares of the distances from P, namely, P B, P *b*, and multiplied by a constant, *f*, thus: Attraction at B : attraction at *b* :: $\frac{2\pi\ m\ t\ f\ (A\ B)^2}{(P\ B)^2} : \frac{2\ \pi m\ t\ f\ (d\ b)^2}{(P\ b)^2}$ :: $\frac{(A\ B)^2}{(P\ B)^2} : \frac{(d\ b)^2}{(P\ b)^2}$. But from the similarity of the very acute angled triangles, A B P, *d b* P, we have A B : B P :: *d b* : P *b*. $\therefore \frac{(A\ B)^2}{(B\ P)^2} = \frac{(d\ b)^2}{(P\ b)^2}$, and therefore attraction at B = attraction at *b*. That is, the body, P, will not move in either direction along the line, B P *p*; and as this line may be drawn in any direction whatever in the shell, the body at P will not move in any direction, and will therefore be in equilibrium at every point. To prove this for thick shells or hollow spheres, it is only necessary to conceive them as made up of an indefinite number of thin ones.

Professor Olmsted has been placed in apparent contradiction with this truth because it was forgotten by the writers who quoted from him that the attraction of gravitation varies inversely as the square of the distance. Thus, if the body be lowered half way to the center, it would be attracted by a mass equivalent to one eighth of the original sphere; but as the distance between the body and the center of the sphere is only one half of what it was before, the attraction will equal $\frac{\frac{1}{8}}{(\frac{1}{2})^2} = \frac{1}{8} \div \frac{1}{4} = \frac{1}{2}$: or in general, if the force at the surface of a sphere, of radius *r*, be represented by 1, and the portion lost in descending a distance, *d*, by *x*, we have: $1 : 1 - x :: \frac{r^2}{r^2} : \frac{(r-d)^2}{(r-d)^2}$; $\therefore 1 : 1 - x :: r : r - d$. $\therefore 1 - x = 1 - \frac{d}{r}$ or $x = \frac{d}{r}$; that is, a body lowered toward the center of the earth would lose in weight and proportion to its distance downward, as Olmsted says.

Your correspondent further confounds attraction with weight when he says: "Guided by this theorem, we should expect a hollow sphere to balance if suspended from any possible point within the void." Not at all. The confusion comes from not distinguishing between the attraction between the earth and the portions of the shell on opposite sides of the point of support, and the almost infinitesimal attraction between these portions and any body at this point.

The theorem is in fact not to be proven experimentally, but is an inevitable consequence of the grand, often verified, never disproved law that every body attracts every other with a force directly as the product of its mass, and inversely as the square of the distance between them, that is, $f = \frac{m\ m'}{d^2}$.

It should perhaps be added that the demonstration above given, as Newton himself pointed out, is only true when each shell is homogeneous, though neighboring shells may vary in density to any extent. In the case of the earth, the curious result is found that the center of the earth is so much denser than the part near the surface that the force of attraction increases at first on descending; and so Professor Airy's clock, in the mine 1,250 feet deep, gained 274 seconds daily.

C. K. W.

Malone, N. Y.

South American Birds.

To the Editor of the Scientific American:

On the eastern shore of the Uruguay river, from Paysandu to Independençia, there is an open rolling country with frequent small ravines, most of which are bordered with a narrow skirt of timber of stunted growth and flowering shrubbery, which makes a fine retreat for the birds, and also frequently shelters the deer, South American tiger, and wild cat, which, however, are not abundant. The hill tops are also crowned with timber of similar growth, making a pleasant shade and resort from the scorching sun. Except on the hill tops and in the ravines, the country is partially covered with tall coarse grass, which makes a fine cover for quail and partridge. On approaching a ravine, the first thing that attracts your attention is the hum of the humming birds, which are of numerous different varieties, each bird balancing nicely on its wings while it inserts its long slender bill and extracts sustenance from the desert flower. Along the ravines, wild pigeons, similar to ours, are to be found in plenty, and are easily bagged. Next is the small partridge, very much like our northern quail, which are difficult to bag on foot and without a dog, as they will hide in the tall grass; but with a trained dog, the sport is fine. On horseback, you may almost ride over them before they will fly up. They are in flocks generally, yet they do not huddle; and it is difficult to get more than one at a shot. But you may sit on your horse and shoot a whole flock singly, as they seldom fly except they are flushed by a dog. The large partridges, which closely resemble English pheasants, are generally found singly, and the mode of catching these birds is rather peculiar.

They are found amongst the tall grass. The sportsman is mounted (carrying no gun, however) and has his dog trained to the work. He walks his horse slowly along, while the dog hunts about amongst the grass; and when he comes close upon the bird, the latter breaks cover, rises a little above the grass, and flies off on a level. When the bird flies, the sportsman puts his horse to his mettle and follows to the spot where he sees the bird alight (probably a hundred yards), and waits the arrival of the dog, who follows at his top speed and rushes in amongst the grass; and soon again the bird breaks cover and flies as before, but only about half as far. The sportsman and dog follow up as before, and the bird is hunted out again by the dog, and divides the distance again, and drops into the grass, pursued by sportsman and dog, this time closing the race for life. The dog rushes into the grass and directly comes out again with the bird unharmed in his mouth; the sportsman in the meantime dismounts and receives the bird, and disposes of him as he thinks proper. I was once an eye witness of such a race, and was told that these birds never break cover but three times, which seems to me rather strange.

Stratford, Conn. TRUMAN HOTCHKISS.

The Atmosphere of the Moon.

To the Editor of the Scientific American:

The moon is considered, by some astronomers, to have no atmosphere, as you mentioned in a recent issue; and in the article you gave some very plausible reasons for supposing that there may be an atmosphere of some kind on that body.

Heat, as you say, would have a great influence in expanding the air to a great extent, and rendering it so rare that it would extend out from the surface of the moon a great distance, so that its presence could hardly be detected by us. Yet when the moon cooled, the air would be condensed, and then be as dense or denser than our atmosphere, and could be easily detected.

To prove that the detection of the presence of the atmosphere would be difficult when the air was rare, and comparatively easy when the same bulk of air is made to occupy a smaller space, is very simple; for if we take a cubic foot of air or any other gas of the density of our atmosphere, the refraction of a ray of light passing through it would be very evident; but, if the same amount be made to occupy one hundred cubic feet, the refraction would be very much more difficult to detect, for, according to the old rule, "the greater the difference of the densities of the two gases, the greater the refraction, and *vice versa*."

Covington, Ky. WILLIAM L. DUDLEY.

The Direct Motion of the Radiometer an Effect of Electricity.

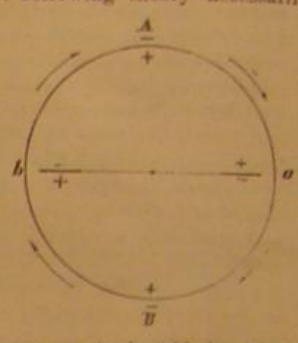
To the Editor of the Scientific American

In the communication I sent you a few days ago, upon the radiometer of Professor Crookes, I showed that the exterior of the glass globe was electrified negatively when exposed to luminous or calorific radiations. Having made, since that time, some more experiments, I have discovered new facts which enable me to explain at least some of the motions of this wonderful instrument. The facts are as follows:

I took a strip of mica two diameters (7·8 inches) in length; and having coated one of the sides with lampblack, when it was quite dry I suspended it in a Coulomb's torsion balance, having previously electrified the metallic disk of the balance needle with positive electricity. The blackened side of the mica faced the electrified disk. When the needle had come to rest I allowed the radiations from a large gas flame to fall upon the blackened surface of the mica. Notwithstanding the light was at a considerable distance and had to penetrate the thick glass shade enclosing the balance, the needle was rapidly repelled several degrees, showing that the blackened face was positively electrified under the influence of radiation. I then turned the strip of mica so that the bright side faced the disk and allowed the radiation to fall as before, upon the blackened surface. This time the needle indicated an attraction between the disk and the mica, thus proving that the bright surface was negatively electrified.

To anticipate an objection to the theory of the radiometer which will be suggested by these facts, namely, that these electrical manifestations are too feeble to account for the rapid revolution of the arms, I made the following experiment: I rubbed the globe gently with a brush composed of fine threads of glass; the electricity developed on the globe, acting by induction upon the nearest mica disk, caused a brisk oscillation. I then measured the intensity of the electricity upon the glass globe by means of the proof plan and Böhnenberger's electroscope. There was no indication of greater intensity in this case than there was when the globe was electrified by the radiations from aluminous or obscure source and tested in the same manner.

From the above facts the following theory necessarily flows as a corollary: The hemisphere, A, being negatively electrified, as we have shown, upon its whole exterior surface, we justly conclude that the interior is positively electrified. The hemisphere, B, is electrified in the same way, but its intensity is different, the charge being less at B than at A.



The mica disk in the position, *a*, with its blackened side turned towards the radiant source, is electrified positively upon the black and negatively upon the bright surface, as we have proved above. As like electricities repel and unlike attract, the positive electricity at A will repel the arm, and that at B, acting upon the bright face, will attract it, so that it will necessarily rotate in the direction of the arrows, namely, A *a* B. When the arm has reached *b*, the direction of the rotation will not be changed, but A will now attract, and B repel, and it will continue to move in the direction B *b* A. The direct and most usual movement of the arms in Professor Crookes' radiometer is thus explained in the simplest manner.

JOSEPH DELSAUX, S. J.

11 Rue des Recollets, Louvain, Belgium.

[For the Scientific American.]

NOTES ON THE RESISTANCE OF MATERIALS.

The ordinary formulæ and tables in technical works for proportioning the parts of machines and structures are based on the ultimate resistance of the material which is to be employed, accompanied by recommendations that a certain fraction only of the breaking load should be applied in practice. This fraction varies from ⅓ to ¼, according to the views of different authorities. It has been found, however, that a material may be strained in such a manner as to become unsafe, by a load that is generally less than half the ultimate resistance, so that some of the best authorities consider that the fraction of the breaking load, or factor of safety, should be chosen with reference to the elastic limit of the material rather than its ultimate resistance. Still more recently, attention has been directed to experiments showing that materials could be ruptured by the repeated application of a comparatively small load. It is obvious that a rule for proportioning a machine, which provides for safety by using only a part of the strain allowed by the theory in which the rule is founded, is at best only a makeshift, and is unsatisfactory on many accounts. If the structures of the materials used in the arts were understood, so that the effect of strains could be accurately noted, it would of course be easy to give rules which would enable the material to be disposed in the most effective and economical manner. The experiments on the effect of repeated strains, referred to above, furnish some facts on which a novel and interesting theory of molecular structure has been based. Although this theory is far from being fully verified by experiment, it is, to say the least, not absolutely contradicted. A good discussion of the subject has recently been given by Professor Spangenberg of Germany, and a translation of the same has been published in this country, from which the following account has been condensed.

What is commonly regarded as a solid is supposed, in the theory referred to, to be made up of a number of atoms and molecules, surrounded by ethereal atmospheres, and grouped in various forms, according to the temperature and nature of external strains. Most readers know that the theory, so far, is in accordance with that generally adopted by scientists. Perhaps it neerv can be absolutely proved, although it has been shown to be extremely probable. Now it is known that when a mass of metal is melted and poured into a mold where it is rapidly cooled, it tends to crystallize in groups, and this is regarded as the first normal condition. Wrought iron and steel are generally rolled or hammered before use, and this breaks up the crystalline groups and produces a fibrous grain. When a metal is subject to strain, the grouping of the atoms will be changed, and they may return to their former position when the load is removed, or may take new forms, according to the amount of the strain and the rapidity of its recurrence. The effect of repeated strains is to break up the crystalline structure, and induce an amorphous condition. In changing to this state, the strain may act so quickly that all the crystals are not affected, and rupture will occur. The atoms of the body are supposed to have a mutual attraction for each other, and the other atoms attract those of the body and mutually repel each other.

It seems to be settled by experiment as well as theory that, contrary to general notions, the resistance to rupture of a body is less, the more crystalline is its structure, and increases as the amorphous structure is produced. It is supposed that the cohesion between separate crystalline groups is less than the cohesion of molecules forming a crystal.

The experiments given in connection with this theory show conclusively that the number and duration of strains are of quite as much importance as their magnitude. Whether then, the theory on which this action is explained is accepted or not, the facts seem to show the point to which future experiments on the strength of materials should be directed. Possibly the United States testing board may derive some hints from Professor Spangenburg's treatise.

R. H. B.

CHEMICALS AT THE CENTENNIAL.

THE FRENCH EXHIBIT

The number of exhibitors is about the same as in the German department, but the exhibits taken together are less interesting, we think, than those of Germany. The want of a good French catalogue of their chemicals is severely felt. Beginning with the aniline colors, those of A. Poirrier, Paris, are particularly noticeable, both for quantity and color. One huge mass of *violet de Paris* (dimethylaniline violet) is over 2 feet long and 18 inches wide. Several of the aniline dyes are exhibited in glass fruit dishes, the foot of each dish being wrapped with silk dyed therewith, and exhibiting a striking manner the difference of color which these dyes have when dry or in solution, as most of the reds and violets form green crystals. This seems due to the fact, equally difficult of explanation, that they reflect one color and transmit another, wherefore solution and films are red, thick masses and crystals green or bronze. In addition to several aniline colors, so called, this firm exhibits the new and costly cosine in larger quantity than almost any one else. Also specimens of benzyl chloride and benzoic acid made from the latter, as well as benzyl anilin. This exhibit is unequaled except in the German department, where Bayer & Co. and the Berlin Joint Stock Company compete for the first place. Some large blocks of corallin, anilin red, etc., are exhibited by Guinon's Sons & Co., Lyons, as also orzulin, cochineal, picric acid, and bisulphite of soda. Clauseau exhibits madder root, whole, in powder, and flour, alizarine and purpurine from madder, alcohol from madder, and madder extracts. A. Beslier exhibits the whole plant of *thapsia garganica*. Several parties exhibits dye woods and extracts used in dyeing. Charles Dubois exhibits a number of cyanides and other poisonous salts for use in the navy, probably as wood preservers, including cyanides of lead and copper, sulphocyanides of mercury, copper, and arsenic, chromate and arsenite of mercury, etc.

Solvay & Co. exhibit both here and in the Belgian section a set of substances to illustrate their new ammonia soda process, namely, salt water, crude ammonia liquor, carbonate and bicarbonate of soda. The analyses show the extraordinary purity of the soda obtained in this process. The carbonate of soda contains 99·438 per cent of the pure salt, $Na_2 CO_3$), 0·21 of common salt (Na Cl), 0·0015 of sesquioxide of iron. The bicarbonate is, of course, less pure, containing bicarbonate of ammonia to the amount of 0·42 per cent, which is expelled along with the extra equivalent of carbonic acid, on heating to form the monocarbonate. Photographs of the exterior of the works are shown.

The most interesting pharmaceutical exhibit is that of C. Torchon, Paris, containing a huge block of chloral hydrate, ditto in crystals, a whole guinea pig preserved by the injection of chloral, specimens of hydrosulphide of chloral, metachloral, and alcoholate of chloral. In the same case is a bottle of petroleum said to have been produced synthetically, by the action of carbonic acid and steam on sulphide of iron

There are, indeed, many soap and candle exhibits, a few carbolic acid exhibits, sulphur in several forms, capsules and pills, insect powder, glue, gelatin, and bone black; but little of real interest to the chemist. Of ultramarine we noticed but two exhibits, those of F. Richter, of Lille, and Guimet, of Lyons. Faure and Kessler's pan apparatus for concentrating sulphuric acid is also to be seen in this section.

THE BELGIAN EXHIBIT.

One of the most interesting objects in the Belgian section is a working drawing (elevation) about 6 feet long, illustrat- A. De Hemptinné's new method of making and concentrating sulphuric acid. We think this process has not been tried on a manufacturing scale, but it is attracting more attention at this moment, among practical men, than any other novelty in this important industry. Solvay & Co., Couillet, near Charleroi, have a better exhibit of the ammonia soda process here than in the French section above referred to. The other exhibits are unimportant, excepting the coal tar colors of Max Singer.

THE SWISS EXHIBIT.

Bindschedler & Busch, of Basle, deserve notice for their coal tar products, which include some remarkably large needles of crystallized anhydrous phtalic acid, diphenylamine, artificial alizarine, crystals of anthraquinone, resorcin, toluidine, eosine, and ether of tetrabrom-fluorescene, which latter is the correct scientific designation of the beautiful eosine already mentioned. A manufacturer of coffee substitutes, fig coffee, vanilla coffee, etc., makes quite a display here, as does Hurlimann, who shows artificial Swiss honey. We also noticed several specimens of phosphorus bronze, which are interesting, although not strictly chemical

HOLLAND

The Netherlands are poorly represented in this department; even coal tar colors are absent, and soaps, oils, glass, inks, and paints, with one large pyramid of crude sulphate of ammonia, exhaust the list. One case contains a fair show of minerals, including a large mass of malachite, and smaller pieces of amethyst, *lapis lazuli*, and labradorite (locality not given). Von Ketten exhibits a powerful horseshoe magnet, composed of seven leaves; it is 2½ feet long, weighs 83 lbs., and will lift, he says, 500 lbs. A series of models illustrating in detail the effects of the cattle plague were of particular interest, as showing the care with which this subject has been studied abroad.

SWEDEN.

The land of Berzelius is largely given up to "match-making," if we may judge from the catalogue, where no less than 16 out of the 37 exhibitors deal wholly in safety matches. Norway sends over but five match makers. The well known safety match of the Jönköping's Company occupies a beautiful case, where we find matches, pocket match safes, igniting surfaces, and a new double safety match, which it is said ignites only on the box, and becomes entirely dead instantly the flame is extinguished. In the neighborhood of this famous case are columns covered with matches, with candles, and with aseptine, for the preservation of provisions and animal material. Bengston exhibits some soda and Glauber salts, and Werner some bone oil, in little flasks tastefully suspended to circular rings in tree form. Kimtze & Co. exhibit several water filters, and Almén a variety of medicated gelatin. The celebrated Swedish filter paper, the only paper used in quantitative chemical analysis, is exhibited by the Gryscksbo Factory at Falun. The same firm exhibit writing, drawing, and printing paper, with a copy of Berzelius' commendatory notice of their filter paper. We saw no filter paper elsewhere in the exhibition, but we believe that Germany is now in close competition with Sweden in that line

AUSTRIA.

We were disappointed to find that Austria had not thought it worth her while to send over anything but soap and candles. Ozokerite, or mineral wax, seems to be the staple production of certain parts of Austria, Gallicia more especially, and all the changes are rung on this one substance to the exclusion of more interesting products. F. A. Sarg, Son, & Co., Liesing, near Vienna, have a large white tablet, nearly 20 feet long and perhaps 12 feet high, made of blocks of stearine with a yellow border of wax, and their name and place of business in large letters upon it. This firm exhibits oleomargarin, milly candles, and candles of paraffin and ozokerite, an interesting collection of fatty acids both solid and liquid, glycerin, wax, etc. Another handsome display is that H. Ujhely & Co., Stockerau, fancy wax in great variety. G. Wagemann exhibits refined mineral wax and petroleum; and Paul Dobel, Boryslaw, Gallicia, exhibits the crude ozokerite in its natural state as well as the melted and refined article.

More of a truly chemical nature is the exhibit of anthracene, alizarine, sulphanthraquinone, and its sodium salt, by Przibram & Co., Vienna.

The royal-imperial director of the Idrian mines sends a set of minerals and products such as cinnabar, uranate of sodium, potassium, and ammonia, oxide of uranium, and the like.

Chemical glassware of the latest and best forms is sent by Lenoir & Forster. Small sets of chemical and physical apparatus for national schools comes from A. Kreidl, Prague. The entire collection consists of 76 different articles and reagents, and costs, including packing, 53 Austrian florins (about $26) in Prague. This complete set, as the circular calls it, seemed to us quite incomplete, and, like most little sets of this kind, almost useless either for the instructor or learner. The general display of Bohemian glass ware, of course, is extremely elegant; but a description of it would out of place here

In an out-of-the way corner is a small horizontal case, occupying scarcely two square feet of space, and seldom noticed by the visitors, containing a new kind of confectionery, exhibited by Josef Gobetzky, Essegg. It differs from most articles of this nature in that it contains a tasteless salt of quinine, said to be the tannate. It is probably the same as those made by Rozsnay, in Arad, and described and endorsed by Dr. H. Hager in his *Pharmaceutisches Centralhalle*. The latter analyzed them and found that each lozenge contained 0·97 grain of hydrate of quinine in the form of tannate. The chocolate pastilles contain about 0·93 grain of hydrate of quinine. If they are really all that is claimed for them, tasteless and yet therapeutic, we hope to see them introduced here.

ENGLAND.

Like those of the Austrian section, the English chemicals deserve but brief notice. Soda ash is the staple, and all the possible changes are rung on it, nor are we surprised at this, for this is England's leading industry. Some firms send over chloride of calcium, sulphur, and starch; one firm sends a bust of Linclon made of ozokerite. The Price Candle Company exhibit a large number of photographs of the fatty acids, showing the effect of admixture with varying quantities of other acids or of paraffin. Dr. Siemens exhibits a model of his regenerative gas furnace. Some beautiful iridescent crystals of chlorate of potash are shown by the Greenbank Alkali Company. The finest display of rarer chemicals is that of T. & H. Smith, which, like many others, are not down in the official catalogue. They exhibit a large cake of caffeine, and smaller quantities of codeia, cryptopia, apomorphia, muriate of thebaia, citrate of caffeine, other rare alkaloids, and thebolactic acid, an acid discovered by Messrs. Smith and obtained by them from the mother liquors of morphine. It is possible that it is really nothing but ordinary lactic acid.

Importance of Well Seasoned Timber for Carriage Building.

Lumber for bodies and gearings, including ash and poplar for the former, and hickory for the latter, to be properly seasoned should be nicely piled in the shade, and protected from exposure to wet weather. The cross slats between the boards should not exceed four feet in distance apart, so as to prevent the boards from warping out of their original shape.

Boards, as a general thing, check in at the ends, very often several inches, and sometimes a foot or more, and, of course, the lumber at that part is thereby rendered unfit for use. But to prevent this being a serious difficulty, it is simply necessary to place the end slats as close to the edge of the end as possible. Now, it is very obvious that moisture will be retained at the slats more than on the raked parts of boards; the result is that the boards do not shrink so rapidly at the slats as they do away from them; and consequently the boards remain whole and do not become wavy.

It is said by those who profess to know something about wood that, if you set timber upon one end, it will season quicker than it will if laid down. That is very likely so, and if so it may be caused by the fact that the sap or matter ejected ascends through the pores of wood set upon one end, without any hindrance, while it could not so readily if laid down. It is seen that fibers of the wood are longitudinal connections, and all the substance to be ejected collects between these connections in the pores, running from one end of the wood to the other, and flows out in the same direction. That is why the transverse expansion or swelling of wood is great, while its increase in length is hardly perceptible, when the pores absorb water.

Bodies, to be durable, should have the stuff in them highly seasoned, but not have it cooked too much by suspending it over a stove, so as to deprive it of the requisite substance and render it brittle. Cooking panels, as just described, brings them in such a condition that it is impossible almost to get them solidly glued on the frame without checking them at the ends, and at the same time they are liable to be split in two.

All that panels require after they are thoroughly seasoned, after fastening them to the frame, is to take out the dampness by warming them; and the frame does not need any thing more. But proper seasoning is a requisite.

No matter how well developed constructiveness may be in a body maker, or the other faculties that aid him, or how experienced a mechanic he may be, even if he can make bodies without any person being able to discover the trace of a joint, if the stuff is not seasoned before it is put together, the body will not, cannot, stand.—*J. W. Daron, in the Hub*

THE AMERICAN SOCIAL SCIENCE ASSOCIATION.

A largely attended meeting of this body took place at Saratoga, N. Y., during the week ending September 9, and many papers of value and importance were read. Among the most prominent was one by Mr. Edward Atkinson, of Boston, Mass., on

THE RELATION OF CAPITAL TO ANNUAL PRODUCTION AND SUBSISTENCE.

He commented on the outcry for cheaper transportation by stating that 500 lbs. of meat and grain constitute the full subsistence of an adult man for one year, and it cost to-day but $1.25 to move a quarter of a tun or 500 lbs. from Chicago to Boston, less than one day's wages of a good mechanic. In this low cost it would be difficult to find evidence of the rapacity of the railway monopolists. So far as the people of Massachusetts eat bakers' bread, it costs them more to move the bread from the bakers' oven to the mouth of the consumer than it does to move the flour from the wheat field to the oven. There are, doubtless, grave defects in our railway system, but the fact must not be ignored that those special corporations, against which the most urgent charges of monopoly have been made, are the ones that do the most service in distributing the largest quantity of product at the least relative cost to the community.

The remainder of Mr. Atkinson's paper, which was too long for publication *in extenso*, was chiefly devoted to the capital and labor question; and it closed with a vigorous attack on the greenback form of money.

Mr. H. R. Hayden read a paper on

LIFE INSURANCE AS A SOCIAL FORCE,

in which he pointed out that a sound system of insurance effects a distribution of the loss which afflicts relatives when premature death occurs, and which averages human life as far as the well-being of the survivors is concerned. He complained of the laws affecting insurance in many of the States, stating that they gave advantages to the dishonest and so destroyed public confidence.

Mr. Nordhoff read a paper on

THE INDUSTRIAL AND SOCIAL CONDITION OF THE SOUTH,

a question which can hardly just now be kept clear of politics; and Mr. Nordhoff's essay dealt chiefly with the subject as it shows the difference between republican and democratic misgovernment.

Professor Dwight read a paper on

LEGAL EDUCATION IN THE UNITED STATES,

in which he contrasted the position of the lawyer in this country with his *status* in England. In the latter country, the lawyer confines himself to one branch of the profession, and obtains an accurate though limited knowledge; but here the lawyer prepares himself in each department of professional labor, and obtains breadth and comprehensiveness at the cost of precision and accuracy. He furthermore advocated reforms in the system of college examinations, and an increase in the opportunities for students to acquire sound learning and a high sense of professional honor.

CLEANING BRASS INLAID WORK.—Mix tripoli and linseed oil, and dip felt into the preparation. With this polish. If the wood be rosewood or ebony, polish it with finely powdered elder ashes, or make a polishing paste of rotten stone, a pinch of starch, sweet oil, and oxalic acid, mixed with water

A NEW STEAM ENGINE.

Messrs. Eli James Smith and Benajah Mason, Jr., of North English, Iowa, are the inventors of the novel steam engine herewith illustrated, which was patented through the Scientific American Patent Agency, August 1, 1876. The cylinder consists of two flanged sections, which are bolted to a central partition, C. A valve, *a*, is placed in a slot cut in the head, C, and is pivoted at *b*. D D are pistons, which are placed upon a piston rod, E, the distance between them being a little more than the length of the stroke and the thickness of the central head combined. The valve, *a*, is enlarged above the pivot, *b*, so as to engage with the bosses on the pistons, D D, at the end of every stroke, being moved by each piston in alternation, opening the supply passage, *c*, and the exhaust passage, *d*. The lower end of the valve is continued outside of the cylinder, and formed into a handle at *e*. The cylinder, A, is mounted on suitable supports, and the piston rod, E, is connected with a crank and fly wheel in the ordinary way.

Steam is taken through a pipe, F, and through the open port, forcing the piston away from the central head, the piston remote from the head following, of course, until it strikes the enlarged portion of the valve, throwing the valve over, and allowing the steam to enter on the other side of the central head, forcing the piston toward the end of its stroke. At the same time the lower part of the valve opens the exhaust port, allowing the steam to escape through the passage, *d*. If it is desired to reverse the engine, it is only necessary to move the valve, by means of the handle, *e*, at the proper instant, when steam will be admitted on what was before the exhaust side of the central head. When the engine is made vertical the upper section of the cylinder is made a little larger than the lower one, to compensate for the weight of the pistons.

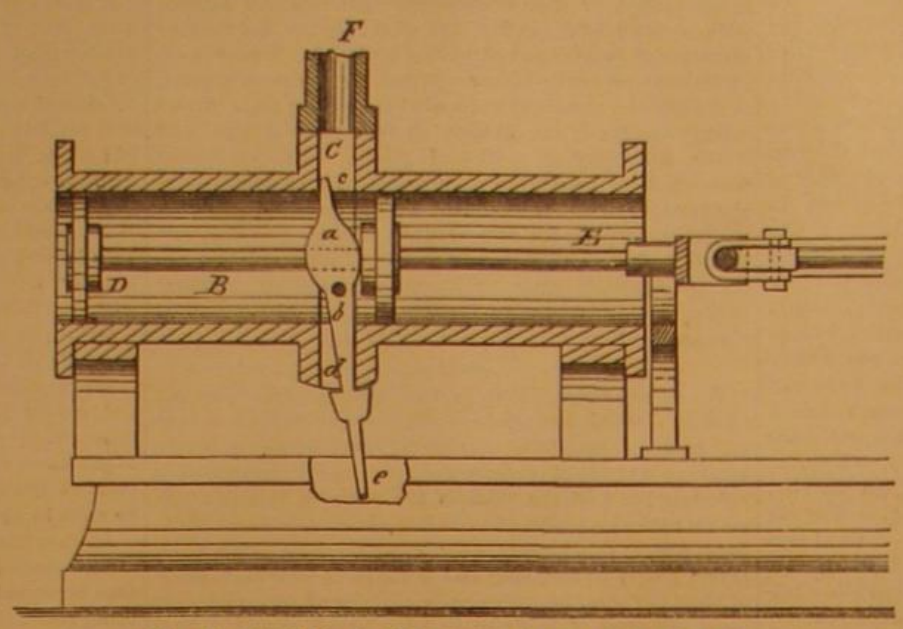


Fig. 1.—SMITH & MASON'S STEAM ENGINE.

THE ORIGINAL STEAM STEERING APPARATUS.

It is very rarely that any invention survives a period of half a dozen years without being made the subject of so many improvements and modifications that, in the end, it often happens that little or none of the original device remains. We know of no exception to this rule more remarkable than that of the steam steering apparatus in which steam, for the first time, was used to operate the rudder of a vessel This machine, in its present form, is practically identical in operation with the first tangible outcome of the inventor's thought. The lapse of 25 years has worked no notable change in its mechanism; and the first apparatus of the kind ever built—an engraving of which as it appears at the Centennial Exposition is given herewith—compares in every way favorably with those of most recent construction, despite the fact that the latter embody mechanical refinements not found in the early model.

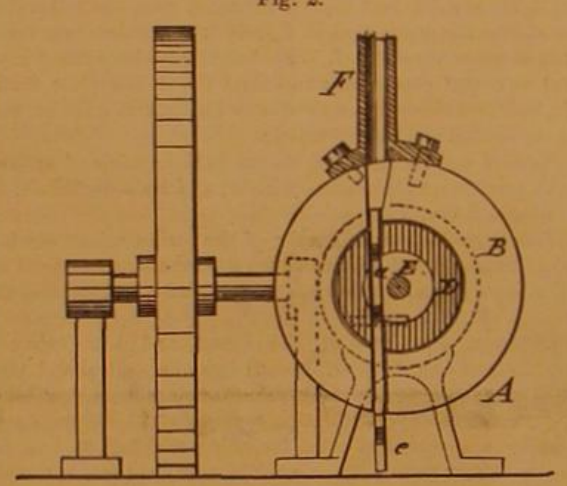
The inventor of this edvice, the importance of which is now recognized the world over, is Mr. Frederick E. Sickels, already one of the most famous of American inventors through his origination of the well known Sickels cut-off. The control of the rudder is secured by operating the valves for the admission of steam to the cylinders by a hand wheel. The rudder is thus compelled to follow the motion of said wheel, which is similar in form and mode of operation to the ordinary helm. Suitable disconnecting and connecting gear is provided, whereby the steam apparatus can be thrown out of action and the helm worked by hand in the usual way.

Apart from its serving as evidence of the non-alteration of the device from its original form, the apparatus at the Exposition is obviously possessed of much historical interest. It was used by negro pilots in the South previous to the war without the slightest failure in its operation; then it was exhibited in the Crystal Palace, in this city, in 1853–4. It was next put aboard the steamer Augusta, running between Savannah and Fernandina, on a route extremely difficult of navigation by single engine steamers on account of crooked channels. It was, when thus located, submitted to the severe tests of heavy gales and rough seas, with out any impairment of its efficiency taking place. When the war broke out, the Augusta was brought to New York, and the machine was removed and sent to the London International Exhibition of 1862. There it attracted great attention, and a medal was awarded it; and from this time the machine, of which it is the prototype, has gradually been creeping into use.

A model which is exhibited at the Centennial beside the large machine, Mr. Sickels states, is prior in date to any attempt, in books, drawings, or models, to devise a power-steering apparatus. It appears further that Mr. Sickels first began experimenting upon the subject as early as 1847.

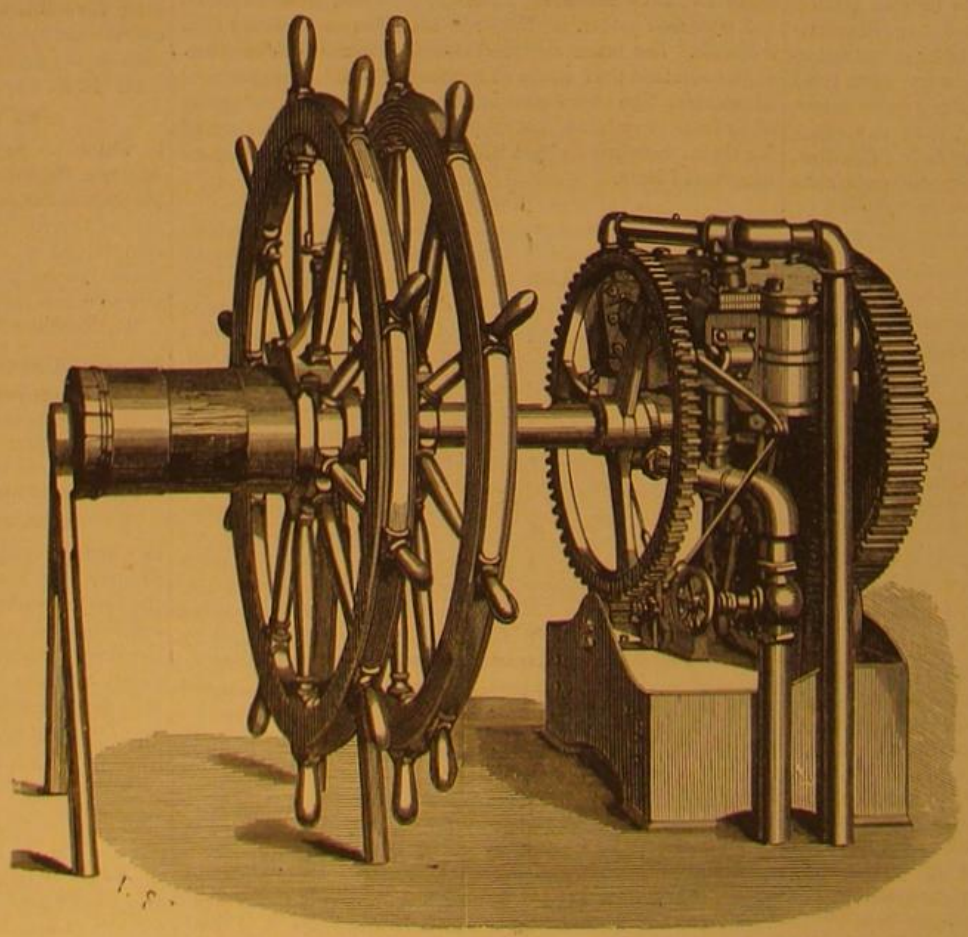
During the present year the invention has been tested by a board of naval officers, and its adoption in the United States naval service strongly recommended. It has already been adopted in the English navy, and is employed on nearly all the British merchant steamers which enter the port of New York. From the owners of these last the inventor receives no royalty, nor do the former in anywise make return for the benefits they enjoy, preferring to avoid

Fig. 2.



doing so by taking advantage of the fact of these vessels being under a foreign flag.

Those visitors to the Centennial, who may make an interesting study of the original machine, will be enabled to judge of the absence of improvements and the perfection of the original model by comparing it with a recently constructed and finely made apparatus of the same description exhibited by the government in the United States building. To the student of the rise and progress of American inven tion we can suggest no more profitable expenditure, of a part of the time devoted to the examination of the Centennial Exposition, than in making just such studies as this. There are other original machines—notably a model of the first sewing machine made by Saint in the last century, beside Elias Howe's original device—which would form profitable subjects for further examination of the same nature.



THE SICKELS STEAM STEERING APPARATUS AT THE EXHIBITION.

A Plea for Inventors.

Of all the mental efforts requiring imaginative construction, none is more difficult than that which is required to develope a new mechanical movement, or originate a new plan-mode or mechanical principle. The faculty of inventing depends more upon natural endowments, or rather instinctive intelligence, than upon education and experience. Experience only serves to familiarize the inventor with the wants or deficiencies in any particular line of industry, and education assists in giving completeness to the conception; but the conception itself is a matter entirely independent of either, and is just as apt to be suggested by an illiterate and inexperienced person as by one who has spent years in studying and investigating the matter: in fact more so, because education and experience are both the results of study and long familiarity with existing devices, so that they, to a certain extent, incapacitate their possessors from looking beyond the boundary of their experience and teaching. Upon the principle that "fools rush in where angels fear to tread," the illiterate inventor will investigate methods and plans which many an experienced artisan or workman would not entertain for a moment, simply because they do not possess that imaginative construction necessary to give the new creation mental existence, and because their teaching and experience do not include the new idea. Thus many of our most important and most novel inventions have been originated and developed by persons entirely devoid of technical knowledge and experience in the field of mechanics to which their inventions belong. Accident, circumstance, and necessity all contribute to the discovery of new principles. Sometimes, however, we find the skilled and educated mechanic possessed of the inventive faculty, and when this is the case he proves a "world mover." Such was Ericsson, who did more to develope the engine and strengthen the navies of the world than all other inventors combined. Such was Morse, who, with a skill and learning which was admirable in its completeness, adapted and perfected the telegraphic system with such precision and judgment that today it retains the principal features that he gave it. Such were Hoe and Colt, and other inventors whose memories the civilized world hold in reverence.

All patents are not productive, neither are all farms; all men are not rich; all mines are not bonanzas; but if we were to strike a balance sheet we would find that the proportion of the profitable and unprofitable patents correspond in a like ratio with the other profitable and unprofitable enterprises which men undertake.

When we consider the vast number of patented articles in the market, many of which are covered by a number of patents, we will realize that the work of the inventor is very often profitable. There is scarcely an article of human convenience or necessity in the market today, that has not at sometime or other been the subject of a patent, either in whole or in part. The sale of every such article yields the inventor a profit. If we purchase a box of paper collars, a portion of the price goes to the inventor; if we buy a sewing machine, the chances are that we pay a royalty to as many as a dozen or fifteen inventors at once. Indeed the field is so vast and the number of profitable patents so great that it would be far preferable to undertake a recapitulation of those patents which are not profitable than those which are.

The universal sentiment is that genius is its own reward; and in order to give effectiveness to the sentiment, the person who possesses genius in any branch of industry is allowed to set his own price upon the result of his labors. It is therefore but a just recognition of the services of the inventor that he be allowed to provide for his own wants from the benefits which he confers upon the public. The artist who produces a picture of unusual merit can find purchasers for it at a fabulous price. The stage actor who can draw crowded houses can demand and receive for a single performance what would be a year's salary for an ordinary workman; and the lawyer that possesses the faculty of swaying the minds of a jury by his eloquence can demand and receive whatever sum of money he desires for his services; yet the labors of the inventor yield more substantial results, and benefit mankind more than all these combined. He is the sapper and miner who prepares

the way and overcomes all our mechanical difficulties; in fact, he furnishes us with the honey, while we are the drones in the hive that derive benefit from his labors. Give credit; then, where credit is due. The inventor is the world's benefactor, and as such we take off our hat to him.—*Mining and Scientific Press.*

Oil of Orris Root.

Orris root owes its use during more than two thousand years chiefly to its fragrance, which, curiously enough, does not belong to the living root. Its slight and by no means aromatic smell is first developed into the agreeable perfume after drying, without doubt in consequence of changes of a chemical nature, concerning which at present our knowledge is deficient. When the dried root stock is submitted to distillation with water, eventually there appears upon the water a crystalline odorous matter, which is justly prized in perfumery and is specially prepared by some of the larger distillers. But the yield is very small, only about 1 part per 1000 of the orris root used. The product is of a yellowish brown color, of the consistence of a firm ointment, and possesses the characteristic odor of orris root.

THE HONEY BUZZARD.

The honey buzzard is one of the *falconidæ* or hawks, and is known to natural historians both as *falco pernis* (*Cuvier*) and *falco apivorus* (Linnæus). It is known throughout Europe; and specimens with a wing measurement of 50 inches are on record, but commonly 20 or 23 inches is the extreme width from tip to tip. The head is always gray, and the eyes, as well as the feet, are yellow. The talons, bill, and cere are black. The plumage on the upper portion of the body is brown; beneath, brown and white mingle indiscriminately, while the tail, which is long, is marked with transverse ash-colored bars; the toes are only half feathered. In the female the plumage is similar in color, only very decisively spotted.

The honey buzzard breeds in trees; the eggs are two in number, color gray, with obscure spots. An egg collector came across a nest of one of these birds while in pursuit of his hobby at Selborne, England. In the nest he found but one egg, which was much smaller than that of the *falco apivorus*, not so round, and dotted at each end with small red spots, being surrounded in the center with a broad blood-marked zone.

HONEY BUZZARDS AND THEIR PREY.

It must not be supposed that the food of these birds is restricted to honey, which only forms its dessert; but they devote attention to small birds, insects, and reptiles, as well as "rats and mice, and such small deer," and have been known, says a writer in the *Young Fancier's Guide*, from the pages of which we select the engraving, to purloin the eggs of other birds.

A Curiosity in the Baltimore Record Office.

In the course of the examination of titles in the record office to the ground comprised in Federal Hill Park, which will involve a good deal of labor yet before completion, Mr. Warfield T. Browning (assisting the city examiner, Mr. Henisler) yesterday came upon a deed which excited remark among the persons in the office for some curious matters referred to in it. The paper is a deed of trust in the nature of a will from Dr. John James Giraud, who resided on South street, and owned a part of the Federal Hill ground, conveying all his property to John S. Tyson in trust for the wife, heirs, and legatees, of Dr. Giraud. The deed was executed March 16, 1826, but Dr. Giraud did not die until 1837. Among the legatees was Right Rev. Ambrose Marechal, Archbishop of Baltimore, for several thousand dollars, and the trustees of the poor of the city and county. Among the bequests are two patents, dated January and April, 1821, to Dr. Giraud for "a discovery in mechanism, consisting of a very simple machine of considerable power, for the use of steamboats and other machinery requiring the application of great power. The patent is termed the handle or cylindrical machine, and the machine carries in itself its fulcrum or point of support." He also bequeaths his right in a discovery of a specific or medicine for the prevention or cure of yellow fever, plague, and malignant and pestilential fevers. The deed says its eminent virtues have been proved by three years of operation and trial by order of the government and medical faculty of Havana. Dr. Giraud's memoir on this subject was published in 1825 by William Wooddy, Baltimore. The specific consists of two liquors, limpid, tasteless, and inodorous; they are neither purgative nor emetic, but recall the secretions through the proper emunctories, and the crisis takes place by perspiration, etc.

The composition of the liquors, he says, cannot be discovered by chemical analysis, and their discovery was the result of the study and labors of one third of his lifetime. The government at Havana was to have given him, the deed states, $120,000 for the discovery; but the commotions in Spain and the death of Governor General Mahy interrupted the negotiations. He says he desires the secret to be sold by the trustees for his heirs to some government, and for that purpose, for the first time, writes down the composition of the recipe. Should any other person, as is not impossible in this age of science and chicanery, be found possessed of the recipe he is to be treated as a fraud, and the trustee is authorized "to prosecute him with all the rigor of the law." The doctor estimated the amount to be realized from the sale of his patents at $60,000, and directs that out of that sum $6,000 shall go to the archbishop and $3,000 to the poor. His sanguine dreams of profit from this source were not realized, however, no government being found to purchase the patent for the specific; and now the missing ingredient is the money that was expected.—*Baltimore Sun.*

The Care of Machinery no Mystery.

The *Mill Stone*, a monthly journal published at Indianopolis, Ind., one of the many good papers printed in the interest of special trades at the West, gives to its readers the following sound advice on the watchful care necessary in operating machinery:

To correctly plan and devise improvements in machinery involves the exercise of a considerable degree of original genius; and to fully develop such improvements, and to bring them into the most practical shape, requires, in addition to this, the application of acquired knowledge of the construction of the machine or mechanical combination, in such manner that each of the different parts thereof may be properly proportioned and arranged with reference to the particular function which it is designed to fulfil. When this is done, and the work completed, its useful mission has commenced, and inventive talent or skillful instructors need not be employed upon it, unless it should be to modify or add further improvements. Yet, however complete in itself, or however effectually it may perform its work, it is not endowed with the faculty of self-preservation, and, unless it be properly cared for, will be subject to numberless accidents and injuries, involving not only its own immediate or ultimate destruction, but, in many instances, the loss of life or limb to those employed in its operation. This necessary care requires, not the expert mechanic or professional skill, but simply the exercise of common sense. It is by prompt attention to little things that the maximum efficiency and durability is attained, with properly designed and constructed machinery. When the bearings of shafts and the spindles are not oiled sufficiently, not only does the increased friction require a greater amount of driving power, but the bearings are roughened or destroyed in a proportionate degree. When the caps of journal boxes are left too loose, the journal wabbles, and, if there is gearing attached to the shaft, its teeth are badly worn out of shape; while, if the caps are screwed down too tight, the oil is forced out, the journal heats, and both the shaft and bearing are soon rendered worthless. These matters are of no small moment, and the aggregate loss resulting from inattention to them is very great. It is not confined alone to the machinery of mills and other manufacturing operations, but occurs in a very much greater degree in machinery employed in agriculture. Many a thrasher, horse power, or harvester has been branded of bad construction, and been prematurely disabled, when a few drops of oil, or one or two turns of the wrench, were all that were required to set things to rights. Many other items might be mentioned, in which attention to little details, requiring only an application of ordinary common sense, will guard against great and unnecessary waste of power and damage to machinery; but these are sufficient to illustrate the almost self-evident proposition that, while talent is required to originate, and practical knowledge to construct machinery, its most efficient operation, and the profit in its use resulting therefrom, can only be secured by bringing to bear upon its management the plain, ordinary principles derived from every day observation and experience.

Etching on Glass.

M. E. Seigwart has lately given some interesting particulars about etching upon glass.

Since fluoric preparations have been produced at reasonable prices, the decoration of glass by their means has steadily made its way. Etched glass is now to be found everywhere, and glass etching runs glass cutting very hard. It is very easy to understand that well etched objects appear actually more beautiful than those which have been cut. The cost of production is cheaper; and since M. Hock, a Viennese chemist, has given us an elaborate work upon the technics of glass etching, the difficulties attending this kind of work have been reduced to a minimum.

As is well known, fluoric acid usually etches smooth, while other fluoric preparations yield a matt surface. The most beautiful ornamentation is obtained when certain parts of the glass surface are rendered matt by means of fluoride of ammonium which has been slightly acidified by means of acetic acid. The matt appearance is not always the same with different kinds of glass, but varies much in beauty

this effect is governed by the composition of the glass, lead glasses being easily acted upon, and furnishing a very fine matt surface.

Where it is desired to have the surface of the glass not altogether matt, but shining like ice, as in the case of window glass, this may be attained in a simple manner by placing the glass plate in a perfectly horizontal position and covering it with fine groats. Then very dilute fluoric acid is poured upon it. The groats act as a shield, and produce upon the glass raised points.

Several ways exist of etching photographs on glass. A good result may be secured by covering the surface with a solution of gum made sensitive with bichromate of potash, and printing the same under a negative; after the image has been thus produced, it is dusted over with minium or red lead, and the red picture thus obtained is fixed and burnt in in the usual manner. The easily soluble red glass, so obtained, is treated with strong sulphuric acid, when a white matt design is produced, and the picture appears by transmitted light as a positive.—*Photographisches Archiv.*

Power of Wooden Vessels to Withstand Pressure.

We have lately received a communication from a correspondent at Dayton, O., referring to an unfortunate occurrence, which caused the instant death of one man, and the narrow escape of several others. It seems that a number of men, in the employ of a manufacturer of artificial mineral waters, were in the act of charging a quantity of water, contained in a large iron-bound oaken cask, with carbonic acid gas, at a pressure of 130 lbs. to the inch. The cask, without any previous warning, exploded, with the results above stated. The explosion was sufficiently severe to splinter the cask and the three-inch planking over head. That such accidents are not of more frequent occurrence is to be wondered at; and under such circumstances we cannot but consider the employment of such vessels criminal. We have often cautioned persons against employing wooden casks for this and similar purposes; as it is evident from their construction that, under such conditions of pressure, the whole strain must come upon the hoops and binding clamps, which, unless of extreme strength, could not be expected to withstand such strain as they were placed under in the above instance. Besides, such vessels are always of doubtful efficacy for such purposes, for, where they hold liquids under pressure, even provided it were possible to render every joint tight, the liquid would gradually ooze through the pores of the wood; and if it so happened, as in the instance above cited, that the liquids contained a free acid, the metal bindings would speedily become corroded and weakened, thus rendering rupture, in time, certain.

Should personal and public safety be sacrificed to the mere question of economy? And is the incurring of such risks justifiable by the small advantages derived therefrom? Before more of such deplorable accidents as the one here recorded have occurred, it is to be hoped that the proper authorities will take the matter in hand, and prevent further loss of life from such criminal practices.

The World's Age.

Mr. William Chambers, the veteran author and publisher of *Chambers' Journal*, contributes to that excellent periodical a summary of some of the many views held by scientists as to the antiquity of our world. The *Quarterly Review* treated the same subject recently, and that most conservative of magazines now admits that the ordinary interpretation of the date of the creation, about 6,000 years ago, is to be set aside as untenable and at variance not only with historic and archæological research, but with the substantial discoveries of geology. The reviewer quotes the opinion that it is impossible that the earth can have existed many millions of years, as the earth is cooling, if not rapidly, at such a rate as to make such an antiquity impossible; and again, there is reason to believe that the earth's rotation is not so rapid as formerly.

The question as to the date of creation must be considered to refer to our solar system alone. The nearest fixed star or sun outside our system—possiby the center of a similar system—is too far off to enter into the question of the age of our sun and its planets and their satellites, being two hundred millions of millions miles away. Sir Charles Lyell gives the date of the Cambrian formation of rocks as at least two hundred and forty millions years ago; while Mr. Darwin assigns to the world a much greater age even than this. Mr. Adams has essayed to calculate the retardation of the earth by the friction of the tidal waves on the atmosphere; and in conjunction with Professor Tait and Sir William Thomson, he allows 22 seconds per century as the time lost by the slackened speed. Mr. Chambers wisely concludes his article as follows: "We can only say that the theories propounded are eminently suggestive, but nothing more. It is not remarkable that there should be differences of opinion among men of science concerning the dark and stupendous questions of the cosmogony of the world. All we deprecate, in the present state of human knowledge, is rash dogmatising, one way or another."

The Poughkeepsie Bridge.

Progress is being made in the construction of the bridge across the Hudson river at Poughkeepsie, a work, which, when completed, will increase the facilities of travel between Pennsylvania and New England. The coal traffic alone, it is anticipated, will bring in a large revenue to the bridge, as the freight to Massachusetts and other manufacturing States will be considerably reduced.

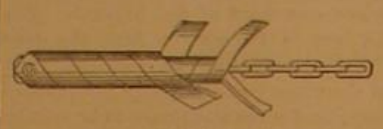
The American Bridge Company is to construct the bridge and its approaches, and the materials for the first caisson are now being delivered. There will be four piers in the river, built on caissons, the foundation of which will be 85 feet below the surface of the water. The piers will be 525 feet apart, and will be built up of masonry to 130 feet above high water mark. The bridge is to have a double railroad track, a wagon roadway, and a way for foot passengers. It is stated that the Erie railway can cross the Hudson by this bridge and enter New York city, making a *détour* of only 10 miles from its present route, which has the disadvantage of landing its passengers in Jersey City.

CHAIN GEAR AND FASTENINGS.

Our extracts this week from Knight's "New Mechanical Dictionary"* include a series of engravings relating to chain, together with others showing forms of fastening rope, etc. These will doubtless prove useful to builders, quarrymen, farmers, and others who frequently have occasion to use tackles, for hoisting heavy weights and for many other purposes.

Fig. 1 shows how a chain, by wrapping it with strips of canvas or leather, may be made into a round belt, whereby power may be transmitted. Fig. 2 is a chain hook which simply clamps one link between two adjacent ones. Fig. 3 shows how chains are fastened by ropes, when, as in the case of a vessel's cable, they are to be subjected to heavy strains. The upper figure is termed a double and the lower a single chain fastening. These hitches are very strong and not liable to slip. Fig. 4 is a chain pulley having pockets or depressions in its periphery, in which lie the links or alternate links of a chain which passes over and gives motion to or transmits from the pulley. In the chain wheel, Fig. 5, the sprockets of the wheel are adapted to receive the links of the chain successively. The power may be communicated by the wheel to the chain, or conversely. The former is shown in the familiar chain pump, and the latter in machines where the operation is inverted, the column of water pressing upon the buttons attached to the chain and causing them to descend in the tubes, thus rotating the wheels.

Fig.



Chain-Belt.

Fig. 2.

Chain-Hook.

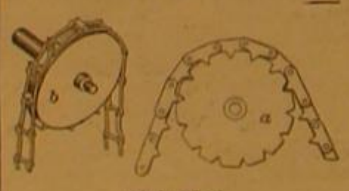
Fig. 3.

Chain-Fastenings.

Fig. 4.

Chain-Pulley.

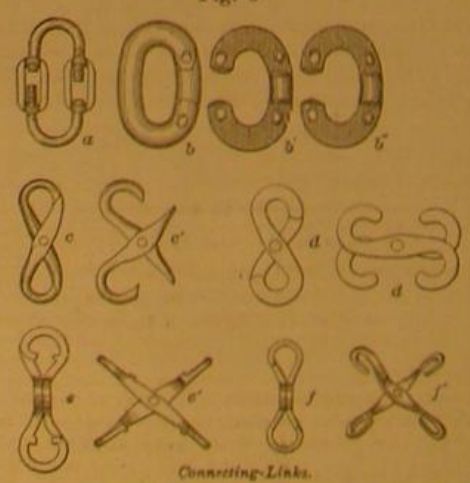
Fig. 5.



Chain-Wheel.

Fig. 6 represents several forms of LINKS capable of being taken apart and thus becoming a means of uniting the broken ends of a chain. Each half of the link, *a*, has a swivel to which it is connected by a head, the swivel of each part forming a nut for the threaded leg of the other portion. The link, *b*, is made of two sections, *b'* *b''*, laid upon each other and riveted. The other figures represent various forms, in which the twin swiveling portions form a mousing for each other.

Fig. 6

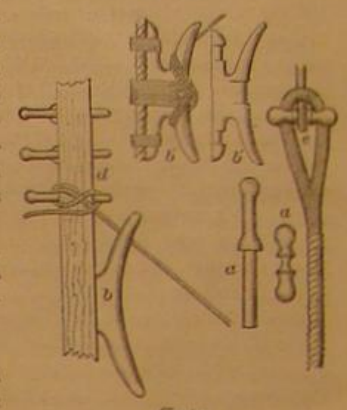


Connecting-Links.

CLEATS.

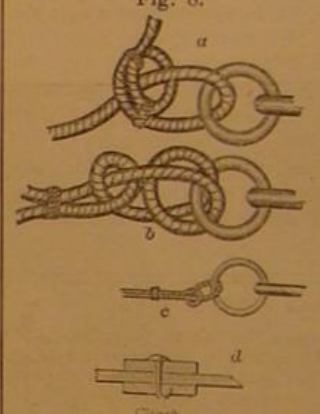
These are belaying pieces, consisting generally of a bar with two arms fastened to a postor stanchion by a bolt passing through its stem. Those shown at *a*, Fig. 7, are simple belaying pins. *d* is a rope belayed. *b* is a common cleat, lashed in place as shown at *b'*. *c* is a belaying pin or toggle, spliced into the end of a rope to secure an eye upon. Forms of CLINCHES are shown in Fig. 8. In nautical parlance a clinch is a mode of fastening large ropes to rings, such as anchors, etc. It consists of a half hitch with the end stopped back to its own part by seizings. *a* is a slip clinch; *b* a clinch secured, and *c* a simple clinch. In carpentry a clinch is a fastening, as at *d*, in which the long end of a nail is turned over, and the recurved end caused to enter the material so as to oppose retraction.

Fig. 8.



Cleats.

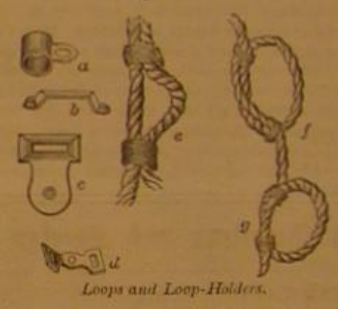
Fig. 8.



Clinch.

LOOPS of different kinds are illustrated in Fig. 9. *a* is the simple sleeve or collar; *b*, *c*, and *d* are modifications of the same. *c* is nautically termed a bastard loop. It is stopped in place with rope yarns. *f* is a loop used as a fair leader for ropes, etc *g* is a bend stopped with seizings.

Fig. 9



Loops and Loop-Holders.

*Published in numbers by Messrs. Hurd & Houghton, New York city.

Gold in America—Its First Discovery by the Pre-Historic Indians.

In a recent speech delivered in the House of Representatives, R. B. Vance, member of Congress from North Carolina, said that the first discovery of gold in the United States was made in Mecklenburg, in that State, in 1820. A correspondent of a North Carolina newspaper corrects this statement, saying that the first gold was found in Cabarrus in 1799, and refers to Wheeler's "History of North Carolina" for evidence.

Old chroniclers give an account of a province called Cofachiqui, which was visited by De Soto's gold-hunting expedition in 1538-40, and which was embraced in what afterward became the States of Florida, Georgia, Alabama, and Mississippi, and, according to Logan, in his history of "Upper Carolina," had its center on the western limits of South Carolina. Its capital and chief town stood upon the tongue of land between the Broad River of Georgia and the Savannah, just opposite the modern district of Abbeville. The Spaniards entered this capital after a two months' march, and found the country ruled by a beautiful Indian queen, Adalla, who entertained the Spanish governor and army with much ceremony. Here they found hatchets formed from an alloy of gold and copper. By this their cupidity was greatly excited, and they concluded that they had found a country abounding in the long coveted precious deposits of gold. And so indeed they had, says Logan (whom we quote freely), but it was neither their good fortune nor their desert to find out the precise spot where gold could be obtained. In less than fifteen miles southeast of the town, on the opposite or Carolina side of the river, lay one of the most extraordinary gold deposits in the world. The Cherokees were well acquainted with the Dorn mine. This is shown by the numerous relics of their handiwork scattered around it, and there can be little doubt that the massive nuggets of its outcropping gold supplied them abundantly with the finer metal of the alloy that so attracted the eyes of the Spaniards. It is no less known, to a few who have inquired into the traditions of the aborigines, that the gold and copper, found in their possession, in the form of solid masses or curious trinkets, by the first white men who visited the country, were obtained from these sources.

The Indian method of smelting these metals was one of the most remarkable devices of savage ingenuity; in practical efficiency the famous blowpipe of Dr. Hare was scarcely superior. Logan tells us that, having first hollowed out a

flat stone in the form of a basin, they filled it with charcoal, and upon this laid the nuggets of metals. A number of Indians now seated themselves in a circle around the basin, each one having in his hand a long reed pierced through its entire length and armed at one end with a clay tube or pipe. Everything being ready, fire was applied to the charcoal, and the whole mass instantly blown into a powerful heat through the reeds, the clay extremities of which were inserted in the basin, while the Indians blew through them upon the charcoal with all their might, and with protracted expiration. No ordinary lump of either gold or copper could long maintain its solidity in such a crucible. With this process the Indians could easily produce any variety of ornament from those metals, using them either alone or in alloy. This method was known to have been in use among the Indians who lived upon the gold-producing lands of North Carolina, and the same process must have been known to the Cherokees.

These chronicles and traditions go to confirm what Lawson says, that the Indians, from time immemorial, were acquainted with valuable mines of gold and silver in Upper Carolina.—*Columbia (S. C.) Register.*

The American Institute Fair.

The annual exhibition of the American Institute was opened on September 6, at the Institute's building at the corner of Third avenue and 63d street. Very few of the exhibits are ready for public inspection; and there is likely to be, in consequence, a limited number of visitors for the first few days. This want of preparation does great harm to the interests of those exhibitors who make a point of being ready by the opening day, and damages the reputation of the whole exhibition; but we have so often commented on it that it is, we suppose, useless to hope for any improvement.

NEW BOOKS AND PUBLICATIONS.

THE WORLD'S SAGES, INFIDELS, AND THINKERS: being Biographical Sketches of Leading Philosophers, Teachers, Reformers, etc. By D. M. Bennett, Editor of the "Truth Seeker." Price $3. New York city: D. M. Bennett, 141 Eighth street.

Mr. Bennett has attempted, as this title shows, to classify together the wisest and best of mankind and the fool (or infidel) who "says in his heart: There is no God." The work is of necessity a signal failure. It is not by placing the names of Socrates, Bacon, Locke, and Colenso in juxtaposition with those of Bradlaugh, Holyoake, S. P. Andrews, and Susan B. Anthony, that any connection between brains and atheism can be established; and it would be a far worthier (and a easier) task for a writer to point out the sharp definitive line which separates the moderate and tolerant philosopher from the blatherskite who proves his want of belief in a God by his perpetual and venomous hatred of all who differ from his crude and frequently blasphemous opinions. The author evidently hopes that this book will, in some households, take the place of the family Bible; for he has bound up in it some leaves for the registration of births, marriages, and deaths.

Recent American and Foreign Patents.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED BRUSH-HOLDING RUBBER STOPPLE.

Ferdinand A. Reichardt, New York city.—This is an improved rubber stopple for bottles, which is so constructed as to serve as a holder for brushes, which may thus be kept within the bottle, and may be exchanged as required. The tapering rubber stopple has its inner end perforated with a tapering hole, to receive and hold a brush handle.

IMPROVED DINNER PAIL AND LANTERN.

David T. Platt, Greenwich, Conn.—This invention consists of a dinner pail with a compartment for heating tea and coffee, contrived to serve for a lantern for the workman going home at night.

IMPROVED CHEESE CUTTER.

Henry S. Jones, Vincennes, Ind.—This invention is a cheese cutter, by which retailers of cheese and others may cut off pieces that will weigh exactly, or nearly so, the amount required, and at the same time cut them of uniform wedge shape, and from the outside to the center. It consists of a circular horizontal revolving table for holding the cheese, with a graduated scale, showing the sizes for different weights, over which is a radial lever cutter, pivoted to a standard attached to the bed piece on which the table revolves, and being adjustable up and down on the standard, to adjust it to the thickness of the cheese.

IMPROVED TELEGRAPH KEY.

James O. Byrns, Jersey City, N. J.—This is an improved duplex key, by which the time taken up by the upward motion of the present key may be utilized, and the sending of the messages be accomplished in about half the former time, and with greater facility and ease. The invention consists of two horizontal and spring-acted keys, whose contact points alternately close the circuit by contact with an intermediate post, the keys being cut out, when not in use, by the rear set screws bearing against a double post with a dividing insulating layer. The contact of either key closes the circuit, so that by the alternate wording of the keys the working of the hand is utilized in both directions for the transmission of telegraphic characters.

IMPROVED CANNON.

Richard B. H. Leighton, Jersey City, N. J.—This invention is a cannon so constructed as to scatter the shot in a horizontal line. It is provided with a wide, flaring, and shallow bore, and is formed of top and bottom plates, side pieces, and breech piece, riveted to each other. In the inner side of the bottom plate is formed a transverse groove to receive a rib formed upon the lower side of the shell of the cartridge, to keep the cartridge square when putting it in, and also to prevent the cartridge shell from being blown out when the cannon is discharged. Round or square, grape or chain shot may be used, as desired. It is claimed that, with this construction, the wide shallow, flaring bore will scatter the shot in a horizontal line, so that it will do much better execution than when a bore of the usual form is used.

IMPROVED COMBINED BUCKLE AND SNAP.

Richard St. L. B. Chinnery, Kankakee, Ill.—This improved buckle and snap is for connecting the reins to the bit rings, and in so formed that it may be colored to represent leather. It consists is the long bent metal strap, the short straight metal strap, the spring, and the buckle, constructed and combined with each other.

IMPROVED ICE CREAM FREEZER.

Charles L. Dexter, Philadelphia, Pa.—This improved machine for making ice cream is so constructed as to operate upon the cream, while freezing, in about the same way as when it is made by hand. This is effected by the combination with an ice cream freezer, of an outer tub having arms, friction rollers, and angle irons, with the inner revolving can and the necessary operating gearing.

IMPROVED CIGAR BOX.

Thomas A. Dodd, Providence, R. I.—The object is to furnish an improved cigar box, which shall be so constructed as to allow the ends of all the cigars in it to be seen, as well as the top layer. The invention consists in a cigar box provided with a glass front, and having a flap hinged to the forward edge of its top, to shut down over said glass front to prevent breakage.

IMPROVED WEIGHING SCALES.

Alonzo Pangburn, Fremont, Ohio.—This consists of one or more beams, in combination with the ordinary beam, connected by suspending the short arm of the additional beam to the long arm of the preceding one, under which it is located, in such manner that the range of the scale can be increased to any extent required. It also consists of a secondary beam to the principal beam for weighing small articles.

IMPROVED COMBINED BUCKLE AND SNAP HOOK.

Francis J. Deisz, Pierce City, Mo.—This is an improved buckle and snap hook, for connecting a breast strap with the hames in such a way as to be easily attached and detached, and which will hold the straps securely. Any strain upon the strap causes a wedge block to clamp it more tightly and hold it more securely, a tongue preventing the strap from slipping before the wedge block has clamped it firmly.

IMPROVED REVOLVING BILL HOLDER.

Sylvester W. Maynard, Kingston, N. Y.—This furnishes a neat and compact device for filing bills, receipts, and other papers, in such a manner that they are instantly and conveniently within reach. It consists of a number of receptacles, with spring-acted covers arranged around a central section or case, and revolved or locked by a sliding and spring-acted shaft and fastening device.

IMPROVED HAME.

August H. W. Michaelis, Monroe, Mich.—This invention consists in breast strap rings attached to the hame tug clips, and in the fastenings provided with the guards and the pins and the loops, in combination with the perforated upper part of the hames, for connecting the hame strap adjustably with said hames.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED BRICK MACHINE.

Richard A. Drawdy, Jacksonville, Fla.—This invention consists in two parallel rollers geared to each other, revolving toward each other, placed in an opening in the bottom of the mud box of a brick machine, and driven from the shaft of said mud box by suitable connecting gearing, and also in the combination of the platform and its rollers with the frame, the mud box, and the rollers of a brick machine, so constructed as to force out the clay into the molds with a continuous pressure, so that there can be no imperfectly filled molds, as there will be when the bricks are molded with an intermediate pressure.

IMPROVED ORE-STAMPING MACHINE.

John Patterson, Belfast, Ireland.—In stamping of minerals and metals there is much difficulty experienced, owing to the substances under operation, when finely divided, getting into the bushes or guides of the stampers, and not only causing much increased friction, but wearing away the said bushes or guides and stamp rods; and in stamping of animal and vegetable substances and textile fabrics and fibers, great inconvenience is experienced from the dropping of the lubricating material on to the substances to be stamped. In order to overcome the above injurious effects, the inventor employs vibrating levers to transmit the motion of the crank shaft, through springs and flexible connections, to the stampers.

IMPROVED DOOR LOCK.

Moses C. Hawkins, Edinborough, Pa.—This lock may be used as a fixed tumbler lock or as a combination lock, in combination with keys having fixed or interchangeable bits. It thus may not be easily picked or tampered with. There is a sliding bolt, with interchangeable tumblers pivoted thereto, and so connected to the casing by a detachable screw that bolt and tumblers may be taken out from the casing for changing the combination. The invention consists, further, in the combination of the sliding and notched bolt and the notched tumbler, pivoted thereto, with a swinging fence plate and rigid fence bar, that enters all the notches when set by a combination or reversible key. The reversible key may be finally locked to the inside of the lock by a revolving escutcheon.

IMPROVED PISTON FOR SYRINGES, AIR PUMPS, ETC.

Reinhold Vander Emde, New York city, assignor to himself and Charles E. Koechling, same place.—This invention consists of a piston rod provided with shoulders and elastic collars, that hold intermediate leather washers placed over the same. The washers and collars are readily replaced when worn out by long use, but keep up their working capacity for a long time by the action of the rubber, without getting loose.

IMPROVED WINDMILL.

Daniel Nysewander, Springfield, Ohio, assignor to himself and David Nyswander, same place.—This invention consists in making the vanes of windmills from sheet metal, of such form that it is possible to attach the points, which are bent over toward the center, to a central plate which is fixed on the end of the shaft. Weights are provided at the extremity of the arms, for balancing the wheel and giving it additional momentum when in motion. There is also a convenient device for changing the relative position of the guiding vane, making it possible to control the motion of the mill by this means.

IMPROVED WATER WHEEL.

Leonard Long, Princeton, Wis.—This consists, mainly, of buckets arranged between an interior cone hub and an exterior cone cylinder, the buckets extending from an outer top flange of the inner cone on an inclined segment of a circle to the cone cylinder, and then on an inward and downward spiral curve to the bottom of the same and the lower part of the cone hub.

IMPROVED WATER WHEEL.

Burrell C. Lambeth, Thomasville, N. C., assignor to himself and I. L. Young, same place.—This consists of a novel contrivance of the alternate gates to form chutes, and the device for opening and closing them is contrived to reverse, for application to wheels running either way. The buckets are provided with spring valves, to regulate the opening according to the volume admitted, so that the water will be applied to the wheel in an effective manner, whether the whole or part gate is used. The wheel is constructed so that it can be reversed to run either way by shifting the attaching disk from one side to the other. The socket of the step has a flat bottom, and the pivot on which it turns has a corresponding flat top. The bearing for the shaft above the wheel consists of boxes let into slots in the tube of the case, the boxes being tapered from bottom up, and being clamped against the shaft by a ring of corresponding form. The case is also reversible by taking off the top and attaching it to the other side.

IMPROVED CUT-OFF FOR STEAM ENGINES.

Julius C. Debes, Jackson, Mich.—This relates to that class of cut-off in which the stroke of the cut-off valves is controlled by the governor; and it consists of a plate placed on a central stud in the steam chest, and provided with oblique slots, which engage with studs on the back of the cut-off valves, varying the time of the admission of steam according to the position of the plate which is varied by the governor.

IMPROVED CAR COUPLING.

David P. Cubberley, Marion, Ind.—The improvements consist in making the latch in the form of a bar of a comparatively small transverse dimension and inclining its rear end (against which the link bears) upwardly, and to the front, so as to cause the link to rise when the draft is exerted and occupy a position more in alignment with the greatest strength of the latch bar, whereby a much lighter latch may be employed, and the manipulation in disengaging the link rendered easier, and whereby also the draft strain is made to assist in holding the latch down.

IMPROVED CAR COUPLING.

James H. Wood, Baltimore, Md.—This invention consists in providing a drawhead with an armed shaft that couples and uncouples with the hook bar, a presser board hinged to the front of the drawhead and forming the cover thereof, and a crank that lifts the presser bar at the same time that it raises the coupling bar. These features of improvement render automatic couplings, heretofore regarded as impracticable, easily manageable and little liable to get out of order.

IMPROVED BELT SHIFTER.

Augustine Crosby, Benton, Me.—This invention is an apparatus for shifting belts for stopping or starting machinery; and it consists of a roller supported in a frame that is placed parallel with and near the tight and loose pulleys on the counter shaft, and is pivoted so that the roller may be made to bear against either side of the belt according to the direction in which the belt is to be shifted. It further consists of an arrangement of a rack and toothed sector, by means of which the roller is moved. The advantages claimed for the invention are that with it belts can be shifted without being subjected to wear, that it is particularly adapted to rubber belts, as it does not chafe them, and that it shifts the belt smoothly, without jarring or noise.

IMPROVED IMITATION STITCH MACHINE.

Edwin Brown, Georgetown, Mass.—The object of this invention is to make what is known as the "imitation fair-stitch" on boots and shoes, that is, indentations on the upper margins of the soles, having the appearance of the stitches by which the soles are sewed on in hand work. It consists of a milled indenting roller on the end of a crank shaft, under which is a carrying roller, made to slide up toward the milled roller by a lever which is to be worked by foot power, to carry the sole and press it against the milled roller, which, being turned by the crank, makes the indentations or imitation stitches, at the same time feeding the work along. The milled roller and its shaft-carrying roller and the lever are all attached to a plate, which may be readily attached to a bench or other suitable support, making, it is claimed, a simple and cheap machine.

IMPROVED AUTOMATIC FERRY BOAT COUPLING.

Thomas D. and George E. Husband, Green Point, N. Y.—This is an improved device for connecting a ferry boat to its bridge, so constructed that it will couple itself as the boat comes into its place, hold the boat securely, and may be easily uncoupled to release the boat when desired. The invention consists in the combination of the sockets, the hooks, the springs, and the levers, with each other, and with a ferry boat and bridge, and in the combination of the wheels, the recesses, and the guide bars, with the ferry boat and bridge for guiding the hooks into the sockets to interlock with the other hooks.

IMPROVED PEG FLOAT.

James Popham and Ebenezer Popham, Montreal, P. Q.—This is a machine for breaking or cutting the projecting ends of pegs from the insoles of boots and shoes; and consists of a grooved cutter, of pyramidal or cylindrical shape, attached to the end of a rapidly revolving shaft, in connection with a protecting guard or casing. The cutter serves to cut off the pegs of long boots, and is for this purpose made cylindrical, with groover and cutting blades at the circumference, for cleaning the peg ends from the sides instead of downwards, and with the pyramidal cutter. One and the same machine may thus be applied, without any special adjustment, to every variety of pegged work, from children's wear to the largest and strongest goods in men's sizes.

IMPROVED DEVICE FOR PUNCHING MACHINES.

Louis Prahar, New York city.—This invention is so constructed as to feed the material forward to the cutting tool as it is required. This is effected by the movement of a pendulum operating feed rollers to carry the material forward to the cutting tool, the rapidity of the feed being regulated by the size of gear wheels.

IMPROVED SHAPING ATTACHMENT FOR ENGINE LATHES.

William Brede, Lihue, Island of Kanai, Hawaiian Islands.—This invention is an improved shaping attachment for lathes, so constructed as to do all the work required by an iron or brass worker, while saving the space that would be occupied by a shaping machine, and at the same time being much less expensive. It consists in the combination of the slotted plate, the arm provided with a dovetail tongue, the blocks, tool holder, and swiveled screw, and the connecting bar, with each other, to adapt them to be applied to the face plate, spindle, and frame of a lathe; in the table provided with the lug, the bent arm, and the adjustable cross bar, to adapt it to be applied to the lathe bed, the carriage, and the frame of a lathe; and in the combination of the cam wheel, the bent lever, the connecting bar, the slotted bar provided with the collar, and the pawl, to adapt them for attachment to the friction wheel and the feed screw of a lathe. For heavy work, the attachment may be strengthened by a brace bar, the forward end of which is bolted to the forward end of the arm, and its rear end is bolted to the bracket or bearing of the lathe.

COMPOSITION FOR LINING PUDDLING FURNACES, ETC.

Marie Eugène Paul Audouin, Paris, France.—This invention is a composition or substance calculated to more effectually resist the action of oxide of iron than any other material heretofore employed for the purpose. This material is oxide of chromium, which is capable of resisting the very highest temperatures employed in furnaces and laboratories—such as the Siemens furnace and furnaces heated by dead oils—and is also proof against the action of oxide of iron at the highest degrees of heat. The inventor claims that there is no danger of the oxide being reduced under the ordinary conditions of working, and, moreover, the presence of a small quantity of chromium will not affect the quality of the iron. This oxide may also be utilized in the manufacture of fireproof blocks to be exposed to the action of furnace cinder and scoria, but with less advantage, as, by the action of certain principles, more especially potash, soda, and lime, chromates are eventually found.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED BENCH PLANE.

Jackson Gorham, Crawfordville, Ga., assignor to himself and Charles E. Smith, of same place.—This invention consists of a stud applied on the top of a smoothing plane stock near the heel, and adapted to fit between the thumb and forefinger of the right hand, while the palm bears against the heel of the stock, whereby the pressure of the hand is distributed over a larger surface, and is thus diminished on the small area heretofore employed for driving the plane by pressing against the heel of the stock. It also affords a bearing or rest for a part of the hand not heretofore having any support on the stock, and therefore making the work easier.

IMPROVED LATH MACHINE.

Edmund H. Hancock, Augusta, Ga.—The invention consists in placing edge-serrated planes in advance of a saw, to cut grooves, in attaching the upper grooving plane to a pivoted shoe provided with a handle, and in combining collared rolls with spiral feed rolls having a right-angled groove next to the collars. The sides of the grooves of the rollers, next to the guide collars, are cut at right angles to the axis of the collars, the taper being all on the other sides, whereby they draw towards the collars better than if beveled alike on both sides. Guard fingers prevent the saws from throwing sticks back against the attendant, which is a common occurrence in gang saw machines, particularly when the saws are out of order: these fingers are pivoted to the frame over the way where the stuff passes, and rest on the stuff in such manner that the friction of a piece of lath or other object pushing back under them causes them to bind it fast and thus stop it.

IMPROVED BRAKE FOR LIGHT VEHICLES.

Charles H. Appel and Joseph S. Rothenberger, Shimerville, Pa.—This improved brake has all of its parts connected with the shafts and front axle, so that the springs are subjected to no strain when the brake is operated, and the arrangement of the parts such that they are out of the way and not liable to be bent or broken from contact with any object. In applying the brakes there is no strain upon the springs, as there must necessarily be when the brake is attached to or connected with the body of the vehicle.

IMPROVED SAW SET.

Christopher Heinen, Fort Laramie, Wyoming Ter.—In this saw set a number of teeth may be set in opposite direction at one operation of the device, and the same be adapted to set any kind of saw by inserting the dies fitted to the saw. The invention consists of a lower base part and a swinging lever part, with removable dies, gage piece, and regulating screw. The saw is set into the dies from right to left, and the lever then brought down to set the teeth. The person operating the set stands in front of the same, adjusts the saw, and brings the lever down without changing his position, setting the teeth thereby directly at one operation, in opposite direction, without reversing the saw or saw set.

IMPROVED ELEVATOR.

John G. Kurtz, Milton, Pa.—This is an improved elevator for use by carpenters, masons, and painters, for raising their materials and themselves upon buildings, in stores, hotels, and other buildings, and by firemen and others; and it consists in a standard made in sections, and provided with a T groove, the jointed rack bar, and the gear wheel, in combination with each other and the frame, and a mechanism for turning the said gear wheel; in the combination of the springs, the pins, and the cam levers, whether the second set of springs be used or not, with the hinged ends of the sections of the standards; in the combination of the bar, the arm, and a platform, gallery, or cage with grooved standard, and with the jointed rack bar and the gear wheel; and in the combination of the spool and the coiled spring with the jointed rack bar.

IMPROVED DUST GUARD FOR CARS.

William Carr, New York city.—The inventor's object is to furnish for the traveling public a portable dust guard for railroad cars, which may be readily attached to the window of a car so as to prevent the annoyance by cinders, while it also may be used as a fan and readily folded up after use, for being carried in the pocket. The invention consists of a guard made of a number of folding pieces or strips, that are rigidly connected by a clamp piece, pivoted to one strip and fitting over the ends, which folds with the strips when released. When the dust guard is detached, it may be used as a fan, and finally be folded into narrow compass, for being carried in the pocket, by releasing the clamp piece from the ends and folding it alongside of the strips. The strips may also be made available for advertisements, so that the dust guard may be used as a convenient advertising medium for the traveling public.

IMPROVED PRIVY SEAT.

Peter D. Howard and Matt. Allard, La Porte, Iowa.—Should a person attempt to stand upon this seat, to use the privy, the seat will tilt, and thus the seat will always be kept clean.

IMPROVED WAGON BRAKE.

Frank Funk, Beverly, Ill.—This invention consists of a lever connected with a fulcrum bar and brake rod, all so arranged that the power is gradually increased, as the brake is pulled by the brake rod connected with it against the wheel. The propelling lever is provided with a longitudinal projection or detent to lock the brake by engaging with a rack bar attached to the side of the wagon.

IMPROVED CHIMNEY COWL.

Jacob M. Davies, Enon Valley, Pa.—This invention consists of a pipe elbow, fitted to turn on a spindle on the top of the chimney, constructed with that portion through which the smoke escapes in a form calculated to be equally as efficient as the hood or funnel commonly used to facilitate the discharge of the smoke, and to be less liable to catch the wind, when contrary and shifting gusts prevail, and conduct it down the chimney into the room, which is so common with the ordinary cowls.

NEW AGRICULTURAL INVENTIONS.

IMPROVED ANIMAL TRAP.

Jacob W. Wilson, Summerford, Ohio.—This trap is so constructed as to close when the animal enters the first compartment, to prevent his escape, and set itself when the animal enters the second compartment or cage. The invention is formed by the combination of the swinging gates, the cranks, the connecting rods, the weighted platforms, and the bent arm with the box of the trap and with the gate hung in the opening through the partition of said box.

IMPROVED POTATO DIGGER.

Edward Bartlett, Renfrew, Ontario, Canada.—This invention consists of arrangements of colters for cutting along the sides of the row of potatoes, a scoop for digging them up, a revolving spout or reservoir for separating them from the earth, beaters for preventing the clogging of vines and wood on the scoop, a contrivance of the separators for discharging the potatoes into a spout, apparatus for separating and discharging the vines and weeds, and a discharging apparatus for removing the filled boxes which receive the potatoes from the spout, also supporting, operating and adjusting devices.

IMPROVED WEANING BIT FOR ANIMALS.

George W. Ingersoll and Harvey L. Fisher, Toledo, Iowa, assignors to Jacob L. Neff and Henry Giebert, of same place.—This is an improved weaning or anti-suction bit for calves, by which the animal is prevented from sucking, and no incumbrance caused to the same in eating and drinking. The invention consists of an outer hollow tube with air holes at the central part, and open ends with an interior revolving tube with central air holes and open weighted ends The air holes are not liable to get clogged, so as to exclude the air and supply the air at every attempt at sucking, thereby preventing it and weaning the animal. When the animal holds its head in a downward position for eating and drinking, the inner tube is turned by the weights, and the air supply interrupted as the connection of holes of the inner and outer tubes is discontinued. This automatic interruption of the air supply of the bit forms the main feature of the invention, as thereby not the slightest inconvenience to the animal in drinking is produced, and the same is not compelled to put its whole nose into the water to exclude the air, which forms a serious objection to the bits at present in use. The friction of the inner and outer tubes prevents the clogging of the air holes, and secures, in connection with the weighted tube, the reliable working of the bit, namely the opening of the air supply holes to prevent sucking, and the closing of the same during eating and drinking.

IMPROVED HARROW.

Jackson De Moss, Noblesville, Ind.—This invention is a harrow or pulverizer, which is claimed to thoroughly pulverize the ground and adjust itself to an irregular surface, so that it will level down a ridge or fill up a dead furrow with equal effectiveness, which may be easily cleared of rubbish, raised to pass an obstruction, and may be easily loaded upon and unloaded from a vehicle for transporting it from place to place. By removing the teeth from the central beam the harrow may be used for cultivating small corn, or other small plants planted in rows, loosening the soil upon both sides of the row at the same time; and by removing a pin from a hook, the harrow will come apart, and may be easily loaded upon a vehicle.

IMPROVED WAGON COVER.

Charles Cremer, Red Bluff, Cal.—This is an improved cover for the boxes of wagons, cars, and other vehicles for transporting swine, calves, sheep, fowls, etc., constructed so as to allow the air to have free passage to the animals, while confining them securely. The invention consists in the combination of the net, the four rods, the connecting snap hooks and rings, and the holding snap hooks, with the body or box of a wagon, car, or other vehicle. By this construction the animals are securely confined, and at the same time have the benefit of a free circulation of air. The rear end board of the box may be removed to allow some of the animals to be taken out or others put in, while guarding against the escape of any.

IMPROVED SULKY PLOW.

Alexander Hamilton, Harrisburg, Ark.—This sulky plow is constructed that the plows may be readily raised from the ground, drawn back from an obstruction, and adjusted to work any desired depth in the ground.

IMPROVED PLOW STOCK.

James A. Price, Houston, Tex.—This improved plow stock is so constructed that any kind of a plow and standard may be applied to it, according to the kind of plowing to be done. Each plow is designed to be attached to its own standard.

IMPROVED GATE.

Uriah W. Hardy, Albion, Ill.—This is an improved farm gate that may be readily opened and closed by a person on horseback, and from the seat of a vehicle. Fulcrumed levers that extend alongside of the road operate, by rods, bars, cords, or chains, a folding or weighting gate A separately pivoted latch piece at the upper part of the gate locks into the recessed post when the gate is lowered.

IMPROVED MILK COOLER.

Thomas Sexsmith, Oneonta, N. Y.—This consists of an elevated cooling compartment in the bottom of the pan which holds the milk, into which the cooling medium is delivered by an inlet pipe, so arranged that the said medium is discharged directly upward from the mouth of the pipe against the shell of the compartment. The discharge passage leads out from the bottom of said compartment, to which the warmer part is forced by the incoming part being discharged between it and the shell of the compartment. The invention also consists of a contrivance for mounting the pans on their supporting stools, so that they can be readily leveled up in case the stools are not level.

IMPROVED GRAIN SEPARATOR.

Thomas C. Jory and John W. Jory, Salem, Oregon.—This separator is designed especially for cleaning wheat, but will, by proper adjustment, separate oats from wild oats. It involves in construction the following four principal features: First, a regulating and distributing feeder, by which the same amount of grain flows from the hopper at each turn of the crank, and is evenly distributed over the entire surface of the cleaning apparatus; second, an arrangement by which cockle and other small seeds are separated from wheat, the same being a revolving cylindrical screen, through which, as it revolves, the grain is conveyed by a spiral flange closely fitted to its inner surface throughout its entire length, and a plain hollow cylinder of sheet iron, surrounding the screen and concentric with it, and having a flange working in the opposite direction to receive and discharge the seeds, small grain, etc., at the opposite end. Thus the wheat flows from one end of the revolving cylinder, and the small seeds from the other, and both may be collected in proper receptacles. Third, an arrangement for keeping the screening apparatus clean by a vertical shake communicated to it (as is also its rotary motion) by cam wheels revolving under each end of the screen. Fourth, the carrier is kept free from wild oats, etc., by means of stirrup-shaped knocker, which strikes a quick, light stroke on the under surface of the carrier at each descent of the screen, from which it takes its motion.

NEW HOUSEHOLD INVENTIONS.

IMPROVED FOLDING CHAIR.

Adile Matthiessen, Cornwall on the Hudson, N. Y.—This chair has a back piece, to which are hinged the seat and arms. The front legs are hinged to the seat, and a brace is pivoted to the back legs in such a way as to be capable of holding the various parts in their places. The principal object of th invention is to furnish a convenient nursery chair, which can be folded and placed in a trunk.

IMPROVED DESK

Charles A. Atkinson, New York city.—This consists in a desk made in sections, so constructed that they may be connected and disconnected at will; and in the combination with the main desk, of one or more side sections or wings, so constructed and hinged that they may be closed against the sides of the said main desk, moved forward to expose their contents, and swung back out of the way while still exposing their contents.

IMPROVED COMBINED DISH AND CLOTHES WASHER.

Asberry C. Jackson, Orange, Texas.—This is a detachable clothes washing attachment for a sink, and a tilting shelf, upon which dishes may be placed for draining off the water into the sink. The wash pan and the draining shelf are surrounded on the sides and top by a cabinet case, which is located in this relation thereto for convenience in storing away the dishes.

IMPROVED FOLDING CHAIR.

Frank F. Parker, Gardner, Mass.—This consists of a folding chair made of a back section, that is pivoted by its recessed ends to fixed projecting pins of the swinging rear leg section, while the front leg section is extended above the seat pivoted to the back, and hinged by a lateral cross piece to staples of the rear leg.

IMPROVED APPARATUS FOR AUTOMATICALLY LIGHTING AND EXTINGUISHING GAS.

Asahel P. Bell, Manchester, and Thomas Thorp, Whitefield, England.—In this invention, a metal cap is secured to the gas main, and wool or other fibrous material acts as a filter for the gas. A receptacle, made of earthenware or other suitable material, contains mercury. The gas from the main passes into the receptacle through vertical holes, all of which may be left open, or some may be closed according to the differences of pressure in the gas main. A center piece, in a recess in the receptacle, contains a chamber for mercury, and this chamber has an orifice, above which is a hollow cylinder, and a second orifice, in which the burner for the flaring jet is fixed. At the lower side is a pipe mouth valve, through which the gas passes into a tube provided with an ordinary burner. A hollow cylinder is fixed to a metal shell suspended to the burner by wire, and a loop of platinum wire, connected thereto, is carried over the burner. When the gas is at its maximum pressure, it depresses the mercury in the center compartment of the receptacle, thereby uncovering a valve and allowing the gas to enter the tube. A small portion of it passes through an aperture to a small interior burner, and this portion of gas is then ignited by the jet and a second platinum wire. The flaring jet from the small principal burner then ignites the gas issuing from the burner. When the cylinder is heated by the wire passing through the flame, the inclosed air expands and expels the mercury, which falls into the chamber and closes the aperture and shuts off the gas.

IMPROVED EXTENSION BEDSTEAD.

Rudolf Rigl, Dobling, Austria, assignor to Franz Xaver Katzmayr, Vienna, Austria.—This invention is an iron sofa bed, for hotels, boarding houses, etc., that may be readily changed from a sofa to a single bed, or to two connected beds, or to two entirely detached beds, as desired, the whole forming a strong, compact, and convenient sofa bed for various purposes. When the sofa covering is taken off, a telescoping section may be used as a single bed. When it is desired to make two separate beds, the sliding action is taken out of the frame, and a foot support clamped or otherwise attached to the end section that has been taken out of the main frame. The sliding section forms thereby a scarate bed, which may be put up in a different room from the main frame, to be replaced at any time by detaching the end support and sliding the bed section back into the main frame, storing the whole in convenient manner below the covering, and allowing the use of the bed as a sofa.

IMPROVED COMBINED STOVE PIPE THIMBLE AND REGISTER.

Charles Pettit, Erieville, N. Y., assignor to himself and Levi P. Greenwood.—This invention consists of a large tube extending through the ceiling and floor, and having a top and bottom plate, through the center of which the pipe passes in a center tube, which is surrounded by a larger tube and a dead air space, or a lining of non-combustible material, to confine the heat, so as to prevent the heating of the floor through the outer tube. The top and bottom plates are provided with openings to allow the air to pass for ventilating and for heating, and one is provided with a register.

IMPROVED SEWER GAS TRAP.

John M. Falk, New York city.—This invention consists of a trap, similar in form to the ordinary trap, or of any other approved form, except that it is preferably larger, and located near the sewer, from the upper end of which is an escape pipe for the gas that may work through the trap, and with or without another trap above the escape pipe to check the gas escaping through the first trap and cause it to escape through the pipe provided for it, which pipe may discharge in any convenient place, such as the gutter or the chimney of the house.

IMPROVED SUMMER STOVE.

Charles H. Chase, Newport, R. I.—In this invention, a fire pot, of any suitable form or construction, large enough to cover the pot hole of an ordinary stove, is made flat on the top, and has an opening therein, in which a cooking pot may be set, and which may be closed by the cover removed from the pot hole of the ordinary stove on which the stove is set. The smoke passes through a damper into a diving flue to escape into the large stove, so that the flue of the latter serves for the flue of the summer stove. An oven may be used in connection with this stove for baking. It is detachably set on the top of the stove, and has a flue passing around it from the opening through its bottom, where the smoke enters, to another opening, where it escapes into the diving flue and passes off as when the oven is not used, the damper being closed when the oven is used.

IMPROVED STEAM WASHER.

Cyrus C. Carter, Neeleyville, Ill.—This invention is claimed to be so constructed as to enable the clothes to be washed evenly and thoroughly, with much less fuel and in much less time than when they are washed in the ordinary way. It consists in an improved steam washer, formed of the flat base or bottom, the inclined sides, the V-shaped concave top, the rounded and inclined ends, and the vertical plates, and provided with the holes to adapt it for use. In using the steamer, water is put into it and heated. The steamer is then placed in the boiler, the clothes are put around and over it, and in a few minutes the clothes will be thoroughly and evenly cleaned, and may be wrung out to dry, the peculiar form of the steamer causing the steam to pass through all parts of the said clothes.

IMPROVED WASHING MACHINE.

John Zeller, Stouchsburg, Pa.—This machine is so constructed as to rub the clothes in a manner analogous to hand rubbing, will enable soiled parts to be rubbed longer than the cleaner parts, and will not injure the clothes.

IMPROVED FRUIT AND JELLY MASHER AND STRAINER.

Adolph Conrady, Cincinnati, Ohio.—This consists in a metal cup with perforated sides, in which is a press follower, with a screw for working it. The screw is mounted in a crosstree, detachably connected to the top of the cup, so as to be readily attached and detached, to facilitate the application and removal of the follower for filling and clearing out the cup.

IMPROVED COOKING STOVE.

John C. McClamroch, Edina, Mo.—This relates to an ash box located below the perforated bottom of the ash pit, and provided with a register in its side to admit air, so that the ash box may be utilized as a fire box.

Notes & Queries

O. J. H.'s letter has been placed in the hands of a prominent physician for reply.—C. W. J. should obtain the best medical advice.—W. R. will find a recipe for a black walnut stain on p. 90, vol. 32.—W. N. will find directions for making concrete gravel walks on p. 50, vol. 32.

(1) J. L. C. says: I have a surveying compass, the needle of which does not traverse well. What is the cause, and how can I remedy it? A. It has probably become demagnetized. You should have it charged again.

(2) G. W. D. says: Referring to your recent descriptions of reflectors and to the article in your paper of November 28, 1874, entitled "A Possible Improvement in House Heating," I beg to inquire if any considerable increase of heat could be obtained by massing, by means of reflectors or lenses, the radiations from furnaces, gas, and oil lamps, or other artificial sources, provided the beams are carried in parallel rays and arrested within, say, 6 feet of the focus. I apprehend no difficulty in so utilizing the sun's rays, but am doubtful as to the gain of heat, in massing heat radiations from other sources. I would not require over 200° Fah. Can this be accomplished, and how? A. All heat rays are susceptible of accumulation by concentrated radiation, whether of the sun or of artificial combustion. Blackened surfaces constitute the heat radiators. Place a wire basket filled with a small shovel full of glowing coals in the focus of a reflector, and the heat rays from it will ignite phosphorus in the focus of a supplementary reflector 12 feet distant. A number of reflectors, so placed behind as many fires as to concentrate the heat rays upon a given point, will cause a degree of heat at that point corresponding in intensity with the combined rays of the fires, less the loss by absorption into the medium through which they pass. Light rays from the moon may be concentrated as readily as those from the sun, but no degree of multiplication of such rays will reveal any appreciable accumulation of heat. From this it is to be inferred of this reflected heat that what little of heat from the sun there may be, that is not absorbed by the moon, is lost on its way to us in its passage through the atmosphere of the earth.

In using compressed air, would there be any gain of power (without reference to the question of economy) by devaporizing and heating before compressing the air? A. If you heat the air at constant volume, before compressing it, the pressure will be increased; and then if it is compressed, the pressure will of course be greater than if it had not been previously heated.

(3) R. K. asks: What is the best material for locomotive boiler tubes for conducting heat, copper, brass, or iron? A. Brass.

(4) W. H. H. W. says: My neighbor has a well 40 feet deep and 800 feet from his house. The house is 10 feet lower than the bottom of well. Will it be possible to draw the water from the well by a siphon? Is it necessary to lower or cut away the hill that the water will not be required to rise more than 30 feet. What size of pipe should be used? A. It will not be advisable to attempt to raise the water more than 25 or 26 feet, nor to use a pipe smaller than 1 inch in diameter.

(5) A. F. B. asks: Is it a saving of battery material for a Callaud gravity battery to stand open at night? A. Yes.

(6) J. T. B. asks: 1. Will electricity, passing through a magnet, change its poles? A. Yes. 2. Which is the cheapest way to run a strong electric battery? A. A carbon battery excited by bichromate of potash is the cheapest where great power is required.

(7) G. W. McD. asks: Does the air in the air chamber of an hydraulic ram change in the operation of the ram, that is, does more enter and some escape, in the working of the ram? A. Yes.

(8) C. C. J. R. asks. 1. If the circumference of a steel wheel be placed near a large magnet, does the wheel become a magnet? A. Yes. 2. Where are its poles situated? A. One pole would be next to the permanent magnet, the other would probably be on the opposite end of the wheel. 3. Does the horseshoe magnet of a magneto-electric machine lose its power by use? If so, is the loss much? A. Yes, gradually; but the loss is sometimes almost insensible for a long while. 4. Does it continue to lose as long as it is used? A. Yes. 5. How many revolutions ought a magneto-electric machine to make in a minute to produce the strongest current of electricity? A. The current will increase with most machines until the velocity of the movable magnets exceeds 1,000 revolutions. 6. Does a magnet lose its power when placed near the circumference of an iron or steel wheel which is revolving? A. Yes.

(9) W. N. M. says: I have the two conductors of an electrical machine, and the plate, shaft, and crank. There are no rubbers, and I want to know of what material to make them, and whether to put them between the wheel standards or on the same standard as the brass globe. A. Make the rubbers of leather and stuff them with horsehair. They should be attached to the standard carrying the brass globe.

(10) C. H. R. says: I notice in your accounts of the working of some of the many cables that electricians have experienced much difficulty in attaining a speed in the transmission of signals that was sufficient to relieve the pressure of business, and, in order to hasten it, have formed a metallic circuit by joining two wires, thereby overcoming in a measure the effects of the secondary current produced in the cable by the primary. I have often noticed in some of my experiments the strong natural tendency of the electricities when separated to reunite, and would suggest to electricians, if they think it worthy, a trial (my facilities in regard to the necessary apparatus being too limited for any conclusive experiments). If a vessel could be so constructed as to hold negative electricity (which could be accomplished by charging it, and drawing the positive to the ground), by attaching it to one end of the cable, and by working the opposite end with positive electricity, it might possibly not only hasten signaling, but overcome some of the other difficulties and make one cable free to work in opposite direction. A. The idea is impracticable for the reason that a signaler cannot operate opposite ends of the cable at the same instant.

(11) T. E. asks: What size of boiler should I use for a small engine, with 1 inch bore and 2 inches stroke? A. Make one 9 inches in diameter and 15 inches high.

(12) J. P. asks: How would you determine in horse power the best way steam heating should be charged? A. This must be a matter of argument, as there is no universal standard. A very common rating would be to charge the number of cubic feet of water evaporated per hour for heating purposes, as so much horse power. Others would multiply this by 2, to get the horse power.

(13) L. W. says: I am told that telegraph messages, in traveling from one station to another, go through the ground, and that the wire serves to complete the circuit. Our operator says that the current passes over the wires, and that the ground wire serves to complete the circuit. A. The signals pass over the wire only. The earth merely completes the circuit by acting as a reservoir for the electricity discharged at each end of the wire.

(14) J. W. S. asks: 1. Is the actual pulling power of a locomotive engine with 4 feet driving wheels greater than with 5½ or 6 feet wheels, weight of locomotive, size of cylinder, and all other things being equal? A. Yes. 2. Why are small driving wheels generally adopted for freight locomotives? A. Because they are required to haul heavy loads, and great speed is not wanted.

(15) J. A. W. says: How much more will a screw 3 inches in diameter lift, than one 1½ inches, of the same pitch or number of threads per inch? A. Disregarding friction, the rule is as follows:

$$\text{Weight raised} : \left\{\begin{matrix}\text{force}\\\text{applied}\end{matrix}\right\} :: \left\{\begin{matrix}\text{circumference}\\\text{described by}\\\text{force}\end{matrix}\right\} : \left\{\begin{matrix}\text{pitch}\\\text{of}\\\text{screw.}\end{matrix}\right\}$$

Hence the relation will be the same for all screws having the same pitch.

(16) W. S. W. asks: Is there any difference between an open crank motion or an eccentric motion? An eccentric motion is a solid crank, but the positiveness in the motion seems not to be the same. Are there the same dead points in an eccentric as there are in a crank? A. Yes, the motion is the same.

(17) F. C. W. asks: How many times will a locomotive cylinder fill and exhaust in a second? A. Take the case of a locomotive with 6 feet driving wheels, moving at the rate of 40 miles an hour. The wheels would make a little more than 3 revolutions per second, so that the cylinder would be filled a little over 6 times.

(18) H. W. K. asks: What is the process of tempering solid steel dies in lead? A. By heating steel in melted lead the outside becomes sufficiently hot to harden before the inside does; hence the inside is left comparatively soft, and the steel is therefore not liable to crack in the hardening. Another advantage is that the heating, and hence the tempering, is very uniform.

(19) W. C. A. asks: Will it make any difference in the working of a main telegraph line if I should use it for a return wire for a short circuit, putting keys, sounders, and local battery on the short circuit wire? A. It would not interfere with the working of the main line. Vocal sounds have been sent through a few feet of wire.

(20) J. W. S. says: Does steam at pressures from 40 to 125 lbs. per square inch destroy the elasticity of steel springs working in the boilers? A. Good springs are quite durable in such situations if they are protected against corrosion.

(21) E. W. W. says: I am building a cistern in my cellar with the inlet pipes each 2 inches in diameter, running from the roof, about 20 feet. How large should the outlet pipe be to prevent overflow? A. Make it 3 inches in diameter.

(22) A. R. asks: What is the formula for the number of feet in a telegraph pole? A. The following is given for timber measuring: G = ¼ girth at middle in feet. g = ¼ girth at one end in feet. g' = ¼ girth at other end in feet. L = length of log in feet. c = cube contents of same in feet.

$$c = L\left(\frac{G+g+g'}{3}\right)^2.$$

(23) M. G. says: I have been trying to gold plate a chamber of a revolver. It had been nickel plated, but it had partly peeled off, so I took it all off. I cleaned it thoroughly, and (to plate it with copper first) I plunged it into a solution of sulphate of copper, and it turned all black. I would like to know what is the reason for this. A. Clean the chamber again carefully, and use a cyanide instead of an acid solution of copper for the first thin deposit. The superior chemism of the acid for iron or steel over that of acid for copper is sufficient to produce the results obtained. Do not use too much battery.

(24) W. F. C. says: What is heat lightning? A. Heat lightning is a name given to the reflection of lightning discharges that take place below the horizon or behind clouds.

(25) A. R. W. asks: Can you give me a recipe for a phosphorus paste for cockroaches? A. Take phosphorus 1 oz., warm water 1 pint; put in a bottle, cork up, and agitate till the phosphorus is in a minute state of division, adding towards the end moist sugar ½ lb. Then add lard melted by gentle heat 1 lb., and repeat the agitation till the whole is nearly cold; when cold, form it into a stiff dough with oatmeal, and make into small cakes. Dry in the air.

(26) I. E. H. asks: How can I make rubber stamps? A. Vulcanized rubber is used, as prepared by the manufacturers, and can be procured in strips about 3 inches wide and ⅛ inch thick, and of any length desired. The name and address should be set up in type and well oiled; a rim about ⅛ inch in hight should be placed around the form, and dentist's plaster, mixed to the proper consistence, poured in and allowed to set; then the plaster cast is to be separated from the type. A piece of the vulcanized rubber is then cut out, of the size of the plaster mold, and laid upon it, and both together are placed in a screw press, and heat sufficient to thoroughly harden the rubber is applied. The screw is then turned down hard, and left for a time until the rubber is perfectly forced into the mold. After the whole is cold, the rubber is separated from the model, and any irregularities trimmed off with a sharp knife; the rubber stereotype is then fastened, with glue or other cement, to a block of wood, and the stamp is ready for use. 2. Of what is the well known oil bath for vulcanizing rubber composed? A. At the present day Parkes' method is generally adopted; the caoutchouc is simply immersed in a mixture of 40 parts sulphide of carbon and 1 part chloride of sulphur; it is next placed in a room heated to 70° Fah., and, when all the sulphide of carbon has been volatilized, the process is so far complete that it is only requisite to boil the material in a solution of about 1 lb. caustic potassa in 2 gallons water, the vulcanized caoutchouc being next washed to remove excess of alkali.

(27) H. D. M. F. asks: What is a bogie? A. "A four-wheeled truck supporting the fore part of a locomotive, and turning beneath it to some extent, if necessary."—*Knight's Mechanical Dictionary.*

(28) C. D. K. asks. 1. How can I stain light yellow brick so as to give them a dark color? A. You cannot stain brick a permanent color as you can some kinds of wood. The nearest approach to it probably is the cement wash which permeates the pores of the brick. Something of the nature of a glaze might be fixed into the face of the brick in the kiln. Light brick may be made darker by smoke, but the color will be neither even nor agreeable. Cement or oil paint is the most practicable.

(29) C. M. asks: Would a moist blast for forges, etc., be injurious to the iron? A. No, but there would be no advantage derived from the introduction of moisture.

(30) C. F. G. asks: For what are barytes used? A. The sulphate of baryta is the permanent white of water color artists; it is also employed to adulterate white lead. When mingled in excess with the latter pigment it forms Dutch white: in equal quantity Hamburg, and in lesser amount Venice, white. But it becomes, when ground with oil, translucent, and impairs the opacity of the lead paint.

(31) O. J. H.—Paris green (Schweinfurt green) is an aceto-arsenite of copper. In 100 parts: oxide of copper, 31·29; arsenious acid, 58·65; acetic acid, 10·05. Dr. Ehrmann gives as its formula:

$$\left.\begin{matrix}(C_2H_3O)_2\\Cu\end{matrix}\right\} O_2 + 3\,(CuO,As_2O_3).$$

(32) A. M. S. says: You stated some time ago that glycerin was a low form of alcohol. Some students tell me it is an oil. A. The alcohols are classified after the number of the O H, or hydroxyl, groups contained in them. Thus: ordinary alcohol (ethylic alcohol)—$C_2H_5(OH)$—is a monatomic alcohol; $C_2H_4(OH)_2$, or ethyline alcohol, is diatomic; $C_3H_5(OH)_3$, or glycerin, is triatomic, etc. We do not know what you mean by "low form" of alcohol; glycerin, the last named alcohol, is more highly constituted than the former.

How are photographs fastened to glass for the new style of oil painting? A. Cover the picture with a fine cloth, and remove all air bubbles by means of a soft rubber roller.

(33) W. B. W. asks: How can I make a petrifying solution to make vegetable tissues hard and durable? A. The time required for ordinary petrifaction renders its artificial application impracticable. There are various methods of metalizing leaves, etc., usually by electro-deposition of the metal, which, when properly applied, copy perfectly. These may be afterwards enameled to suit.

(34) J. D. E. asks: 1. What are the sizes and distances apart of the lenses in the eyepiece illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, vol. 1? A. For medium power, focus of 1st lens, 1·30 inch: focus of 2d lens, 1·30 inch; focus of 3d lens, 1·40 inch; focus of 4th lens, 1·00 inch. Distance between 1st and 2d lens, 1·73 inch; distance between 2d and 3d lens, 2·25 inch; distance between 3d and 4th lens, 1·47 inch. Diameter of 1st and 2d lens, 0·48 inch; diameter of 3d lens, 0·68 inch; diameter of 4th lens, 0·34 inch. Distance of diaphragm from 1st lens, 1·45 inch; aperture of diaphragm between 1st and 2d lens, 0·08 inch; aperture of diaphragm between 3d and 4th lens, 0·46 inch; distance of cap from 4th lens, 0·30 inch; aperture of cap, 0·17 inch. 2. Should there be a diaphragm at the focus of the object glass? A. There should be diaphragms in the tube to cut off the reflections from the inside. 3. What is the ratio between achromatic lenses of different foci? A. In telescopic objectives the magnifying power varies directly as the focal length. If the focal length is double, the magnifying power is double. 4. Is it necessary to have the focus of the field lens of the Huyghenian eyepiece longer than that of the eye lens? A. Yes. 5. Is it necessary to have the rays of light parallel when they enter the eye? A. They should be nearly enough parallel to enable the eye to bring the object to a focus.

(35) E. P. M. asks: How can I soften some such substance as black hard rubber so as to mold it into small round tickets, with letters on them? A. The rubber is usually formed into the shape desired while still soft and warm, before vulcanization.

(36) H. N. R. asks: 1. Which is the most powerful, a reflecting or refracting telescope? A. A refracting one. 2. Can I get one which will distinguish objects 16 miles distant for $30? A. Yes. 3. Where can I get it? A. Address the opticians who advertise in our columns. 4. Would it be too long to carry? A. No. 5. Would it be a night as well as a day glass? A. Yes.

(37) A. L. F. asks: What is common pitch? A. It is the residue remaining after the removal of certain volatile bodies by distillation from the so-called Stockholm tar. The tar is originally obtained by a kind of rude distillation of the resinous wood of the pine, in turf-covered kilns.

(38) O. J. H. asks: What is Paris green? A. It is the aceto-arsenite of copper, and is the most poisonous of any of the combinations of arsenic.

(39) F. M. W. asks: Is there such an instrument as a night glass? A. The night glass (telescope), properly speaking, differs from the day glass only in the dimensions of its objectives and in some cases the use of an eyepiece of lower power. Ordinarily the so-called day and night glasses do not differ in any respect.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

T. A. H.—Nos. 1, 2, and 3 are sulphide of iron. No. 4 is sand containing sulphide of iron, oxide of iron, alumina, and clay.—D. S. V.—It is chlorite with felspar, and is of no value.—J. S. M.—The presence of the sand is probably due to the decomposition of certain silicates at the source of the spring, the finely divided silica being brought to the surface by the mechanical force of the water, and there deposited. It is not of sufficient purity to be of value even for glass making.—S. S.—The powder consists principally of sesquioxide of iron, together with a little alumina and sand. We found neither gold nor silver.—P., of Gold Hill, Nevada.—It is a clay containing lime. We do not think it contains any metal in paying quantities. A complete analysis would be required to determine all its constituents.—W. H. W.—It is galena, sulphuret of lead.—J. M.—The very small piece appears to be an artificial product. It contains a considerable percentage of copper.—J. McG.—A complete analysis of the beef did not detect any poisonous matter.—J. F. W.—No. 1 is mica schist. No. 2 is hornblende. No. 3 is chrysoprase-chalcedony, whose color is due to nickel. No. 4 is dolomite, a magnesian limestone. No. 5 is rutile—titanic acid. No. 6 is felspar mica. No. 7 is a variety of basalt. No. 8 is quartz. No. 9 is impure clay. No. 10 is granite. Nos. 11 and 13 are semi-decomposed granite. No. 12 is quartz. No. 14 is flint. No. 15 is clay containing iron. Nos. 16 and 17 are hornblende. No. 18 appears to be a specimen of chlorite, a silicate of magnesia. No. 19 is magnesian limestone.—E. E. Y.—It is a talcose rock containing sulphide of iron, which has gradually suffered partial decomposition; it is not valuable.—J. T.—It is an impure clay containing oxide of iron and sand.—A. W. S.—It contains, or has been in contact while heated with, sand or clay. The scoria consists of silicates of lime, alumina, and iron, together with caustic lime.—S. E. E.—No. 1 is hematite—an iron ore. No. 2 contains oxide of manganese.—No. 3 is hornblende.—R. C.—The yellow body is sulphide of iron. The white, carbonate of lime. The hard dark colored piece appears to be chalcedony. The fourth is a piece of scoria.—Cairo, Ill.—It is impure kaolin, a silicate of alumina.—The two specimens in match box, marked "Alpha" and "Clara," are quartz rock and hematite iron ore.

J. C. R. asks: In what year did the grasshoppers commence their destructive work in this country?—W. Z. R. and others ask: What is baitra, which you mention as a new size for cotton cloth?

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Accumulation of the World. By S. A.
On Bevel Gears. By H. E.

Also inquiries and answers from the following:

W. F. W.—L. W. P.—B. T. K.—P. F.—H. H.—J. B.—W. W. C.—F. M., Jr.—W. D. K.—W. K. P.—M. A. G.—E. G.—P. S. K.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who makes cast iron cannon? Who sells sensitive dry photographic plates? Whose is the best photographic apparatus for outdoor work? Who sells varnishes? Whose is the purest white lead?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

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9,463.—SHIRT FRONTS.—A. Plant, New York city.
9,464 to 9,472.—FABRIC.—R. Scott *et al*., Lawrence, Mass.

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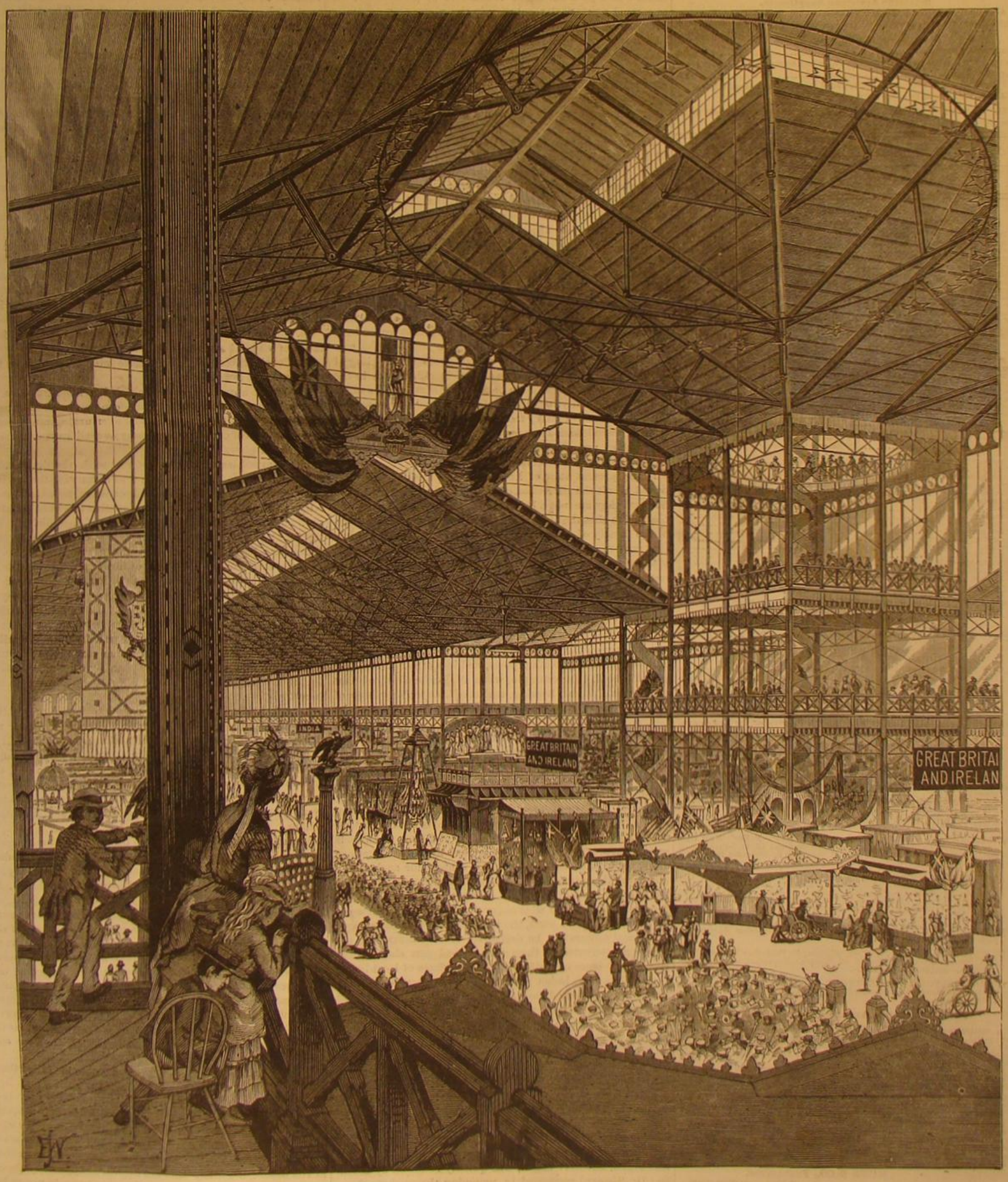
The handsome engraving presented herewith gives a birdseye view of the central portion of the Main Building, from one of the galleries overlooking the music stand. From such a position, an excellent idea of the magnitude, proportions, and general appearance of the colossal structure may be formed; and the visitor will do well to ascend one of the spiral staircases, and ascertain the extent of the building and the localities allotted to the different nations. Much of the finest art workmanship of this country and Europe is clustered round this center; and the jewelry, lace, and other fine manufactures attract large crowds of spectators to the highly ornamental stands over which are seen the renowned names of Tiffany, Starr and Marcus, Elkington & Co., and other cunning artificers in gold, silver, and precious stones. To the left of the center are the spaces devoted to the British colonies, including the exhibits from India, Canada, Australia, and the West Indies. The *coup d'œil* shown in our picture (selected from the pages of the *Illustrated Christian Weekly*), taken in connection with the fact that this is only one of five principal buildings, and that there are besides over a hundred smaller ones, gives an excellent idea of the magnitude of the whole Exposition.



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SURGERY VS. PHRENOLOGY.

For a long time, the popular pseudo-science of phrenology received little encouragement from the advancement of exact knowledge in the department of cerebral physiology and pathology. Indeed its pretensions were quite uniformly repudiated by the better class of students of the brain. But within a year or two, the current of scientific opinion has seemed to turn a little toward phrenology, the theory of brain action through localized functions, somewhat as mapped out in phrenological charts, receiving much apparent confirmation from the experiments of Dr. Ferrier in England, and those of certain German and French experimenters before and after him. Even men of high standing as physiologists have been led, in consequence, to admit that there might be more in phrenology than Science had been able to see: whereat phrenologists were naturally much elated.

Their joy, however, is likely to be of short duration. That most acute observer and experimental investigator in the department of cerebro-spinal physiology and pathology, Dr. Brown-Séquard, is delivering a course of professional lectures in London, calculated not only to knock the last shadow of a prop out of the foundation of phrenology, but to compel a practical revolution in the views now generally accepted by physiologists and physicians with regard to the physiology and pathology of the brain. He boldly asserts that almost all the current notions in this department of knowledge are grounded on data wrongly observed or wrongly interpreted; and what is more, he is presenting an array of experimental and clinical evidence in support of his position, which his opponents will find hard to explain away.

His argument runs in this wise: When we witness a loss of function in connection with a lesion of a part of the brain, we are naturally led to suppose that the lost function has its seat in the part we find altered. So too, though in a less degree, we are disposed to admit that, if certain muscles contract involuntarily when a certain part of the brain is irritated, the part thus irritated contains either the nervous center or the conductors usually employed by the will in moving those muscles. It is upon observations and inferences of these two classes that all the accepted theories of the physiology and pathology of the nervous centers are grounded.

But such reasoning is erroneous, and the conclusions thus arrived at are essentially wrong: as wrong as it would be to suppose the central power of laughter to reside in the sole of the foot, because laughter results from the tickling of that part; or to infer that the seat of intelligence is in the intestinal mucous membrane, because its irritation by a worm may cause insanity: or that the same membrane contains the centers for voluntary movements and the perception of tactual, visual, and auditory sensations, because paralysis, convulsions, anæsthesia, loss of sight, deafness, etc., appear in consequence of intestinal irritation.

In the present state of knowledge of physiology, no one would admit the correction of such conclusions: but to Dr. Séquard they are not a bit further from the truth than the conclusion that the left third frontal convolution is the seat of the faculty of expressing ideas by speech, because when that portion of the brain is diseased the faculty of speech is often disordered or lost: or that the upper parts of the two convolutions bordering on the scissure of Rolando on one side are centers for the voluntary movement of the two limbs on the other side, because these limbs will sometimes be paralyzed when there is disease in those parts.

The fault with all such reasoning lies in a failure to distinguish between the effects of two possible unlike causes—irritation extending to other parts, and loss of function in the part disabled. For example, when Majendie observed that the senses of sight, hearing, and smell, as well as those of taste and touch, on one side of the face were lost when the trigeminal nerve of that side was divided, he and others after him inferred that the real nerve of those senses was the trigeminal. But subsequent experiments and observations have shown the observed effect to be due, not to a cessation of the function of that nerve, but to irritation causing an arrest of the activity of all the special sensorial nerves.

Similarly at fault are the conclusions that have been drawn from the effects of irritation of parts of the cortical substance of the brain by galvanism or disease in animals and in men. The movements incited by such irritations arise, not because the psycho-motor centers for such movements are there located, but because of irritations transmitted to other parts of the brain. Proofs of this position Dr. Séquard draws from a wide range of clinical and experimental evidence of two sorts, the first showing that the alleged functional centers can be destroyed without destroying the function attributed to them: the second sort showing the complete absence of uniformity in the effects of local irritations. The same lesion in the same place may be followed either by an immediate effect, or by effects of the most widely varying character, when due to irritation: when due to the loss of special function, the effects of a lesion must be always present and invariably the same. Accordingly, no special function can be admitted to belong to a part of the brain if there is a single known case of a persistence of the supposed function when the part, if considered as a conductor, has been cut across, or, if looked upon as a central organ, has been entirely destroyed.

For instance, Flourens thought he had found the focus of life, the only origin of the supposed vital force, in the *medulla oblongata*; for in all his experiments, any injury to this organ, however slight, was quickly followed by death. But Dr. Séquard succeeded in removing the *medulla oblongata* entirely from certain living animals, with no other effect than the slow apparition of a lasting epilepsy. The theory that the function of life is localized in that organ consequently had to be abandoned: the sudden death, which occurs in almost all instances when the gray matter at the nib of the calamus is injured or taken away, being attributable rather to the effect produced, by the irritation of the neighboring parts, on other parts of the nervous centers and on the heart. The nervous center for respiratory movements has also been located in the *medulla oblongata*. But having been able to make a transverse section of that organ, below the level of the supposed respiratory center, without producing a stoppage of respiration, Dr. Séquard feels justified in concluding that it is not so restricted, and that when respiration is stopped by the division of the *medulla oblongata*, the stoppage is owing to the arresting influence of irritation on the nerve cells above and below the section, not, as hitherto supposed, to the separation of the respiratory center from its bonds of union with the respiratory muscles.

Evidence, clinical and experimental, not less cogent than the foregoing, is presented in these lectures in curious abundance and variety, disproving the localization of any function in any special part of the brain, whether according to the scheme of phrenology or any other. The drift of the evidence is summed up in the following revolutionary propositions:

1. A lesion in one half of the brain may produce symptoms either on the opposite side or on the corresponding side.

2. A very small lesion, whatever be its seat, can produce most extensive and violent symptoms.

3. A lesion occupying the same extent on the two sides of the middle line of the brain may produce symptoms only or chiefly on one side of the body.

4. Symptoms may appear suddenly from a slowly and gradually developing lesion.

5. Symptoms may appear slowly from a suddenly produced lesion.

6. The greatest variety of symptoms may proceed from a lesion in the same part of the brain.

7. The most various parts of the brain can give rise to the same symptoms.

8. Permanent lesions may produce symptoms by attacks, just as they produce epileptiform seizures.

9. Symptoms may cease suddenly or rapidly notwithstanding the persistence of the lesion.

10. Symptoms of brain disease may appear from an irritation of visceral and other peripheric nerves.

11. Considerable lesions anywhere may exist without the appearance of symptoms.

Unless the numerous cases, which Dr. Séquard cites at length in proof of these assertions, can be shown to be misobserved or misinterpreted, a radical overturning must ensue in our notions of cerebral physiology, as well as the final destruction of phrenology.

The learned lecturer does not rest with the destruction of current beliefs. He endeavors to harmonize the physiology of the brain with clinical observation, to make theory tally with fact, but in doing so his caution shows in striking contrast with his boldness in the work of demolition. He suggests: 1. That as regards localization of function, a great many facts lead to the view that the nerve cells endowed with the same function, instead of forming a cluster so as to be in the neighborhood of each other, are scattered in the brain, so that any part of that organ can be destroyed without a cessation of their function. It makes no difference whatever whether the distance between nerve cells employed in the same function is a small fraction of a millimeter or very much greater, as in either case their communication with each other must take place by conductors (nerve fibers), the length of which is unable to interfere with the function.

2. Each half of the brain is a complete brain originally, and possesses the aptitude to be developed as a center for the two sides of the body in volitional movement as well as in all the other cerebral functions. Still very few people develop very much, and perhaps nobody quite fully, the powers of the two brains: on the contrary, in most persons only one of these two primarily similar organs acquires great power for certain actions, and the other for other actions.

3. Communications between the body and the brain can be more or less fully accomplished by means of a very much smaller number of conductors than would be necessary according to any view like the well known clavier theory. As we know by clinical facts that any part of the *medulla oblongata* can be destroyed without paralysis, and that in some cases a very small portion of it has proved sufficient for the persistence of voluntary movements, it would seem that an order of the will may be transmitted as well by one nerve fiber as another, and that it is necessary to recognize the existence of faculties of a much higher order in the spinal cord than those which are admitted to exist there. Many facts and similar reasoning tend also to show that the nerve cells of the spinal cord possess, as regards sensibility, faculties of a much higher order than those which are now admitted.

In another connection, the lecturer asserts his belief that the experiments of Fritsch and Hitzig, Dr. Ferrier and Dr. Bochefontaine, in proving the sensitiveness of the convolutions of the brain to galvanic irritation—his own experiments showing the excitability of all parts of the brain by the application of heat to the convolutions, to the white substance of the cerebral lobes, and to the great masses of gray matter at the base of the brain—and the evidence supplied by thousands of cases of disease, prove that the brain is not to be considered as different from the peripheric parts of the ner-

vous system; and he promises to demonstrate that all the symptoms of brain disease—such as paralysis, anæsthesia, amaurosis, aphasia, insanity, convulsions, and the rest—are produced by the same mechanism, whether they arise from an irritation in any part of the trunk or limbs, or from an irritation in any part of the *meninges* or of the brain itself.

AMERICAN AND ENGLISH RAILWAYS.

A few months ago the London *Times* editorially instituted a comparison between English and American railways. It took the somewhat paradoxical ground that, as Scotland had the worst possible climate, and therefore educated the most perfect gardeners, and as France has the least material for the kitchen, and therefore turns out the most perfect cooks, so America, having the worst possible railroads, has the most perfect system of management, and the safest. An American editor suggested that under such circumstances the wise thing for the English to do would be to spoil a few of these railways, in order to bring their safety up to the American standard.

Recent accidents have brought out the correspondents of the *Times* on the same subject; and as there is a popular impression that everything in England is safer than in our own country, it may interest our readers to see what Englishmen say on the subject of railways, English and American. "Traveler," in a late number of the *Times*, starts out with the declaration that "English and American railways present at one point a marked and, to us Englishmen, a humiliating contrast." He then proceeds to show that, while Americans have established over running trains a control which is almost perfect, the English still maintain the rude and ineffective methods which were in use at the very dawn of railway traveling.

"When the driver of an English train sees danger before him, he shuts off steam. His fireman begins in haste to turn a lever. The guard, warned of impending peril, makes his way as quickly as possible to a similar lever at another part of the train. In ten to fifteen seconds, the combined efforts of fireman and guard have applied the brake to fourteen wheels, probably one fourth of the number on the train. Ordinarily the feeble action of our brakes is cut short by a shattering collision, and the death or injury of many of the passengers." Such is the English traveler's testimony as to his own country. Of the American roads, he says: "In presence of similar danger, the American driver touches slightly a little handle which stands up before him. In less than two seconds every wheel in the train is grasped by a powerful brake; and before the train has traversed a distance greater than one and a half times its own length, it is brought to a stand."

There is a slight inaccuracy in this statement. Car wheels are usually in groups of four or six, and the brake is applied to two wheels in each group. On the English roads the train is a string of small cars or carriages, and only a portion of these are provided with brakes. Our plan is more "democratic," but more safe; and if the non-exclusiveness of the American railway cars can be an objection, that difficulty is met by palace cars, in which an extra price is charged.

THE FRICTION OF SLIDE VALVES ON THEIR SEATS.

"Mechanic" writes:

"If we have a simple metallic plane, enclosed in a chest charged with steam, moving on a plane seat, without ports in either: Would any more power be required to move this valve than when the chest was not charged with steam pressure? If more power would be required, how much? And if a port were cut through the seat, leaving a portion of the same valve beneath, equal to the area of the port, exposed to the simple atmospheric pressure, how would the valve be affected in the matter of the power required to move it under these new conditions"?

And the same mail brings us a similar enquiry from N. D. S., another subscriber. In reply to these and other communications which we are continuously receiving upon the same subject, we would say as follows: The coefficient of friction for cast iron is 24, that is to say, if two cast iron surfaces are in positive contact, every 100 lbs., weight of the top one will require 24 lbs. to slide it upon the other. The weight of the top one is made up by the weight of the iron added to whatever amount of vacuum there may be between the two surfaces. Suppose for instance a slide valve is 10 inches by 5, and therefore contains 50 square inches of area, and that it weighs of itself 10 lbs.; if then it is surfaced truly, and beds upon an horizontal surface so as to exclude the air, it will be pressed to its seat, first by its own weight, and secondly by the atmospheric pressure of 15 lbs. per square inch, making a total of $(50 \times 15) + 10 = 760$ lbs. If, however, the plate stood edgewise, as in the case of engines having the slide valve on the side instead of on the top of the cylinder, it would have the atmospheric pressure only pressing it to its seat, that is to say, in this case 750 lbs. If we consider the valve of an ordinary 16 inch cylinder engine to measure 8½ by 14 inches, and allow a pressure of 130 lbs. per inch in the steam chest, there would be, supposing the valve to bed perfectly to its seat, a pressure of 15,470 lbs. forcing the valve to its seat; and the whole pressure upon the piston being 26,442 lbs., the friction of the valve would entail a loss of about 58 per cent of the power of the engine.

It is to these considerations that are due the numerous efforts to produce valve-balancing devices. As a matter of fact, however, the pressure to the seat will be in precise proportion to the area of the valve in positive contact with the seat, and this is the point that sets all calculation at naught; since it is impracticable to ascertain, under ordinary circumstances, what amount or proportion of the valve beds sufficiently to its seat to exclude the steam from between them. A writer in the *Railroad Gazette*, of July 28 last, says upon this subject:

"A valve may be made to bed sufficiently to be steamtight without being so perfect a fit as to induce undue pressure to its seat; and there is good reason to believe that, under ordinary conditions, a locomotive slide valve never fits so closely as to induce the pressure due to a flat, true, and smooth surface. Scrape a valve face to its seat as truly as we may, the steam fills the hollows of the scraper marks, and thus relieves the valve of a very large proportion of the pressure due to its area. It would appear that the scraper marks are soon worn down, and hence the valve then beds perfectly to its seat, and this undoubtedly would occur if the wear upon all parts of both the valve and the seat faces was at all times equal, and the conditions were constant; but such is not the case. The bridges between the cylinder ports wear a little the most, and wear hollow in their lengths, for the reason that the wearing surfaces, upon which the valve beds, standing at right angles to the top and bottom of the bridge, are greater and hence suffer less abrasion. Then again inequalities in the texture of the metal, and other causes, in themselves trivial, form in the aggregate the causes which operate to prevent the equal abrasion of the seat and valve face at all parts of the surfaces; and hence it is that, when a locomotive comes to be repaired, we find those faces worn considerably out of true, as might be expected, not only from the variation in the amount of contact on different parts of the surfaces, but also from the irregularity in the speed at which the valve travels while such contact is taking place."

Of more consequence than the above considerations, however, is the fact that the form of a slide valve is continually changing. During the process of the cooling of a casting after the metal is poured, the surfaces lose their temperature in advance of the internal metal, and their crystaline formation takes place more rapidly; those surfaces become rigid sooner than the inner metal, and therefore resist the strains produced in the cooling and crystaline formation of the latter. There is then upon the surface of all castings a tension which is relieved in precise proportion as those surfaces are cut away; hence as the edges and face of a valve are planed, a re-formation takes place, which throws the face out of true. This is remedied in surfacing the valve; but when the valve is placed under steam, the increase in its temperature induces a more complete re-formation: so that, surface a valve as true as we may, we find that it does not bed true to its seat when it is first placed under steam, nor indeed until it is worn down to that degree of practical truth obtainable under the conditions of its wear. If we now turn to the cylinder, we find that a large proportion of its surface area has, by the boring and planing, been relieved of its tension, inducing in it also a re-formation, first, during its manipulation, and secondly, when placed under steam; so that we may scrape up the valve and seat surfaces as truly as possible, but we cannot hope to make them fit sufficiently close to keep a vacuum between them when heated to the temperature due to the steam pressure. It would appear, however, that, after the re-formation had once completely taken place, the valve would wear to a close fit; but the pressure of the steam, and hence the temperature of both the cylinder and the valve, is continually changing, not only because of variations in the boiler pressure but also by reason of the action of the link motion in giving more or less steam to the cylinder. The irregularity of the shape of both the cylinder and the valve causes their expansion and contraction to vary under different temperatures, operating to alter the fit of the valve to its seat. The valve also, as it wears thinner, undergoes continuous change of form, so that it springs more from the pressure due to the steam.

From these considerations we cannot define the pressure of a valve to its seat further than by saying that it cannot be less under any circumstances than that of the area of the valve exhaust port multiplied by the pressure of the steam, because that amount of pressure cannot be balanced by any want of contact between the valve face and the seat. Of the amount of force necessary to move a valve under any given pressure to its seat, we can form no estimate, because that again depends upon the fit of the valve to its seat. If the faces permit of a film of steam beneath them, they will glide, one over the other, much more easily than if they are steamtight.

AN OPPORTUNITY FOR INVENTORS.

One of the most fruitful sources of discomfort and disease of the eyes is their use in a fluctuating light. Artists, whose professional success hinges on healthy vision, are very careful to have the studios face the north, for their own comfort in working quite as much as for the advantage of a uniform light for estimating the effect of their lines and colors. But all persons who work with their eyes cannot command a north light. The pupils in our schools, the readers in our libraries, the writers in offices, typesetters, and fine workmen in every department are forced to take such light as they can get, often with rapid changes from glare to gloom. No one need be told how exasperating such changes are, or how injurious they may become to eyes constantly taxed for nice perception. Particularly injurious are such sharp and sudden variations of light to the sick, more especially to the patients in ophthalmic wards.

The problem is to devise a system of inexpensive blinds, which shall automatically open and shut with the varying intensity of sunlight, so as to admit a uniform amount of light into our reading rooms, offices, workshops, hospitals, and so on. An ingenious person who is able to meet the requirements of the case might make a good thing out of it for himself as well as for the public.

The motive power should be the sun, whose rays are to be admitted or excluded according to their force and brillancy. The apparatus might be a system of lightly moving blinds worked by a thermo-electric current, generated by the action of the sun's rays on a thermopile. In such a case the motion of the blinds could be made directly proportional to the brightness of the sun, and the light admitted perfectly equalized. Or the immediate source of motion might be a battery of selenium bars, that metal being electrically sensitive to light.

These are merely suggestions which any experimenter can improve upon. The field is a new one.

Trial of a New Coffer Dam.

The coffer dam invented and patented by Mr. J. E. Walsh, of this city, and illustrated and described by us on page 287 of our volume XXXII, was submitted to a public trial on Tuesday, September 13. A large number of officials and engineers were present to witness the operations. The sides and ends of the structure (which is called the Centennial) enclose a water space of over 4,000 square feet, with solid timber walls, 15 feet wide, and built double, with the space between them divided into compartments. The walls are fitted with keels, so the dam, when it is lowered into the mud, rests steadily, the keels in the mud making a perfectly watertight joint all round.

When the valves in the walls were opened to admit water, the dam began to sink slowly and steadily; and when water level was reached and the valves closed, additional water was pumped in to sink her. When the weight of the structure and the water ballast brought her to rest on the bottom, the full power of the pumps was applied to empty the interior of water, and the bed of the stream was soon laid bare. Large numbers of fish were deprived of their element, and workmen descended into the mud to keep the foot valves of the pump clear. The water inside the dam was 23 feet deep when pumping commenced; and the dam sustained the pressure of this depth without any leakage being apparent. Commissioner Salem H. Wales, President of the Dock Commission, and many members of the engineering profession present expressed themselves as perfectly satisfied with the trial, and complimented Mr. Walsh on his invention, and on the substantial and efficient manner in which his ideas have been carried out in the coffer dam under trial.

Tensile Strength of Cement.

La Compagnie du Gaz Parisien, previous to constructing some large gasometers near Paris, experimented on the different materials to be used in their construction; among others, on the cement which was to be used for the vertical walls of the reservoirs (*cuves*), with the following results: The cement used was Portland cement of Pouilly in Burgundy. It was found that a brick of pure cement six weeks old, which had been kept in water during that time, broke under a tensile strain of 170 lbs. to the square inch (12 kilogrammes per square centimeter); that a brick six months old, which had also been kept under water, broke under a strain of 441 lbs. to the square inch (31 kilogrammes per square centimeter); that cement hardens more rapidly, when exposed to the sunlight and fresh air, than when affected by humidity; but that this is at the expense of the tenacity and impermeability of the product: hence masonry walls should be sprinkled regularly until the cement has set; that the degree of fineness has an effect on the setting of cement, and consequently upon its ultimate tenacity, for it is a rule that the tenacity is in inverse proportion to the rapidity of the setting; that a mortar made of two parts sand to one of cement broke under a strain of 277 lbs. to the square inch (19 kilogrammes per square centimeter), while a mortar of equal parts of sand and cement broke under a strain of 427 lbs. to the square inch (30 kilogrammes per square centimeter). The effect of sand upon the shrinkage was shown by the facts that pure cement was defaced by cracks a little more than a foot apart; when mixed with equal parts of sand, the cracks were little more than a yard apart; when three parts of sand to one of cement were used, there were no cracks at all: hence it was this mixture that was used in constructing the reservoirs.

Fire near the Centennial Buildings.

A fire recently broke out in Shantytown, as the Philadelphia papers call the wooden structures adjacent to the Centennial grounds. They are located on the broad avenue opposite the Main Building. These wooden structures were thickly clustered together near the gates; and before the fire could be got under control, $80,000 worth of property was destroyed, including some twenty small hotels, restaurants, etc. The heat was sufficient to blister the paint on the gates of the Exposition grounds, and warm up the interior of the Main Building.

The New Bergen Hill Tunnel Completed.

The new Delaware, Lackawanna, and Western Railroad tunnel is completed, and will be ready for use as soon as the *débris* is removed, which will not be later than November 1. It is 4,270 feet long, has six shafts varying in depth from 75 to 90 feet, and cost $1,000,000. The filling of the road bed from the eastern end to the river, across the meadows, where stone ballast has sunk to a depth of sixty feet before reaching a solid foundation, has been a source of great perplexity and expense, requiring much engineering skill

THE VICTOR DRILL CHUCK.

We illustrate herewith a new self-centering drill chuck, in which the clutches are flush with the face or front of the device, by which arrangement, it is claimed, the workman has less difficulty in adjusting the drills, and the said clutches are not liable to be broken under strain or through dropping the chuck. The invention embodies a new device for operating the levers which control the clutches, and there are various other advantages which will be noted as we progress.

The chuck head has a spindle whereby it is secured to the lathe mandrel, and also a small screw which gears into the female screw formed inside the chuck holder. A spindle on the head carries a cylindrical follower, as shown in the sectional view, Fig. 1, which is provided with three longitudinal slots having bottoms inclined as represented.

Fig. 1.

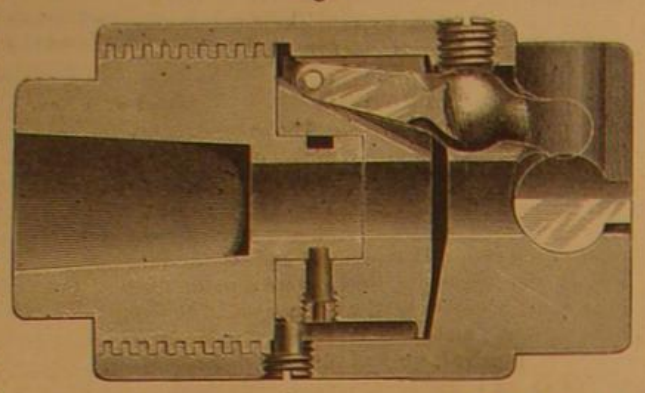
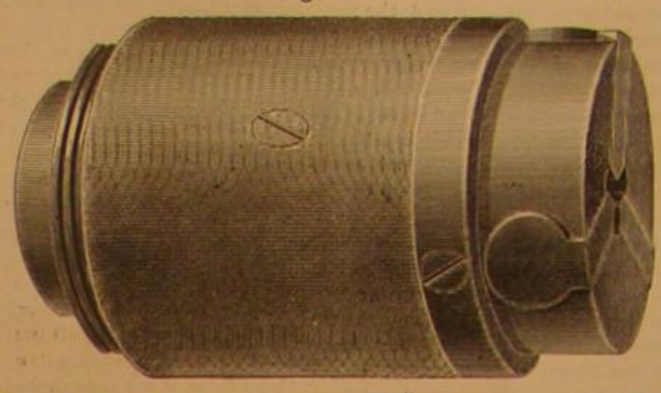


Fig. 2.



THE VICTOR DRILL CHUCK.

The rear ends of the levers which actuate the clutches enter the above mentioned slots, and at their fulcrums are enlarged and rounded, so that they there have spherical bearings which rest against adjustable set screws passing through the walls of the holder. The clutches each consist of a short metal cylinder having a broad longitudinal feather and beveled at the lower edges. These fit in a series of radial cylindrical chambers near the face of the holder, the latter being slotted in front of the cylinders to receive the feathers on the clutches, which come flush with the front of the chuck. The front ends of the levers fit into recesses of the clutches, the rear ends being provided with pivots to return the clutches or throw them out when the rear ends of the levers are released by the follower. To effect this, the recesses in the follower are grooved on the sides on a line parallel with the inclined bottom. Into these grooves the lever pivots enter, so that the levers are thrown back on the return motion of the follower.

The device holds from 0 to ¾ inch drills, or will carry ¾ by reducing the shank, as shown in Fig. 3. The drill being inserted between the clutches, the chuck head is then turned so as to advance the follower, when the inclined bottoms of the recesses force the rear ends of the levers apart, pressing the clutches together in their radial chamber toward their common center, causing them thus to grasp and hold the tool. When the latter is to be released the operation is reversed. The pivots and the grooves in the follower then act upon the levers, bringing them back to their original positions and moving the clutches away from the tool.

The exterior appearance of the chuck is shown in Fig. 2. Its construction, of steel throughout, is durable and strong, and the arrangement of the levers, as already explained, admits of its easy adjustment.

Patented by Geo. M. Pratt, June 1, 1875. For further particulars address the Victor Sewing Machine Company, Middletown, Conn.

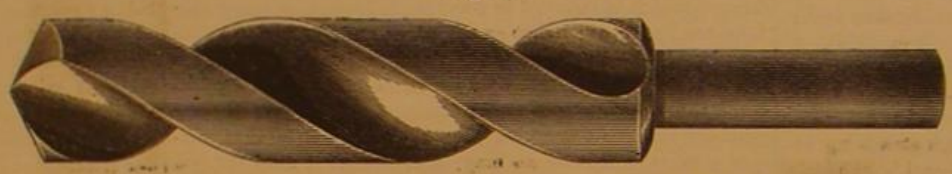
AUTOMATIC LEATHER SCOURER AND HIDE WORKER.

The improved leather scourer and hide worker herewith illustrated is complete in itself, and is independent of buildings or extra framework. It can be put up on any ordinary strong floor, without bolting down or bracing, with safety to both machine and building. It is simple in construction, and its many movements are effected by direct and positive means. It is made wholly of metal, disposed so as to secure great strength, and is further protected by air cushions, which relieve it of thrusts and strains.

The machine can be set up at any angle with the line shaft, and belts may be attached at either end, from above or below. It requires comparatively little power to run it, from one to three horse being sufficient, according to the thickness of leather to be dressed. But little more space is occupied than that required for a table alone, thus saving, it is claimed, fully seventy-five per cent of the room occupied by the oldfashioned scourer. The machine is universal in its movements; and it can be readily managed, being so far automatic that the strength of a man's finger will guide its movements. It is capable of the widest range of work, from the lightest to the heaviest; it will scour, set out, or gloss; it can be made to take a slow or quick stroke, a long or a short one, the stroke being effected by the epicycle and cam combined. Lastly, it is claimed that, through the efficiency of the apparatus, it will save its owner from fifty to seventy per cent of the cost of scouring and setting out.

Patented by F. A. Lockwood, of Fall River, Mass., July 26, 1876. Manufactured by S. C. Forsaith & Co., Manchester, N. H. W. E. Plummer, Boston, Mass., is sole agent for the Lockwood Leather Scouring Machine Association.

Fig. 3.



Defects in the Human Eye.

We have already called our readers' attention to Helmholtz discovery of several defects in the human eye; and from statements made at a recent meeting of the Physical Society, London, it appears that a kind of chromatic aberration must be added to the list. It was stated that to short-sighted persons the moon appears to have a blue fringe; and that, in using the spectroscope, different adjustments of the focussing glass are required for the two ends of the spectrum. Moreover, a black patch on a blue ground appears to have a fringed margin; but on a red ground, the edge of the black patch is sharply defined

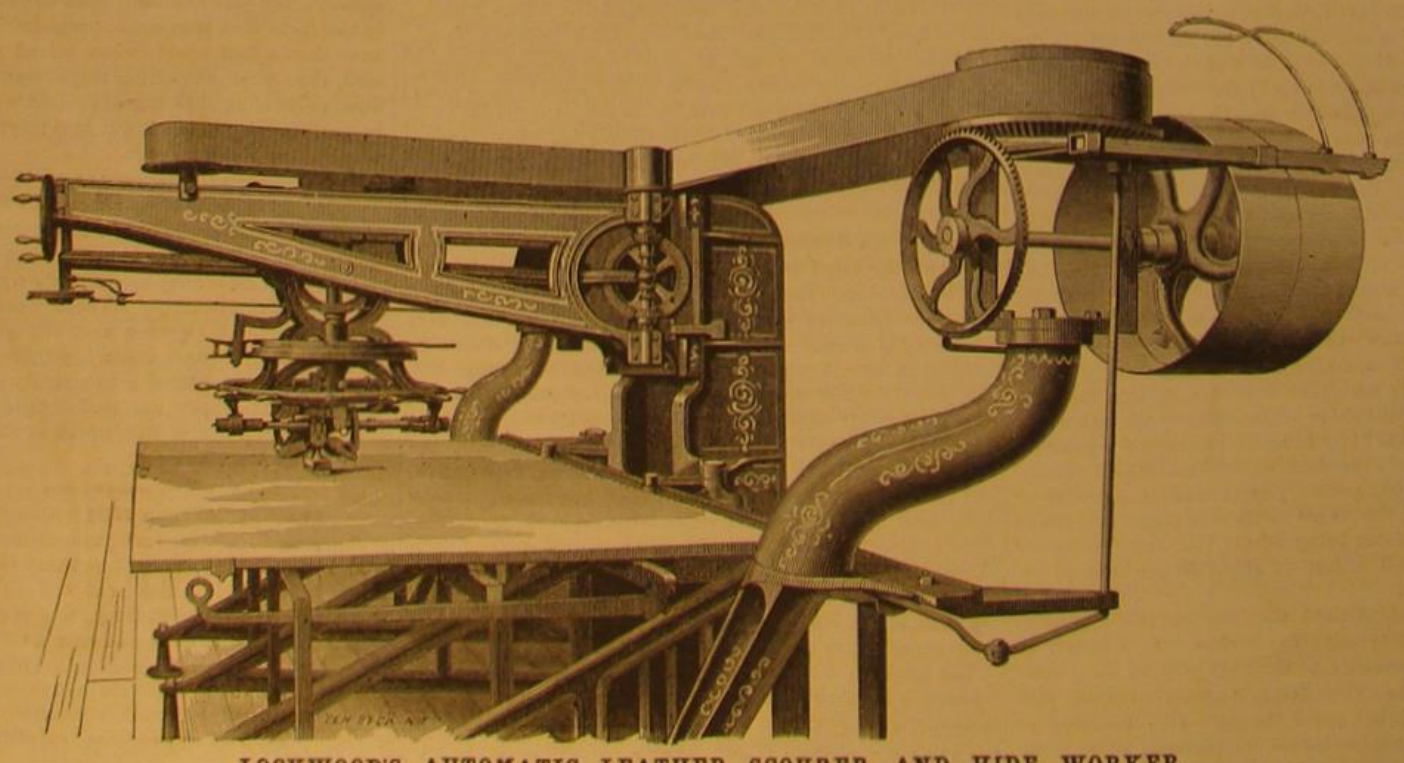
History of a Young Kingfisher.

As the kingfisher is not often kept in confinement, the following account may be of interest. It was one of five brought to us in a basket, on May 31, by a boy who had taken them from a nest in the bank of a small stream not more than three feet wide; they were fully fledged, and we think about three or four weeks old. We kept one and gave the others to the Zoölogical Garden, Dublin, thinking that they would be more likely to thrive there than with us, but unfortunately the four all died after being there four days. The one we kept was put into a cage, which was often placed out of doors in the daytime. After two or three days we began to allow it the use of a bath room for the greater part of the day, so that it might learn to fly, which it did at once. When brought to us it did not fly more than half a yard, and then only in a downward direction. During the first week of its captivity we fed the kingfisher with six to twelve minnows and sticklebacks each day; we gave them to it head foremost, so that the fins might not stick in its throat; it always kept them in its bill for a short time, and then bolted them suddenly. When it began to take the minnows off our hands it always got them in its bill crosswise, where it held and shook them before swallowing them; from this time on, wards it ate every day about two dozen minnows and sticklebacks, and occasionally a young gudgeon. It had been in our possession for a fortnight when we first saw it fishing for itself, but we believe it helped itself for two or three days before it was noticed doing so, because it was often not at all hungry when we went to give it a meal. While it was unable to feed itself we occasionally gave it dead fish, which it swallowed as readily as living ones; it always swallowed the latter without killing them, although it shook and squeezed them, and frequently made them bleed. In the bath room where the kingfisher lives we keep a stock of minnows, etc., in a large earthenware basin; until lately we several times a day put some of them into a saucer, from which it took them, but now it fishes in the large basin. It is very interesting, and has given pleasure to many of our friends, to watch the kingfisher perched on the edge of the basin, intently looking down into the water until a minnow comes within its reach, when it darts at and seizes it with its bill, without wetting its feathers. "The castings or pellets cast up by the kingfisher vary considerably; some are pure white, and remind one of very fine crystals, and others are of different shades of drab or gray: they are composed, I believe, entirely of fish bones, and are about half an inch long, and oval; I believe they are cast up at different times of the day, and the average number produced is about one per day. I have not yet heard the usual note of the adult bird uttered by this young kingfisher; it has a kind of whistling chirp, much less shrill and loud than the old bird's. Its plumage is as brilliant as that of the kingfisher at any age, but I do not know whether it is a male or female; I suspect it is a male from the length of its bill (one inch and three quarters to one inch and seven eighths), which probably is not yet fully grown. It is stated by Montagu that the bill of the male is two inches long; he does not give the length of the female's, but says it is not so long as that of the other sex."—*J. E. Palmer, in the Zoölogist*

Race Horse War Steamers.

The London *Daily News* says: "Half a dozen steel corvettes, each 2,300 tuns, are forthwith to be added to the navy: swift, well armed vessels, to serve as cruisers. For some time past steel has been regarded by shipwrights with a favorable eye, being tougher and altogether less liable to fracture than iron, and now the Admiralty has taken the bold step of concluding a contract for building six war ships of this material without delay. They are to be built on the Clyde, and to be ready for service, with their engines on board, within two years. These corvettes will not serve in any fleet along with big ironclads, but are designed especially for foreign service in China and the Pacific, as also for cruising in the vicinity of our colonies and foreign possessions. They will be remarkably fleet sailers, and, it is anticipated, will be able to make twenty miles an hour without difficulty. Their armament is to consist of fourteen guns of different calibers.

"As their great speed will always enable them to show their sterns and prevent hostile craft from approaching, these steel corvettes should prove most useful additions to our navy; and it may safely be taken for granted that where they are likely to cruise there will be little chance of falling in with heavy ironclads, which are unable to trust themselves very far from land."



LOCKWOOD'S AUTOMATIC LEATHER SCOURER AND HIDE WORKER.

IMPROVED COMPOUND STEAM PUMP.

The special advantages claimed for the improved steam pump illustrated herewith are as follows: 1st. It has only two moving parts, except the pump valves, thereby reducing friction to a minimum. 2d. The steam, having performed its work in the high pressure space, is afterward expanded, thereby extracting all the power possible from it, and effecting a large saving in fuel. 3d. The high pressure and expansion are both carried on simultaneously throughout the entire stroke, thereby maintaining a more uniform aggregate piston pressure to the end of the stroke. 4th. It is simple, compact, durable, and portable, and can be used without expensive foundations.

The indicator diagram shown in Fig. 1 was taken from one of these compound cylinders, and a study of it will demonstrate the economy of such a pumping engine in comparison with pumps that must use a cylinder full of steam at each stroke. Attention may also be directed to the very short passage ways for live steam between the valve and the high pressure piston, thus insuring less waste of steam from steam passages than is usually the case.

In Figs. 2, 3, and 4 three sectional views of the machine are given. The elongated piston has two ends provided with packing, and has a cylindrical portion of a less diameter extending between the said ends, the said portion being fitted to work steamtight in a central partition in the cylinder. Two annular chambers are thus formed, nto which steam is admitted to act upon the smaller areas of the piston ends; and it is afterward expanded into the spaces between the piston ends and the cylinder covers, to act upon the larger areas of the said piston. A double cylindrical valve regulates the movements of the steam, each half of it being formed with a passage to connect two ports, through which steam passes from the annular space to the space between the piston and the cylinder head, and also with a passage which connects the larger steam space with the exhaust passage. Steam is admitted into a space between the two parts of this valve, and finds its way by suitable openings into the end spaces between the said valve ends and valve box covers; the said end spaces are connected by passages with ports formed in the aforenamed partition; and as the piston moves to and fro, passages formed in the said piston establish a communication between the said ports and a port leading into the exhaust passage, thus relieving the valve from pressure on one end and causing it to be quickly pushed in that direction by the steam at the opposite end; the parts are all so arranged as to provide effectually for sufficient steam to cushion both the piston and valve so as to prevent striking under any circumstances.

For further particulars address the manufacturers, Messrs. E. & A. Betts, Wilmington, Del.

Fig. 1

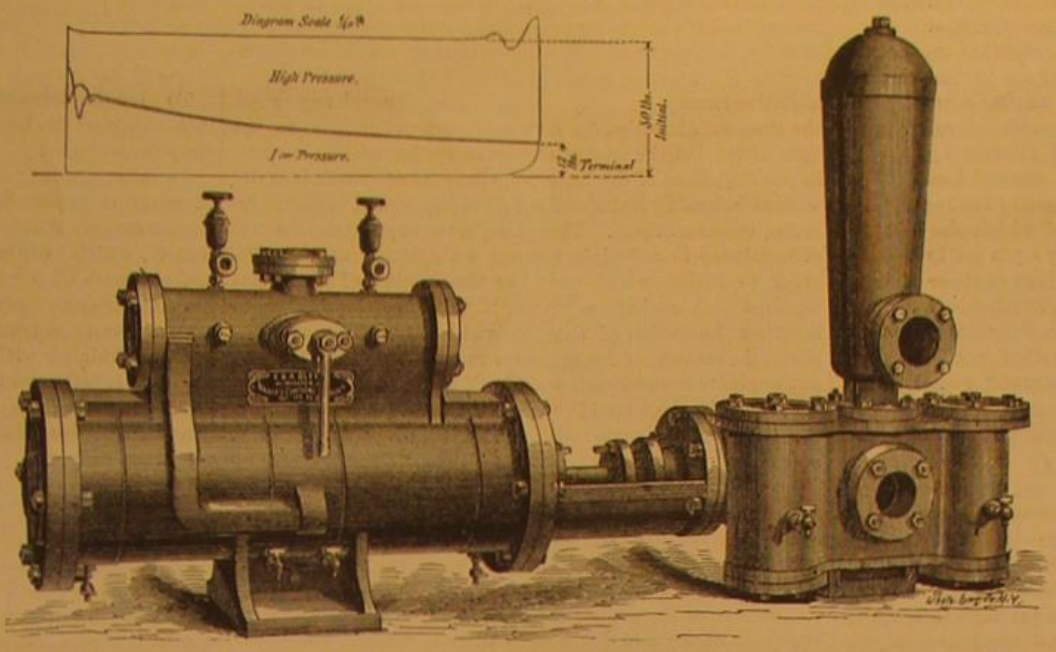
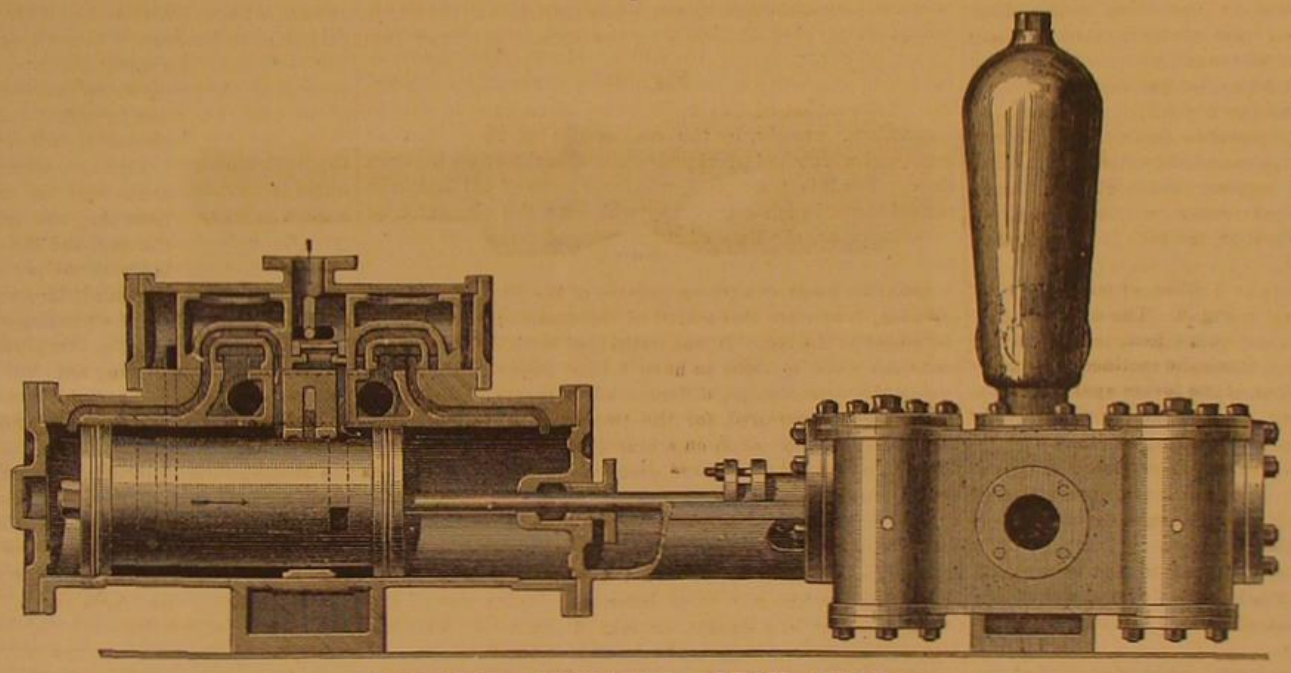


Fig. 2.



WALKER'S COMPOUND STEAM PUMP.

Fig. 3.

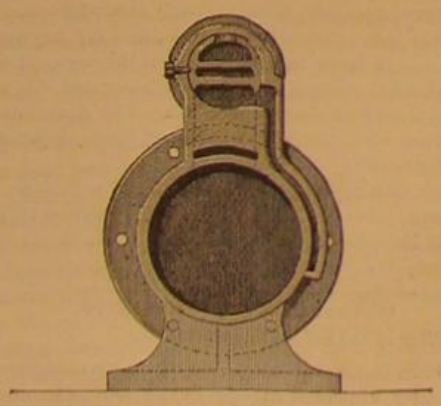
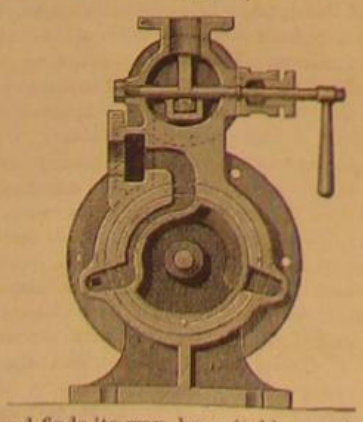


Fig. 4.



American Nickel Mines.

The nickel deposit near the Gap, Lancaster county, Pa., is considered the largest yet discovered in the world, and the only deposit of the ore worked in America. The mine is on the high dividing line between Chester and Pequea Valleys. Besides nickel, copper, iron, and limestone are found in the same locality. Nickel was discovered here about the year 1856, though copper, which is taken from the same mine, was known in the same locality seventy years ago. The ore has a gray color, is very heavy, and so hard that it is mined entirely by blasting. After the ore has been broken into small fragments, it is put into kilns holding eighty or ninety tuns each, and subjected to heat produced at first by the burning of a small quantity of wood, and continued by the conversion of the expelled gas. It is then put into a smelting furnace, and undergoes a treatment similar to that of iron ore.

New Steam Canal Boat.

A new invention for the propulsion of canal boats was tested at Rochester, N. Y., recently. The peculiarity of this boat is in the position of the propelling wheel or screw. It is placed in the middle of the boat, and works against the water at an angle of thirty-eight degrees, in this way throwing the water against the bottom of the canal instead of horizontally. It works in a casement from which the air is exhausted and which is consequently full of water. On the trial, without a load, three miles an hour was run by a boat to which the screw had been affixed.

Extension of the Greenwich Railway, London.

The London and Greenwich Railway was constructed and opened upwards of forty years ago, not long after the opening of the Liverpool and Manchester railway—the first steam passenger railway in England. The Southeastern Company, who are now the owners, have extended it to the North Kent line, *viâ* Maize Hill, Charlton, and Woolwich, which places Greenwich in direct railway communication with Gravesend, Chatham, Maidstone, and other districts in North and Mid-Kent.

The old London and Greenwich line is carried entirely on masonry arches, and on a high level, that is to say, it is a city elevated railway. The extension line about to be opened is, however, an underground line, diverges from the elevated line near Deptford Creek, and is thence carried, in a northeasterly direction, along a descending gradient, until it arrives at London street, which it passes under, immediately on the south side of the parish church. In constructing this portion of the line, about 150 houses had to be purchased: and as the whole of one side of a thoroughfare was also absorbed and diverted, the company have had to construct a new street, with a roadway under the new line leading into Greenwich road. At this point a heavy outlay has likewise been incurred by the company in the diversion of about 1,700 feet in length of the main sewer belonging to the Metropolitan Board of Works, near London street. The new sewer, which is carried at a considerable depth under the railway level, is 11½ feet in width. It is circular in form, and lined at the bottom with blue Staffordshire brick, and all round with white gault brick. There are staircases at intervals for the purpose of descending into the sewer from the street. The cost of this sewer was $260 per yard. From London street, Greenwich, the line is carried forward in a tunnel, 26 feet in width and half a mile in length, which passes under the Royal Naval Schools. At the end of the tunnel the line is carried on to the Maize Hill Station, through a cutting which is walled in throughout its entire length. The portion of the line from Maize Hill to Charlton and Woolwich, where a junction is formed with the North Kent line, was opened nearly two years ago; the entire length of the line from Greenwich to Woolwich is between two and three miles.

The whole of the works have been designed by Mr. Brady, the company's engineer, and executed by Messrs. Lucas & Aird, the contractors.

MAY'S IMPROVED BILLIARD TABLE LEVELER.

The invention herewith illustrated is a combination of leg bolt and leveler, so that a single bolt holds the leveling attachment firmly to the leg, and at the same time secures the latter to the table. In some billiard tables the legs are merely doweled on, but this is liable to give trouble in case

Fig. 1

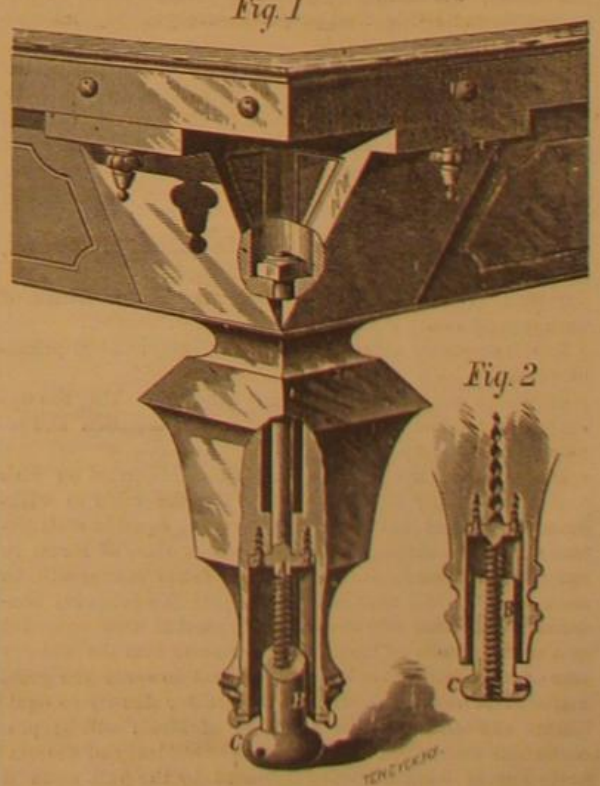


Fig. 2

of accident, packing, etc. The screw in the present device is not exposed, and the arrangement generally is neat and substantial, and, we are informed, cheap.

In the lower end of the leg is a deep socket, Fig. 1, through which passes the screw rod, A, on the extremity of which is a long nut, B, having an oval head, C. The leg has preferably a metal cap with a flange, projecting downward to conceal the nut and the upper side of the head thus making a neater finish; or the cap may be omitted, as in Fig. 2, as the nut will ordinarily appear like an ornamental foot.

In Fig. 1 the rod is represented as extending up through the leg into the head block and bolting the leg fast thereto. In Fig. 2 there is simply a short bolt having a wood screw formed on its upper end to enter the wood. A collar is attached on the rod at the point where it rests against the bottom of the socket, when the bolt is screwed home. This is fastened by suitable wood screws entering the leg through the notches on the collar, by means of which the latter is screwed up. The nut, B, is adjusted by a pin put in its hole. The device is well adapted for piano legs or those of bagatelle and other tables requiring to be adjusted level.

Patented to Samuel May through the Scientific American Patent Agency, July 25, 1876. For further particulars address Messrs. Riley & May, 81 Adelaide street west, Toronto, Canada.

Correspondence.

On a Mechanical Theory of Gravitation.

To the Editor of the Scientific American:

The main cause of the failure hitherto to construct a mechanical mode of gravitation action, which would be found consistent with acknowledged scientific principles, in agreement with the facts of observation and mathematical developments of the theory itself, appears to be the supposition that no mode by which tension would be produced is admissible: etherial pressure or impulsion being alone scientifically allowable. But this contradicts experience, and even general analogy. The tension of a cord is used as an elementary illustration; and optical phenomena not only show etherial vibrations to be transversal to the course of propagation, but that in impalpable matter the ether is densest, and therefore probably condensed instead of rarified around it. We have only to suppose the ether to equilibrate by condensation any enforced tension within it (say, by being stressed toward dense matter) to make the propagated vibrations transversal, and their velocity unvarying.

If we assume the energy of the Universe to be concentrated in the continuous mutual transmutations of ether and dense matter, masked by various and transformable modes of manifestation: such transmutation occupying more time than the periods of molecular vibration where radiant energy is displayed, but less time than any molar motion: we can perceive unconstrained translatory motion of masses to be possible even in an absolute plenum, there being merely a transmutation movement. A constant aberration would follow as a natural result. If the thorough transmutation of molecules be less rapid than their general motions, their extra motive forces will be transferred to the ether until the periodic time of motion reaches that of transmutation, when the radiant energy is all dissipated by there being no more etherial resistance.

Such rapidity of transmutation is the only novelty of the present hypothesis. But this assumed rapid action of the constituted forces of matter finds its parallel in the transmutation of force itself; while the principle finds its analogy in physiological action, in which matter assimulated takes on the constituted quality of the matter emitted. This continuity of molecular transmutation implies neither growth nor decay, but simply continuous "manufacture": like molecules having identical properties everywhere, constituting them alike.

I assume the ether to be of equal density throughout, except where differences of pressure or tension are produced, when the density will vary equally by the tendency to maintain equilibrium of condition. But with this difference of density I also (as Professors Challis and Clerk-Maxwell have done) assume that the ether resists any break in its continuity, because:

1. No portion of the Universe can be isolated in its action, nor unaffected by the rest.

2. We avoid making the mathematical quantities of nothingness vastly greater than those of substance.

3. We are more consistent with thermodynamical principles; and

4. We do not contradict common sense in making the dynamic bond of the Universe consist in the isolation and repulsion of its every atom.

If we suppose the process of assimilation carried on with a greater rapidity than is possible for the ether to withdraw the emitted matter into its naturally equable distribution of density throughout free space, a state of stress in the medium towards every particle of dense matter will be necessitated. We need not inquire into the primeval condensation of ether into gross matter; but if it be conceded as a truth, it follows from our hypothesis that the absorption of ether will cause it to be strained towards the gross matter, and be drawn thereto with greater density to equilibrate the tension. The condition of stress will be precisely like that of our atmosphere, the tendency of the condensed ether to expand being balanced by the pull upon it for assimilation. This conception of the ether agrees with that of Newton. In his letter to Boyle, he says: "I suppose that there is diffused through all places an æthereal substance, capable of contraction and dilatation, strongly elastic: in a word, much like air in all respects, but far more subtile." The result then would be that the ether contains within itself as many spheres of stress as there are particles of matter: every atom being the center of such a sphere, which may be assumed to reach to any assignable distance, and coeval with the being of the atom.

The force of stress around gross matter is thus the balance between the activity of transmutation and the tendency to ethereal dilatation; and an increase of the one would correspond to a decrease in the other. If the ether, by offering increased resistance to transmutation, thereby lowered its activity, an equal and opposite resistance would be developed by the constant tendency of the body to give its transmutative energy free play. Should also, through any cause, the lines of dilatation be deflected perpendicularly to the lines of tension, the energy of transmutation will be lowered in the directions of the latter, the amount of which it is decreased becoming transformed into an equal and opposite reacting tensional force. Therefore, however great the amount of resistance to a body's natural assimilation of ether in order to maintain existence, or the number of directions whence such resistance comes, if the effect merely be to lengthen the period of time in which transmutation takes place, the amount of dense matter remaining constant, equal and opposite counterpulls to all will be developed. Now a body alone in space could be subject to no difference of stress, the self-caused etherial tension around it, being equable, making the lines of force straight outward from it in every direction; and the molecular energy of transmutation in the present condition of the ether would be at a maximum. But the presence of other bodies similarly conditioned would destroy the equilibrium of the ether on the sides toward each other, and its tendency to dilatation would act perpendicularly to the opposing stresses, being the directions of least resistance; and coalescence of the stresses would result, bringing the bodies at their centers together. The sides towards each other, being the sides whence resistance to transmutation comes diminishes therefrom its potential energy, which becomes changed into the actual energy of bodily motion. It will be seen that this theory of the action of gravity is similar in form to Faraday's conception of the action of dissimilar poles when face to face in magnetism, namely, by the coalescence of their lines of force, and which had previously existed in the space between them. For it is plain that, whatever faces of all bodies be turned toward each other, they will bear the character of opposite poles, the lines of steps being directed inward to each from every direction.

Transmutation energy and gravitation action would, according to this, be mutually convertible the former: being diminished by decreasing activity wherever there is a resultant attraction. The resistance to transmutation developed during the coming together of bodies is the equivalent of the motive force given out in yielding to the increasing tension; while the diminished resistance during any enforced withdrawal of them is the equivalent of the work done in overcoming their tendency to come together by the coalescence of their spheres of stress: or in other words, by diminishing such resistance, and increasing transmutation activity.

We can thus see how every particle of matter may be potentially infinite, without being substantially penetrable, and the molecular force of every mass impotent, as regards its own change of rest or motion in the aggregate, while potential in altering the conditions of rest or motion of all others. The fundamental correlation of matter and manifested force is also evident from the result that their dissipation would be mutual, as there could be no equilibrium of stress arrived at in the Universe until all the dense matter became again dissolved into the ether, without possible return into gross substance.

Although the force of tension exercised by different bodies is equal, the distance through which each sphere will be drawn during coalescence will be in the inverse ratio of the masses at their centers. For the potential energy of transmutation in bodies taken as wholes being directly as the masses, a portion of which becomes transformed into kinetic energy while yielding to their mutual tensions, the motive force will be according to the proportional diminution in each of such potential energy required to produce equality of pull. And a transmutation action stresses the ether from every direction; the potency of resistance to it, through the combining of mutual stresses, will be as the number or breadth of surface of the lines of force coalescing. The tensional power of coalescence will thus increase with the concentration of the spheres of stress, being potentially an element of the radial distance from every body. It is evident that particles free to move in any direction will tend to group themselves spherically during aggregation around the point which would be the center for all the spheres of stress were they to become blended into one, being the converging point for the equilibrating tendencies: while it will become the balancing point or center of momen's around which would revolve all those bodies whose deviating forces of motion are sufficient to overcome the tendency towards it.

If the efforts of the spheres of stress to coalesce be resisted by the motions of bodies under an opposing impulse, the lines of tension, by being inoperative, will be necessarily accompanied by equal pressures perpendicular to them along their whole length in the tendency to etherial equilibrium, and the tensional force will become constantly neutralized. In the case of any cosmical couple (the only kind of balanced motion in free space) the mutual tensions will be constantly equaled by the motive forces of the bodies acting perpendicularly to them: their joint masses or amounts of transmutation energy determining the measure of both. The volume of the sphere of stressed ether around which any determinate masses revolve is also, by its internal equilibrating action, a measure of the motive force exercised, or the time occupied in revolution squared. In other words: taking the major axes of any orbits as the diameters of naturally elastic spheres of stressed ether, the times of revolution squared by the bodies producing the stress, divided by the number of units of volume in the sphere around which they revolve, will give the amount of kinetic energy, which is a constant for the same masses throughout all space; or the square root of the number will give the time, which is Kepler's harmonic law, viewed as a physical reality.

To give the appearance of a physical reality to the fundamental law of the heavenly motions might thus be consistently formulated:

An infinite sphere of stress and proportional condensation of ether is produced around every body by rapid mutual transmutation of substance, and resistance to breach of continuity, which, while permeating, is constantly striving to coalesce with all others in the effort towards etherial equilibrium: thereby resisting all impressed tendencies of the central masses to recession by altering the direction of their paths, combining with them in coupled motions, or bringing them together with a force inversely as the squares of their distances: the coalescing energies and moments of cosmical couples being directly as the masses.

Philadelphia, Pa. WM. DENOVAN.

Zinc as a Preventive of Boiler Incrustation.

To the Editor of the Scientific American.

The articles on zinc as a remedy for boiler incrustation recall to my recollection an experiment of some magnitude in that direction, made half a dozen years ago by a party of which I was a member. Experiments on a smaller scale than that in question had proved that iron in contact with zinc was not only protected from corrosion during immersion in most fluids, but that any covering upon the iron would be removed by the action of one of these metals upon the other, or by their mutual action. This action was not confined in its operation to salts, oxides, resins, grease, and dirt of all sorts; but in some instances it loosened electro-plating. When the iron became perfectly clean, and the condition of the fluid used admitted of it, the latter when charged with oxide of zinc deposited the metal upon the iron by the well known galvanic process. The oxide of iron was removed with the same facility as any other substance; and this latter fact probably originated the prejudice against whatever thoroughly cleanses the boiler, such cleansing being supposed by some to cause leakage. Doubtless this mode of cleansing a boiler would take out iron rust even from the joints of the plates; but this should be taken as a needed premonition of danger, and the iron itself is absolutely protected from further oxidation in the presence of the zinc.

The experiment alluded to was within the boiler of an ocean steamer, plying between this port and Savannah. Zinc was introduced and suspended upon the tubes near the points of incrustation, and sundry necessary conditions were provided. At the termination of the trip, it was found that the zinc which was, wrongly, in sheets, had fallen down, having separated at the fold or bend over the tubes; it was eaten up at these points. The crust was about one third the usual thickness, showing, perhaps, that the trip was two thirds performed before incrustation began. The crust consisted of the usual salts accumulating in the use of sea water, and was deposited upon the zinc as well as on the boiler; but under the crust on the zinc, and between the two, was a uniform coating of black oxide of zinc in contact with and lying upon the latter. Clearly this oxide was placed there before incrustation took place; and my impression is that none would have been deposited if the metal sheets had been substantial enough to resist the wear and tear and the increasing weakness from oxidation. The remaining zinc and the crust, with the oxide between them, separated almost with a touch.

Although this experiment was in itself a failure, it was deemed conclusive of the fact as to the operation of zinc in preventing incrustation in boilers. R. H. ATWELL.

Baltimore, Md.

Weight in a Hollow Sphere.

To the Editor of the Scientific American:

I have been interested in reading the communications tha have recently appeared in the SCIENTIFIC AMERICAN int support of the hollow sphere theorem, notably those from Messrs. Pratt and Palin, page 181, current volume, each of which is an unanswerable demonstration of the truthfulness of the said theorem. The single point upon which I stumbled, as it clearly appears, was in assuming the force of gravity, as measured at the surfaces of spheres differing in size, to be directly as their respective masses. Upon this point the whole matter turns; and the proportions supposed to be hostile are at once harmonized. I was conscientious in my attack upon the theorem, doubting its truth; and it was my purpose to do so vigorously, and to use terms as to to the significance of which there could be no mistake, hoping to provoke a controversy that would result either in its complete vindication or overthrow. I now cheerfully acknowledge my error, and am as thoroughly convinced of the truth of this oddly appearing theorem as I am of the truth of the properties of the triangle.

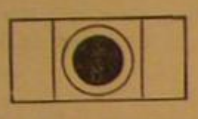
Rochester, N. Y. E. B. WHITMORE.

THE French meter is inaccurate to the extent of $\frac{1}{775}$ of its length. Is short that much. So said Professor Hilgard to the scientists the other day.

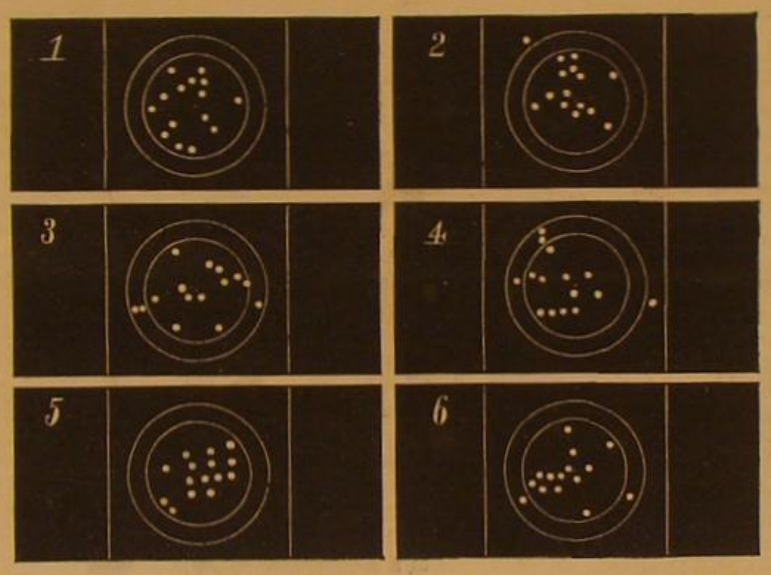
THE CENTENNIAL INTERNATIONAL RIFLE MATCH.

The international contest between the five best rifle teams in the world has resulted in a substantial victory for the American marksmen. The match was organized under the auspices of the Centennial Commission and held at Creedmoor near this city, and the American riflemen were brought in competition with picked teams representing the crack shots of Canada, Ireland, Scotland, and Australia. The contest lasted during two successive days, and on each day each marksman fired fifteen shots, respectively at targets located at distances of 800, 900, and 1,000 yards. The system of counting hitherto practised was employed, a bullseye marking 5, a center 4, an inner 3, and an outer 2, so that the highest amount possible to make by any fifteen shots was 75. At the end of the first day, the Scotch team led, the total scores footing up as follows: Scotch, 1,586; Irish, 1,582; Americans, 1,577; Australian, 1,545; and Canadian, 1,490. On the second day, however, the Americans worked steadily ahead, making a final score of 3,126 points, which left them 22 ahead of the Irish, who were second with a score of 3,104 points, and 64 over the Scotch, who netted 3,062 points in the two days shooting. The Australians finished with a score of 3,062, and the Canadians came last with a score of 2,923.

Some shooting was accomplished which, when the accidental difficulties to which the marksman is subject are considered, was simply marvelous. Two of the three distances shot over exceed half a mile. To obtain an idea how a target, having a bullseye 3 feet in diameter, looks to the rifleman when located so far away, pin this paper to the wall and regard the diagram herewith given from a distance of 20 feet. The black dot in the center then represents



the exact size of the bullseye 1,000 yards away. To hit a mere speck like this is certainly difficult enough; but there are numerous accidental disturbances which combine to vitiate the straightest aim. If the wind is blowing with the direction of the bullet, the latter is accelerated; and unless allowance is made, the shot flies over the target. If the wind blows in reverse direction, then the bullet is retarded, and is liable to fall short. In case of a side wind, the bullet is apt to deviate; while the grooving of the rifle gives the bullet a natural drift to the right. A "fishtail wind," which blows partly up or down the range and partly across, with varying strength as well, is extremely perplexing, and the sights on the rifles are readjusted for every shot. If the ground be damp and the sun hot, a shimmer of mist on the surface makes the target appear to dance; variations of light and shade apparently lift or depress the target center; heat and cold affect the metal of the gun. Then, besides, the bullets must be perfectly smooth and of uniform density, and the rifle perfectly clean. After all this, when the man has learned to hold his rifle true to the little bubble of the spirit gage which rests between the front and rear sights and across the barrel, and can hold it with a vice-like grasp, can repress for a moment all motion, and hold his head as steady as a rock and pull the 3 lbs. resistance of the trigger, and care not at all for the 200 lbs. kick which the rifle gives a shoulder probably already black and blue through previous blows, then, if he has not misjudged in any particular, he stands a chance of hitting the bullseye. Now imagine men overcoming all these difficulties and making such targets as these here reproduced. No. 1 shows 15 bullseyes in succession, the finest target ever made at 1,000 yards. It counts 75. This was done by Mr. J. K. Millner, of the Irish team. The second best target at the same range is given in No. 2. The count is 73, made by Dr. J. Mitchell, of the Scotch team.



The next two targets are the best at 900 yards. No. 3 was made by Mr. R. Rathbone, of the American team, and counts 72, and No. 4, by Mr. R. McVittie, of the Scotch team, scores 71.

The last two targets are the best at 800 yards. No. 5 is another very remarkable instance of 15 bullseyes in succession, made by Mr. E. Johnson, of the Irish team; and No. 6, by Mr. N. Thorburn, of the Scotch team, counts 73.

HEATING BY STEAM.

"The frequent occurrence, during the past few months, of fires in steam-heated buildings and dry kilns, and more particularly the burning last week of the dryer attached to the Mason Lumber Company's mill, at Muskegon, Mich., which I understand was of this type, must lead every one who has occasion to use steam heat, in any way, to inquire what causes them.

"It is certainly time that this subject should be more carefully and scientifically studied, and I think when the matter is better understood that all will be convinced that the trouble is not in the steam pipes or steam heating, but only in the imperfect construction of the heating apparatus. It matters not how the heat is produced, whether by steam, furnace, or hot water; all may be alike safe, or all dangerous, only dependent on how it is generated and applied. During the last decade I have examined hundreds of steam-heated dry rooms, and I am satisfied that, in a large majority of cases, either the supply pipe or a large part of the heating pipes have been supported by wood, and, in many cases, the former packed in sawdust and shut completely from the air. I have seen a pine timber six inches square and eighteen feet long (on which a 4-inch steam supply pipe has laid for months in daily use), when removed, so charred that I could and did split off pieces from one to two feet long with my hands, it breaking almost as readily as charcoal. Again, I have seen sawdust, that had been long packed around a steam pipe, so browned or scorched as to be almost black. I have also seen, in dwelling houses where tin conductors are used to carry the heat from a furnace, the pipe nailed to the wood, and upon examination have found the wood so charred around the nails that they could be removed with the fingers. The latter occurs most frequently directly below the register, and is the result of closing the valve, thus stopping the flow of air and confining the heat; while the fire in the furnace burns on as if the register was open. This explains why so many houses burn down where furnaces are used. But steam heat will accumulate as well as any other.

"Place a pipe on a wood support or closely pack it with any combustible material; and there being no circulation of air between the pipe and the wood, the heat is confined and accumulated, until at last, the conditions being just right, ignition is effected and all is gone. In other words the principle of accumulation applied to heat will make anything hot or burn any combustible substance up at last. In science I believe they call this law "the accession of forces"; it may be tested and illustrated by any one. Let any man who uses steam put his hand lightly on any heated pipe, and he may hold it there for several seconds without inconvenience. But let him grasp the same pipe with a firm grip, and, although the temperature of the pipe is not changed, he at once feels an increase of heat, and in a moment his hand will be blistered wherever it comes in contact with the iron. Now suppose we bind the hand there, and surround it with sawdust or any other non-conducting substance; how long would it take to literally roast that hand and cook all the flesh off the bones? Only a few hours at most. What then is the law? Simply that of holding the heat; and although received at only 212°, by keeping all we get and taking all that comes, it soon runs that up to 250°, 300°, or more. Now the hand might be held within one half inch of that pipe all day and no inconvenience felt, as the free circulation of air would prevent the temperature increasing. The law I understand to be the same, whether it is a hand, a piece of wood, or any other substance, that incloses the pipe. If we cut off the circulation of the air next to the pipe and surround it with a poor conductor like wood, the heat must accumulate, and doubtless often does, to the point of igniti of.

"When we lay our pipe on wood we convey the motion on the fire along the pipe by the steam, and it again passes into the wood under the pipe, where it accumulates and increases until the ignition point is reached and the wood takes fire."

The foregoing is from a letter from "H." to the *Northwestern Lumberman*; it is excellently written, and contains pertinent and interesting examples, but unfortunately it reaches a conclusion which is altogether baseless. The temperature of saturated steam depends on the pressure, and it cannot be augmented without augmenting the pressure likewise. In order, however, to check the too free radiation of heat and consequent diminution of pressure, we felt or jacket boilers, steam pipes, cylinders, etc. These roughly stated facts are part of the A B C of engineering; but the above writer seems to have forgotten them, and he commits the more grievous scientific error of confounding the mechanical energy resident in steam with the physical properties of that vapor. Some brief reasoning will show this, and may prove interesting. Professor Trowbridge, in his recent work on "Heat and Heat Engines," admirably defines a steam boiler as "the apparatus by which, through the process of combustion, a rapid degree of heat motion is developed in the fuel and gaseous products of combustion and transferred to the particles of water." These last, in a steam-heating apparatus, communicate their heat motion to the molecules of their pipes or other enclosing vessels, thence the heat motion passes to the air molecules, and lastly to the molecules of our bodies, and the sensation called warmth is experienced. Now if we interpose any substance which prevents or retards these waves of heat at any point of their transmission, we merely confine them or render their escape slower. We do not accumulate them. The case is analogous to that of a suspended weight; the energy is there constant so long as gravity acts; it is in potential form; cut the string and the weight falls, and in so doing does work. It will not be pretended that the weight will exercise any more potent effect by hanging two hours or two centuries. No additional power is stored up. Now the steam pipe unjacketed communicates heat motion, jacketed it does not. The jacket in this case is the same as the cord which suspends the weight in the other, for heat and mechanical energy are mutually convertible. Obviously then no more additional heat is stored in the first than force or energy in the second instance. Further, if by jacketing through accumulation we can augment heat, therefore we augment mechanical energy, therefore we obtain an accession of power through a purely mechanical device, and therefore we land in the principle of a perpetual motion.

The error lies, as we said before, in confusing the molecules of steam with their mode of motion. Shut steam up in an invariable space and apply heat continuously, and temperature and pressure will steadily increase until the last element of liquid vaporizes and then the steam goes on to assume the properties of a permanent gas. But it will not do to confound the steam jacket with the safety valve, and such the above writer seems to have done.

As regards the ignition of wood, etc., by steam pipes, the true theory is pretty well settled as follows: The temperature of saturated steam, such as circulates in heating pipes, even at the unusual pressure of 120 lbs., reaches but 341° Fah. The temperature of 900° is about that of the red heat necessary to set dry woodwork on fire, so that it must be clear that saturated steam can never directly excite a conflagration.

The molecular conditions under which the oxidation, resulting in spontaneous combustion in many substances, occurs originate at a very much less temperature than 341°; and it would appear that under certain circumstances the heat of steam pipes is sufficient to determine these conditions in certain woods. There is good ground for crediting the idea that two circumstances here play a prominent part. These are, first, that the wood or other fibrous material must be, by ptotracted heat and dryness, reduced to a punk-like state in which it is easily friable, and, second, that it becomes pulverized and so offers a very large surface to the effects of oxidation, which last are assisted by the high temperature of the contiguous pipes. Some woods are more liable to become in punk state than others; and if the foregoing probabilities, through that much needed thorough investigation into the whole subject which we have long hoped to see, be rendered certainties, then it will be one of the first duties of architects to avoid such woods in house construction.

The above, in our opinion, is the true philosophy of the phenomenon; but if the writer of the foregoing extract or any reader still feels inclined to adhere to his "accumulation" theory, it is only necessary to fasten a thermometer against a steam pipe, cover it well with felting, and observe, after a few hours or so, whether the mercury rises beyond the known temperature of the steam corresponding to the pressure.

Those Collided Locomotives.

In our issue of July 1 last, we published a large engraving of a railway collision, wherein the two locomotives, on meeting, had reared up in a most remarkable manner and remained sitting, as it were, on the ends of their respective fire boxes. We stated that our illustration was prepared from a photograph of the actual scene, but where the event took place we were unable to affirm, and therefore asked of our readers any information leading to the discovery of both railroad and locality. We received in reply a host of letters. Some writers detailed accidents which happened long ago, which they were sure were the foundation of the picture, while others doubted the veritability of the occurrence and even took us to task for being so easily imposed upon. Others again, not content with mere assertion, exercised much ingenuity in explaining to us in detail how the appearance of the various parts of the engines and appendages utterly negatived the idea of any such collision.

The upshot was that we determined to ferret the matter out, and we have done so. In the SCIENTIFIC AMERICAN SUPPLEMENT, of even date with the present number, will be found the whole story. We publish several of our doubting correspondents' letters, and also that of the person who prepared the original photograph. The collection is extremely amusing and interesting, the latter especially, inasmuch as the circumstances of the strange collision are fully explained.

Arrival of German Workmen.

Two delegations of French workmen have been over to visit the Centennial, and have returned to their native country. The steamer Mosel, lately arrived in this city, brought a delegation of German workmen, members of the Berlin Central Bureau for the Benefit of Workmen. The following are their names and trades:

Albert Anderleit, locksmith; Otto Bærwolff, draftsman; J. Berckenhagen, engineer; Eduard Breslauer, engineer; Carl Burchardt, engineer; Carl Cario, technicist; George Daunert, technicist; Richard Fleck, machinist; Richard Fleischer, engineer; Oscar Hadank, goldsmith; Joseph Hoffmann, tinsmith; Wilhelm Kraemer, technicist; Johannes Leman, of Polytechnic Academy of Berlin; Joseph Luedtke, printer; Robert Maerz, engineer; Louis Meissner, engraver; Otto Neumann, mechanician; Franz Pest, coppersmith; Otto Pilz, engineer; George Rodenwoldt, architect; H. A. Schneider, boot maker, etc.; O. Schneider, draftsman; Julius Schreiner, sculptor; Oswald Strasser, engineer; Carl Strietzel, technicist; Max Unger, of Polytechnic Academy, Berlin; J. Wichelmann, goldsmith; Carl Wirth, sculptor.

Free Trade with the Sandwich Islands.

By the terms of the new treaty made with the Hawaiian Islands, the following products may be imported duty free: Arrowroot, castor oil, bananas, nuts, vegetables, dried and undried, preserved and preserved; hides and skins undressed; rice, pulu, seeds, plants, shrubs, and trees; muscovado, brown, and all other unrefined sugar, meaning hereby the grades of sugar heretofore commonly imported from the Hawaiian Islands and now known in the markets of San Francisco and Portland as Sandwich Island sugar; sirups of sugar cane, melado, and molasses; tallow.

REMOVAL OF THE HELL GATE ROCKS.

The great obstruction impeding the ship travel between the Atlantic ocean and New York city *viâ* Long Island Sound is located at a promontory of Long Island, called Hallett's Point; it extends out into the East river, approaching Ward's Island, which occupies three fifths of the width of the river at that point, and some dangerous rocks are found in the immediate vicinity. The narrow channel thus formed has been a danger and a difficulty to navigators ever since this part of the country was first explored, and the rush of water taking place through the pass gave it the name of Whorl Gate, afterwards Hurl Gate, whence the name by which it is now known was easily derived

Our readers have been informed, from time to time, of the progress of the great work of excavation, which has now been completed; and the blast which will shortly take place will put an end to the difficulty in navigating this now dangerous pass, and end the years of labor that have been so perseveringly bestowed upon it. A very widespread interest has been centered on the operations; and the work is one of national importance, although this city is of course more interested in it than any other section of the country.

The first mention of preparations for commencing this work is found in the report by Lieutenants Davis and Porter, of the United States navy, made in the year 1848. This document gives a very accurate description of the course of the tidal currents, the dangers to navigation caused by rocks, obstructions, etc.; and it recommends that Pot Rock, the Frying Pan, and Way's Reef be blasted and scattered. The two former are single rocks of a pointed shape; the latter is long and has the character of a ledge. The report also recommends that the middle channel be improved by blasting so as to make a clear channel of sufficient depth for common vessels and steamboats; and it also speaks of the increased facilities for naval defence which this improvement would afford. The difficulty of blockading the port of New York, with her two outlets instead of one, would be at least doubled. Lieutenant Porter did not exactly agree with Lieutenant Davis as to the best plan for improving the channel. They both recommended the removal of the small rocks—Frying Pan and Pot Rock—from the middle of the channel, and Porter included a part of the reef at Hallett's Point, the shell of which is now so nearly ready to be blown into atoms, its interior having been removed and deposited far away on dry land. But the art of blasting under water was almost unknown at that time, and engineers agree that even the little improvement recommended by them could not have been effected without the inventions and discoveries which have since been made. The process adopted in those times for submarine blasting was to take down cans of powder, place them against the side or top of the rock, and explode them by means of a galvanic battery. This did well enough for rough and jagged rocks and boulders; but so soon as the surface had been leveled off, it was of little or no use to attempt to continue the operation.

Fig. 2.—SECTION VIEW OF A TRANSVERSE AVENUE, HELL GATE.

In 1852, Congress having made an appropriation of $20,000 for the removal of rocks at Hell Gate, Major Fraser, of the Engineers, began operations according to the Maillefert process above described. The sum of $18,000 was expended on Pot Rock, and the depth of water was increased from 18·3 feet to 20·6 feet.

This is all that had been accomplished up to 1868, when the duty of an examination of Hell Gate was committed to General Newton, of the United States Engineers, who made his report in January, 1867. For operating on the rocks in the middle of the channel a steam drilling cupola scow was constructed. It had a well hole in it 32 feet in diameter, through which 21 drills were worked, while the scow lay on the surface of the water directly over the rock to be operated on. This formidable machine was first used in the spring of 1869, on Diamond Reef. A large number of holes were drilled into this rock, varying from 7 to 13 feet in depth, 4½ feet in diameter at the top and 3½ at the bottom, and the rock was broken up by charges of nitro-glycerin of from 30 to 35 lbs. Coenties Reef was operated on in 1871. Ninety-three holes were drilled and charged with nitro-glycerin, and seventeen surface blasts were made. In 1873, three hundred and seven holes more were drilled and thirty-nine surface blasts were made. The amount of nitro-glycerin consumed was 17,127 lbs., and the reef was thoroughly broken up. The *débris* had been partly removed, when, in 1875, Congress, owing to a mere clerical blunder, failed to include Diamond Reef in the appropriation, and work at that place had to be suspended. In 1872 the drilling scow was towed to Frying Pan Rock. Seventeen holes were drilled and eleven surface blasts made.

COMMENCING THE WORK.

Operations for removing the reef at Hallett's Point were begun in August, 1869. A coffer dam was built of heavy timber, securely fastened to the rocks by bolts passing through the framework. This structure is shown in our engraving, Fig. 1.

The coffer dam was pumped out about the middle of October, and operations on the interior for sinking the shaft

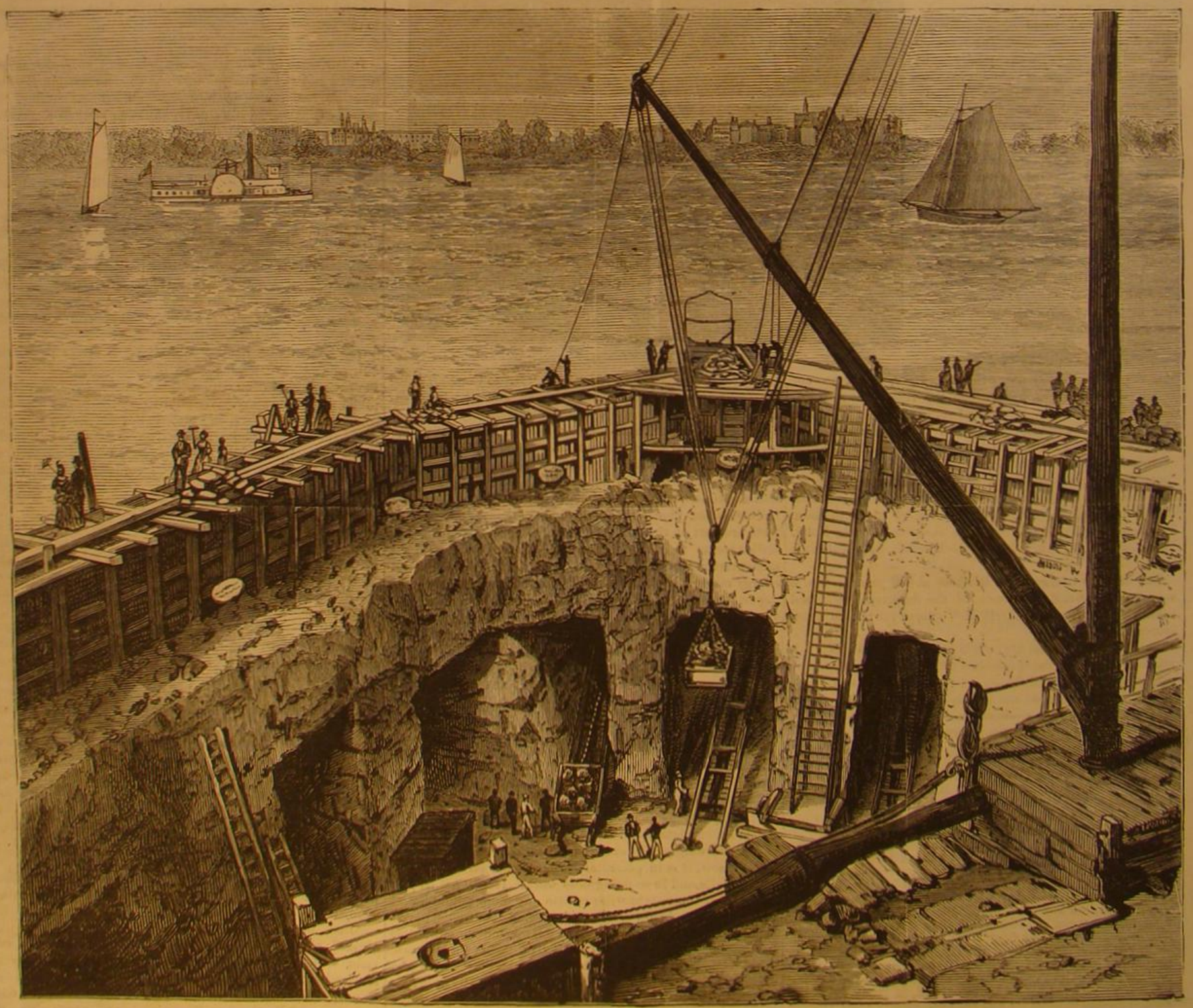


Fig. 1.—COFFER DAM, MAIN SHAFT, AND ENTRANCE TO HEADINGS, HELL GATE, EAST RIVER.

were begun early in November, and continued till the middle of June, 1870, when work was suspended on account of the funds appropriated for this part of the work being exhausted. At that time 484 cubic yards of rock had been taken out, at a cost of $5.75 per yard. In the latter part of July, operations were resumed, and during that fiscal year the shaft was sunk to the required depth of 33 feet below mean low water, and the heads of the ten tunnels opened to distances varying from 51 to 126 feet. Two of the cross galleries had also been opened. The amount of rock excavated from this place that year was 8,306 cubic yards, and the drilling was all done by hand. During the next year the use of steam drills partially succeeded hand drilling, and the work was pushed more rapidly. The number of feet of tunnel driven during the year was 1,653, and of transverse galleries 653·75. The quantity of rock removed was 8,293 cubic yards.

A sectional view of one of the cross galleries or avenues is given in our engraving Fig. 2; and a ground plan of the work, Fig. 3, gives an excellent idea of the extent of the excavation, which is now complete. A longitudinal section of one tunnel, called by General Newton "Grant heading," is given in Fig. 4.

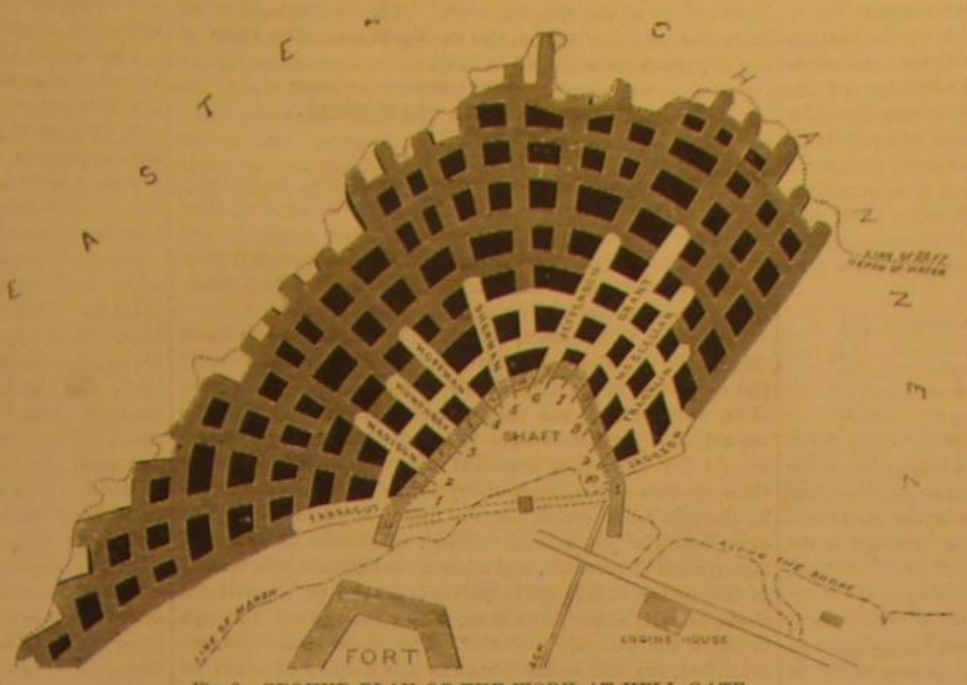


Fig. 3.—GROUND PLAN OF THE WORK AT HELL GATE.

An exceedingly well executed model of the works is now on exhibition in the United States Government Building at the Centennial Exposition at Philadelphia. It is made exactly to scale, and well represents the nature and extent of the vast operations that have now been successfully completed. The rock bed of the river is, in the model, raised from the pillars that support it, so that a close inspection of the interior may be made. There are 172 of these pillars, pierced with about 4,000 drill holes; and the shell, or roof, or bed of the river varies from 6 to 16 feet in thickness. No less than 30,000 cubic yards of broken stone will be left under water, all of which will have to be removed by dredging. The model referred to is accurately represented in our Fig. 5, and Fig. 6 shows a birdseye view of Hallett's Point, with the large coffer dam inclosing the entrance to the submarine works.

THE RIVER SURVEY.

A detailed survey of the upper surface of the reef was made in 1871 by Mr. William Preass, assisted by Mr. F. Sylvester. They took more than 16,000 soundings, each separately located, by means of instruments, from the shore. Great pains were taken to delineate exactly the surface of the rocks. The appropriation of 1871 was $225,000, just one half the amount asked for by General Newton, who regretted that the beginning of operations on the Gridiron was thus prevented, as he considered this rock more dangerous to the navigation of large vessels than the Hallett's Point reef. For the next year he asked $600,000, but got less than half that sum. About the middle of November, 1873, work was suspended for want of funds, but at the end of the fiscal year, June 30, 1874, it was found that, for the four months and a half during which operations had been carried on, 896 linear feet of tunnels had been opened, and 4,648 cubic yards of rock removed. The total length of tunnels and galleries then amounted to 6,780·67 feet. The excavation now being nearly finished, the manner of finally blowing up the whole mine began to exercise the minds of the engineers.

EFFECTING THE BLAST.

General Newton finally suggested his own plan for blowing up the reef at Hallett's Point, which was to perforate each pier with drill holes entirely or partly through its mass, a sufficient number of those being provided to complete the destruction of the pier when fully charged. The charges in the different holes of the same pier were to be connected together, and a fuse, composed of a quick explosive, would connect the system of charges in each pier with those of the neighboring piers. By this mode the communication of heat or the electric spark to a few centers of explosion would suffice to propagate it through the whole system, because the explosion of the connecting fuse would advance more rapidly than the demolition of the rock. General Newton's plan is the one that has been adopted, although a few slight changes, principally suggested by himself, have been made. Instead of depending on explosives to convey the fire from pier to pier throughout the mine, an electric spark will be sent directly to every center, insuring the simultaneously explosion of the whole mine, unless some unexpected difficulty shall intervene to prevent it. General Newton decided that the minimum amount of explosives could be determined by placing one charge in each square pier and two in each oblong pier, but this mode would make the lines of least resistance the maximum, and thus increase the shock, which would be propagated through the reef to the dwellings upon the land. It was therefore determined to decrease the lines of least resistance, which will multiply the number of blasts and increase the quantity of explosives, but will, at the same time, reduce to a minimum the vibrating influence through the reef. It is hence calculated that the exterior effect, except an agitation of the water, will be small.

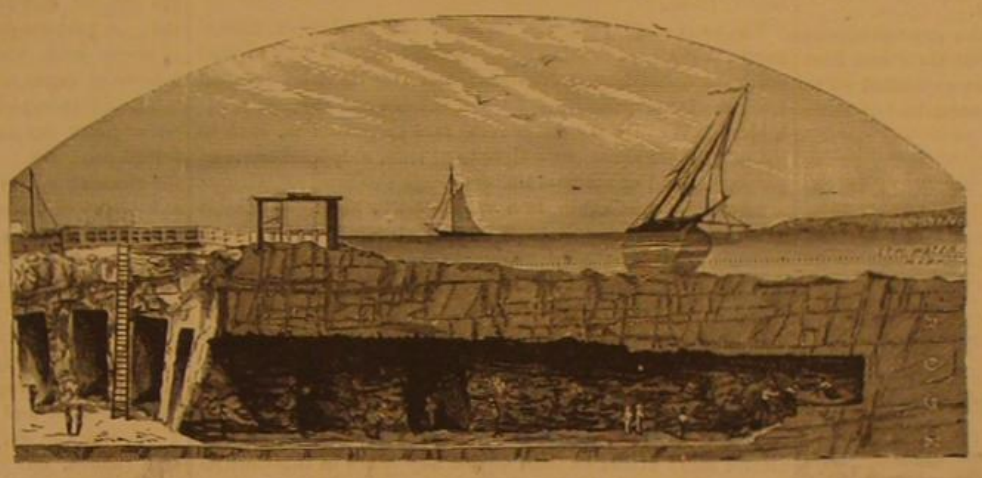


Fig. 4.—LONGITUDINAL SECTION OF GRANT HEADING.

THE FORM OF THE REEF.

Hallett's Point Reef is in the shape of an irregular semi-ellipse, the major axis, which lies next to the shore, being 770 feet in length, and the minor axis, projecting straight into the channel, about 300 feet. The cubic contents, above the depth of twenty-six feet at mean low water, amount to 51,000 yards. Besides the risk of striking the reef, it produces eddies on both sides of it according to the direction of the tidal currents, and is much in the way of vessels coming down in the ebb in the effort to hug the shore and thus avoid being drawn upon the Middle Reef.

THE EXPLOSIVES.

The explosives used in tunneling at Hallett's Point have been nitro-glycerin and its compounds, and gunpowder, the latter being used only when the rock was weak and seamy. Nitro-glycerin was always used for driving the headings of the tunnels. To drive a heading, the drill holes are made at an angle with the face, so that the charge lifts out the rock by its explosion. A cavity being made in the middle of the heading, holes are drilled around it and the surrounding rock blown into it. Only one blast is exploded at a time, as great care has to be taken not to shake the structure overhead by too heavy vibrations. There is consequently no volley firing, and the galvanic battery is not used for discharging the blasts.

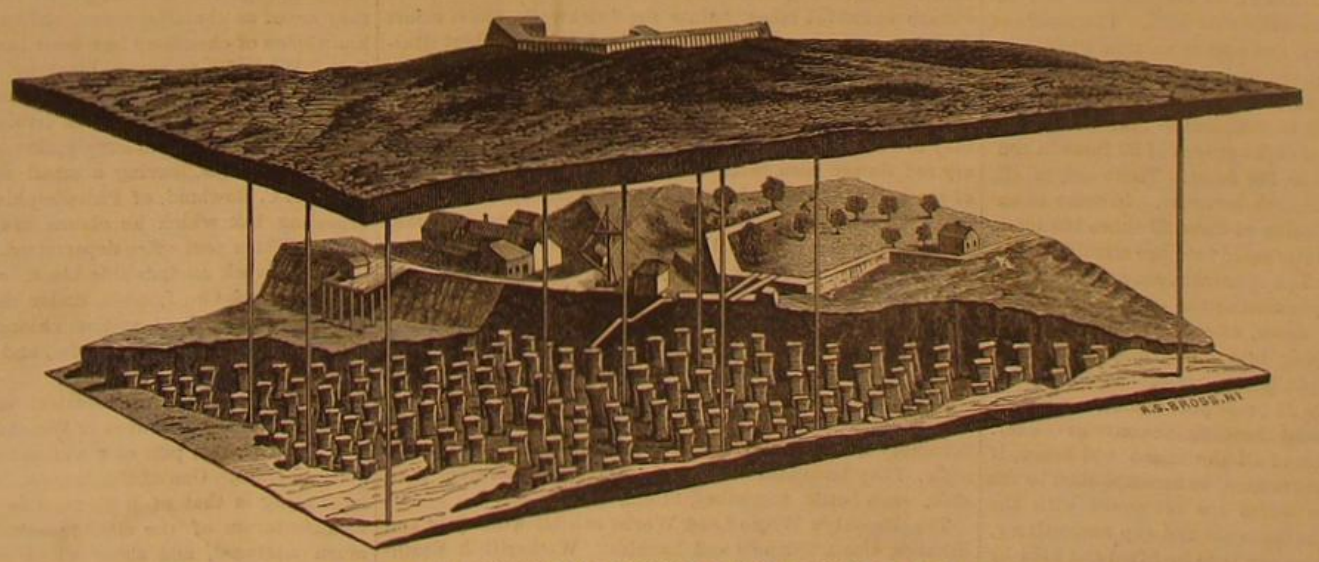


Fig. 5.—THE CENTENNIAL MODEL OF THE HELL GATE WORK.

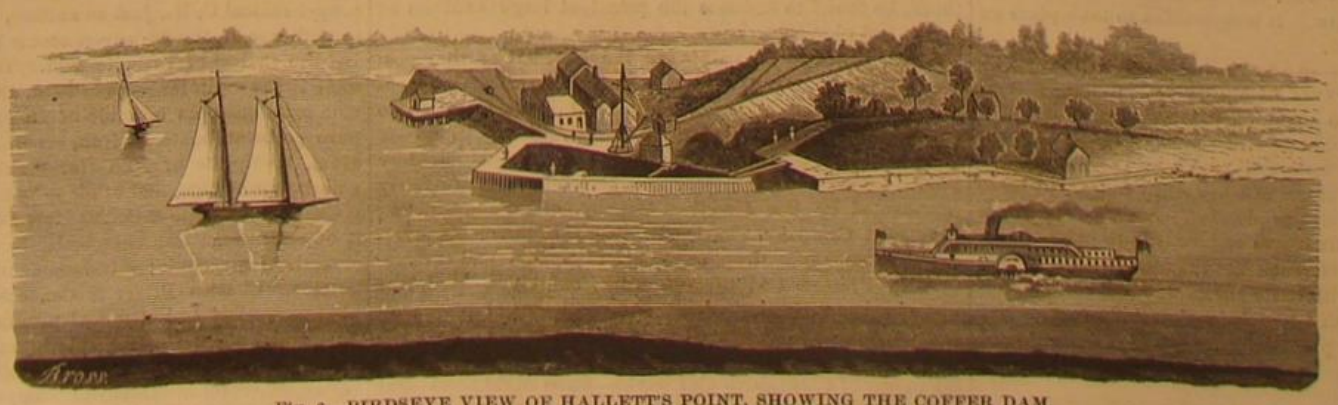


Fig. 6.—BIRDSEYE VIEW OF HALLETT'S POINT, SHOWING THE COFFER DAM.

THE DRILLING.

The average of twelve months' work with six Burleigh drills was the excavation of 235 lineal feet of heading per month. Up to June, 1872, the work had been prosecuted by hand drilling, with the exception of 20,160 lineal feet of drilling by the Burleigh drill, and 7,000 feet by the diamond drill. That by the Burleigh drills was done by contract at so much a foot; and the diamond drill, purchased for the purpose of exploring the rock ahead, was put in competition with it. The cost of drilling, after a long trial with the Burleigh drill, is found to be between 36 and 37 cents per foot, including repairs, etc. The cost of hammer drilling was found to be about 95 cents per foot. The number of feet of holes, drilled by each machine per shift of eight hours, was 30 feet. The diamond drill, owing to the encounter of frequent

veins of pure quartz in the rock, often gives out and has to be repaired. Owing to the restricted area of the tunnels and galleries, the work of excavation was almost exclusively that denominated heading, without the advantage of enlargement. The rock, after being blasted, was lifted by hand into a box resting on a truck car, which was run down to the place upon a rail track, and thence drawn by a mule to the shaft, where the box was hoisted by a derrick and its contents emptied into the dump cars, to be rolled away and deposited in the pile. Calling the cost of blasting and removing one cubic yard $1.00, the following gives the proportion of each item of expenditure:

Blasting	0.46
Transporting rock to shaft	0.17
Hoisting	0.0128
Dumping	0.0203
Pumping	0.1087
Incidental	0.2132
	$1.00

The work of excavation having been finished, the drills were set to work perforating the roof and piers with holes to receive the final charges which are to explode the mine. These holes were made from two to three inches in diameter, and from six to ten feet apart, and their average depth was about nine feet. The size of the holes and their direction and distances apart were made to vary according to the character of the rock to be broken. The drilling of these holes up into the roof of the mine soon increased the leakage of water into the works from 300 gallons per minute to 500, it being impossible to avoid tapping a seam occasionally. Many of the holes that were found to be leaking were plugged up temporarily, and the leakage thus reduced. The outside gallery and the No. 4 heading were deepened so as to concentrate all the leakage, and cause it to flow to the shaft end of that heading, where the pumps were placed.

THE COST OF THE WORK.

The following shows the amount of the appropriations made by Congress each year for the Hell Gate and East River improvement, and the whole amount expended up to the date of the last report of General Newton to the chief engineer:

1868	$85,000	1873	$225,000
1869	140,000	1874	250,000
1870	250,000	1875	250,000
1871	225,000		
1872	225,000	Total	$1,690,000

Amount expended, $1,434,129.99.

Since this report was made, Congress has appropriated $250,000.

Total amount of appropriations to date	$1,940,000.00
Total amount expended to August 1, 1876	1,686,841.45
Estimated cost of completing the entire work of improving Hell Gate and the East River	5,139,120.00

Care has been taken to test the various kinds of explosives. Up to the middle of 1874, nitro-glycerin had been principally used for blasting purposes. Several hundred lbs. of mica powder were then tried, some giant powder, several thousand lbs. of rendrock, and later considerable vulcan powder was used. All of these are nitro-glycerin compounds. Neither of them was found to be as powerful as the glycerin itself; but it was repeatedly demonstrated that, with 10 ozs. of rendrock or vulcan powder, they could break as much rock as they formerly did with 8 ozs. of nitro-glycerin, while the cost per lb. was less than one half that of the glycerin.

THE FINAL EXPLOSION.

The blast is to be effected by 96 batteries of 10 cells each, which are to be placed in a bombproof structure. The cells are charged with the fluid known as electropoion and bichromate of potash in dilute sulphuric acid. The zinc and carbon plates are 4x6 inches, and oppose an area when lowered into the fluid of 40 square inches each. The cells are connected for intensity, about 42 of them forming one battery, the intensity of which is sufficient to ignite simultaneously one set, consisting of eight groups of 20 fuses in continuous circuit, equivalent to 160 fuses. There are, in all, 23 sets to be exploded by 23 such batteries. In order to ensure the simultaneous explosion of these 23 times 160 fuses, a novel apparatus will be interposed into the circuit of each of these independent sets. The apparatus consists of a gravity circuit closer, a brass pin closing the open circuit when the batteries are lowered down, after the charging of the mines is finished, by dropping into a cup filled with mercury, both brass cup and pin being part of the circuit. It is understood that there are 23 brass pins and as many mercury cups in the instrument forming the circuit closer. The simultaneous explosion of all the mines will hence, if no accident changes the programme, be accomplished in the following way: After the wires are connected with the poles of the battery, and the brass pin and cup respectively, the plate containing the brass pin is to be lifted and held by a cord containing the fuse, the destruction of which, by a separate battery, will cause the closing of the circuit by the contact of the brass pins with the mercury in the cups, and the explosion must follow. It is appointed to take place on Thursday, September 21.

Discovery at Pompeii.

A discovery has been made at Pompeii, consisting of a number of objects of gold and silver, and close to them the carbonized skeletons of two men, who would seem to have been borne down in the storm of ashes while endeavouring to escape with their valuables or plunder. Among the articles found are eight rings, six pieces of money, two pairs of earrings, two large armlets, each ornamented with thirteen pairs of half globes, with little shells upon them, held together by chainwork, and a necklace of chainwork, all of gold; a silver ring, 332 pieces of silver money, a *casserole* of the same material broken in pieces, and three large bronze coins.

The city of Pompeii, it will be remembered, was completely buried up in the year 79, nearly 1,800 years ago, by ashes from the neighboring volcano of Vesuvius. The ruins of the city were rediscovered in 1748.

CHEMICALS AT THE CENTENNIAL.

THE AMERICAN EXHIBIT.

Not only does America occupy a great deal more space with her chemicals, as with nearly every thing else, than any other country, but the display is more gorgeous and imposing. Large and handsome, we shall see whether it possesses as much intrnisic value and excites as much deep scientific interest as that of Germany, directly opposite.

Powers & Weightman, of Philadelphia, make the finest display of all the manufacturing chemists. In a little palace erected in a conspicuous spot on the transept or cross aisle, they exhibit the costly medicinal alkaloids by the bushel, and poisonous ones in quantities sufficient to destroy a city. The most beautiful things, however, that they show are two large dishes of crystallized nitrate of ammonia, the salt from which nitrous oxide is prepared. Then come beautiful crystals of caffeine, of nitrate of silver, of tartaric and citric acids, and other more common substances. In the center of this little palace is a cake of crystallized alum, as tall, almost, as a man, with openings cut through to show the beautiful interior. But these exhibitors, we shall find, are not so far ahead in the display of alum as they are in some of the *more* costly but less showy specimens, like lithium salts, tannate and ferrocyanide of quinine, bromide and iodide of iron, monobromide of camphor, nitrite of amyl, nitrate of cerium, codeia, prussic acid, and opium and its alkaloids, with numerous salts of each. The display reflects great credit on the enterprising firm which sent it there.

The next display on the right of this is that of Rosengarten & Sons, of Philadelphia, second only in size to that before described, and like that deriving its chief interest from the large quantities of the alkaloids and their salts exhibited. We also noticed several rare preparations, such as iodide of manganese, subsulphate of iron, sulpocarbonate of potassium and of ammonium, etc.

Adjoining this, again, is a very prettily arranged exhibit of oils in numerous tall bottles on an elevated stand. They embrace natural, mineral, vegetable, and animal oils for commercial, chemical, and medicinal purposes, and are exhibited by F. S. Pease, of Buffa'o, N. Y. Next follows a good display of camphor, by William F. Simes & Son, of Philadelphia, and near this again an exhibit of paints by Charles Moser & Co., of Cincinnati, O. And here we may note, in passing, that, from the very nature of the exhibit, paints and colors, if tasefully arranged, present a pleasing sight and attract more attention than almost any other in this department. This is particularly true of the exhibit of C. T. Raynolds & Co., of this city, well known from their customary display at the American Institute.

Directly opposite to Raynolds & Co.'s is the no less attractive display of Harrison Brothers & Co., of Philadelphia. In the center rises a tall pyramid surrounded by bright mineral colors. In a case near it is a pile of wood on which are arranged the products derived from the wood by dry distillation: pyroligneous acid, wood spirits, methyl alcohol, acetic acid, white, gray, and brown sugar of lead, charcoal, etc. Then come some bones, with a group of the necessary chemicals for converting them into home-made fertilizers. There too are beautiful lakes, paints for brickwork, moist colors for paper staining, and lastly white lead, with the best illustration that we have seen of the process of manufacture known as the "Dutch method." First we have the ore, galena; then the metallic lead cut into grates, or buckles, as they are technically called; then the pots, resembling ordinary red flower pots, with the grates in them; then a bed of tan bark, in which the pots are set while the conversion takes place; and finally pots as they come from the tan, filled with white lead, still preserving the shape of the original grates, and adhering loosely to the undecomposed lead within.

Another first class display of paints and varnishes is made by John Lucas & Co., of Philadelphia, Pa. It embraces, among other things, zinc ores, spelter, white lead pots, and buckles, sugar of lead, gums, kauri, dammar, copal, shellac, etc. They exhibit some bright green paints comparing very favorably with Paris green, but claimed to be free from arsenic. They have also fitted up a miniature laboratory with sink, wash bottle, test tubes, filters, funnels, etc.

The Brooklyn White Lead Works exhibit white lead and litharge, also a few pots and buckles. Wetherill & Brothers, of Philadelphia, exhibit red and white lead, litharge, and the like. Jemett & Son make the usual exhibit of white lead, as do also some others; but the above will, we think, be found to embrace the principal large exhibits of paints and pigments.

Nearly allied to the paints are the oils; but as they possess little or no novelty, we must pass them with mere mention. Gest and Atkinson, Cincinnati, O., draw attention to their exhibit of lard, tallow, and oils, by a large boar mounted above their case. Cotton seed oil is exhibited by Boyl & Lewis, Philadelphia. The petroleum oils are fairly represented by the Aladdin Company, of Pittsburgh, Pa., Elaine Oil Company, Charles Pratt & Co., Devoe Manufacturing Company, Oleophena Oil Company, and others. Charles Pratt & Co., of New York, exhibit a model of their works at Hunter's Point, and specimens of petroleum and its various products. The model, which is on a scale of ½ inch to a foot, is very interesting, as showing not only the extent of these particular works—some eight acres—but as giving a faint idea of capital invested and machinery, buildings, and apparatus required to make the Astral oil and other illuminating and lubricating oils.

The Elaine Oil Company exhibit, under the name of petrozcene, a greenish, odorless, solid substance with crystalline fracture somewhat like paraffin This, they state, is a new product of petroleum, and exactly what it is we are unable at present writing to say. In another place the same company have a working model of an oil well with a pump run by clockwork, and this conveys a good idea of this most important branch of American industry.

One of the best displays of alum is the alum cave exhibited by the Philadelphia Salt Manufacturing Company, Philadelphia. This immense cake of alum is said to weigh nine tuns. In the same case is a large mass of cryolite, a fluoride of aluminum and sodium, chiefly imported from Greenland, this company having a monopoly of all the cryolite brought from there. They exhibit models of the Esquimaux fishing boats, and of the cabins built of blocks of ice and moss, the ice being represented in the model by blocks of wood. This company also exhibits alumina, alum lyes, chloride of calcium, and soda.

Directly opposite we see another beautiful alum cave, with its stalactites of crystals, and on either side tall monuments of concentrated alum and sulphate of alumina, while round about are large and fine crystals of nitrate of lead and other salts. These constitute the exhibit of the Tacony Chemical Works, Philadelphia.

If alum seems omnipresent in the chemical section, what shall we say of acetic acid and its salts that greet us at every turn? We have referred to it several times already in connection with other exhibits. Browning & Brothers, Philadelphia, exhibit pyroligneous acid and a series of acetates, as also dye wood and naphtha. H. J. Baker & Brothers exhibit this acid along with camphor, saltpeter, and borax. A prettier display is that of O. S. Follett, New York, of acetic acid, vinegar, chloroform, and fine large crystal masses of sugar of lead.

The Philadelphia Quartz Company make a good show of water glass, dry and in solution of various strengths, for different purposes. Its use in cleaning the cotton waste used for rubbing off machinery was forcibly illustrated by the exhibition of quantities of the waste before and after treatment with water glass

The only exhibit of cream of tartar and argols that we saw was by the well known importers Dreyfuss & Co., New York. H. Bower, Philadelphia, exhibited the largest, if not the only, mass of crystallized ferrocyanide of potassium, also small specimens of sulphate of ammonia and the fatty acids. Savage, Keyser, & Stovell, of Philadelphia, exhibit tin salts and the mineral acids. H. D. Gray, of New York, was the only exhibitor of sulphur, which he imports and refines, our own immense sulphur deposits not yet being worked, although magnificent specimens of pure native American sulphur are to be seen in the United States Government building. When we shall be independent of Italy for our supply of sulphur is only a question of time and transportation.

Nickel salts, batteries, and specimens of nickel plating on iron, brass, and tin are exhibited here by Condit; but the display of nickel and cobalt with the ores and salts, by J. Wharton, in the metallurgical section farther north, is still more interesting.

There is no end of stale and uninteresting specialties distributed through this section, purely for advertising purposes; they are of no chemical value, although in some few cases a knowledge of chemistry has been invoked in their preparation. We refer to soaps, blacking, varnishes, perfumery, baking powders, mucilage, and printing and writing inks. The ink competition seems as lively as any, although one manufacturer claims to supply nine tenths or more of all the banks and offices, leaving a small field for other makers. Dr. J. S. C. Rowland, of Philadelphia, exhibits an indelible canceling ink which he claims has been adopted by the United States post office department. We omitted to mention last week an indelible black ink exhibited by Blackwood, John, & Co., London, under the name of jetoline. It consists of chloride of aniline, chlorate of potash, and chloride of the rare metal vanadium, and is in fact a kind of aniline black.

To return to the pharmaceutical and rarer chemicals, like those exhibited by Powers & Weightman and Rosengarten, we find in another part of the chemical section several very good displays. One of the largest, best mounted, and most interesting is that of Billings, Clapp, & Co., Boston, the manufacturers of the cinchoquinine which has been so much analyzed, and about which so many contradictory statements have been circulated. This firm exhibits two gallons of propylamine, $C_3 H_7$, HHN, one of those organic ammonias in which an atom of hydrogen is replaced by the propyl radical $C_3 H_7$, just as aniline, C_6H_5, HHN, is ammonia with one of the hydrogen atoms replaced by phenyl, $C_6 H_5$, the radical of carbolic acid. The chloride of propylamine is shown in large quantities, as are also the more common salts such as bromide of ammonium, citrate of iron pure protocarbonate of iron, bromide of potassium and sodium, bisulphite of soda (for making the hydrosulphite) valerianate of zinc, and other salts used in medicine.

Charles T. White & Co., of New York, make a good exhibit of pharmaceutical chemicals, including some very fine crystals of strychnin, valerianate of quinine, and other alkaloids. Charles Pfizer & Co., also of this city, exhibit pharmaceutical and chemical products in large and showy quantities, including refined borax and camphor. Kurlbaum & Co., of Philadelphia, exhibit camphor, cream of tartar, chloroform, mercurial compounds, and the essential oils. The finest specimen of crystallized monobromated

camphor is that exhibited by Hance Brothers & White, of Philadelphia. The rest of their exhibit, extracts and pills, belongs rather to pharmacy than chemistry. The latter statement may apply in part to the exhibit of Keasbey & Mattison, of Philadelphia: but some of their preparations, such as pancreatine, pepsine, crab orchard salts, Vichy salt, and compounds of lithia and bismuth, all on a grand scale, attract our notice.

The exhibit of Alexander Fries & Brothers, of New York, of artificial fruit and liquor essences, is particularly interesting as showing how far the chemist in his laboratory is able to imitate the natural productions of the plant. The number is very large, most of them being compound ethers derived from methylic alcohol or fusel oil, and imitate not only the flavor, but the composition, of the natural essences. The same exhibit contains a large specimen of carbamide, $CO(NH_2)_2$, a white crystaline solid, which has the honor of having been the first organic substance produced synthetically, a thing previously supposed to be impossible.

The United States Salicylic Acid Works, New York, exhibits the only specimen of American salicylic acid. The acid is both sublimed and crystallized, and compares favorably with the foreign specimens made under the immediate supervision of Professor Kolbe.

Aniline colors are exhibited by two firms only, and in such insignificant quantities as scarcely to deserve notice. The Silliman Chemical Works, of Philadelphia, exhibit six flasks holding about a quart each of as many different colored solutions of aniline dyes. The same company exhibit several other coal tar products, including the tar itself, dead oil, coke, benzol, toluol, xylol, rosolic acid, rosolate of lime, anthracene, and naphthaline: also a set of pure chemicals, designated in the catalogue as Fresenius' tests.

A much finer exhibit of coal tar products is made by Page, Kidder, & Fletcher, of this city. Besides the tar itself, they exhibit seventy five different derivatives thereof, among which we noticed the latest product of the synthetical chemist, artificial oil of spirea or salicylic aldehyde. Professor Kolbe's discovery of a new and certain method of preparing salicylic acid cheaply from carbolic acid has caused chemists to direct attention to its ethers and other derivatives, the result being the production of artificial oil of wintergreen (also exhibited here), or salicylate of methyl, the substance which was previously the source of salicylic acid having come at length to be a product of the latter. In addition to these two new and curious synthetical products obtained from salicylic acid, we noticed the following rare and interesting scientific preparations: Benzylic aldehyde (oil of bitter almonds), pyrene ($C_{16}H_{10}$).stilbene ($C_{14}H_{12}$), chloranile, pyramic acid, pyridine (C_5A_5N), picoline (C_6H_7N), a substance isomeric with aniline yet of totally different properties, crude and refined anthracene, anthraquinone, alizarine, leucaniline, etc. A few aniline colors in small tubes are shown. One portion of this exhibit, and indeed the larger part, is devoted to creosote and its use in the preservation of timber. A model of the creosoting apparatus is shown; and numerous specimens, of wood decayed or bored by insects and wood protected by creosote, prove its efficiency.

J. Bishop exhibits a large variety of costly platinum utensils for chemical use.

E. B. Benjamin, of New York, exhibits a few chemicals, with some fine chemical glassware, in the educational department, and also in the United States government building. In his exhibit in the Main Building may be seen two of those new scientific puzzles called radiometers, which are usually in motion on a clear day, a fact not equally true of the dozen or more exhibited in the English department, by Mr. Hicks, of London.

In the exhibit of the Stevens Institute of Technology, Hoboken, may be seen a large dish of beautifully crystallized nitrate of uranium, and a full set of the other uranium salts used by President Henry Morton and Dr. H. C. Bolton, in their recent researches on the fluorescent spectra of these bodies.

There are several exhibits of gunpowder, but none of nitroglycerin, although there are plenty of the harmless materials from which it is made.

A few chemicals are met with scattered about in most unexpected places, especially in the United States government building, but the above embrace the most interesting exhibits in the Main Building.

CENTENNIAL NOTES.

A THREE HUNDRED DOLLAR HAT.

There are two exhibits in the Peruvian section which attract an unusual share of attention. The first is the hideous collection of mummies and fragmentary portions of the bodies of ancient Peruvians; and the second is what appears to be an ordinary Panama hat, until the sight of the price label, inscribed $300, induces one to examine it more carefully. Close scrutiny elicits the fact that the article is woven with wonderful fineness; and by the aid of a lens, 108 stitches, or picks, as weavers would call them, may be counted to the inch, measured radially from the center. The hat is exhibited by Juan Daste, of Monte Christo, Peru. The material is *jipijape*, a species of palm, the leaves of which are gathered before they unfold. After the veins and other coarse portions are removed, the leaves are made into bundles and macerated in boiling, and then in cold, water until they become white. Bleaching in the shade follows and then the hats are plaited from the straw by the Indian natives of the country. For so fine a fabric as the hat exhibited at the Centennial, the above process would be too rough The only wetting the straw receives is done by the dew, to the influence of which it is exposed. Then the braiding is done in a dark damp room; and to produce a single hat, a woman often works from five to six hours daily for three or four months. When the article is finished it will wear indefinitely, provided there be no defective straws in it. Probably the $300 hat exhibited in Philadelphia would outlast the lifetime of its purchaser, and serve as an heirloom to his descendants for years afterward.

FLEXIBLE SHAFTING.

Imagine a workman handling the nozzle of a short section of hose. In place of the nozzle, substitute an auger; and then conceive the astonishing appearance of the man directing the auger toward a block above his head, then to the floor, then sidewise in every direction, twisting the hose meanwhile into all sorts of kinks and curls, while the tool, wherever it touches, sinks into the solid material as if the latter were putty. Yet the hose does not rotate. Certainly the invention is a remarkably ingenious one, and it is as simple as it is effective. A long section of wire is made into a close spiral. Over this is wound more wire, the turns being, however, in reverse direction; then follows a third spiral envelope, and so on until suitable thickness is attained. The extremities of the flexible shaft thus formed are brazed. One end is feathered into a driving pulley; the other has a clutch for the tool. A piece of hose or other suitable covering envelopes the shaft, which transmits rotary motion to any desired distance from the source of power and through any number of curves, so that the power may be taken to the work instead of the work to the power. We were told that the device has been successfully applied to marble, granite, and other stone surfacing, polishing, and working; iron drilling and surfacing; wood boring, carving, and facing; horse cleaning and clipping; casting, cleaning, and emery grinding of all kinds. It has been tested, we learn, up to the transmission of 9 horse power.

A NEW STEERING APPARATUS.

This is exhibited in the Russian section in Machinery Hall, and is the invention of M. Nozikoff. The helm being located directly above the propeller shaft, motion is communicated from the latter by a bevel gear to a vertical shaft, which rises immediately abaft the wheel. By turning the latter in one or the other direction, one of two clutches is thrown into action, the effect of which is to communicate the motion of the vertical shaft to an ordinary hand wheel which moves the rudder in the usual way. The essential feature of the device is the mechanism whereby the power of the main engines is utilized to manœuvre the helm, thus obviating the use of the additional small engine commonly employed in steam steering gear for a like purpose.

A PAINTING MACHINE.

Everyone who has had to paint slats or laths, or like narrow work, knows that doing so is a tedious and not over easy operation. Plenty of paint is wasted in using a big brush, and to employ a small one is to throw away time. Mr. W. Roberts, of Liverpool, exhibits, in the English section of Machinery Hall, a very ingenious little apparatus which performs this work very rapidly and in a much better manner than it could be done by hand. The paint is poured into a lower tray. Above are located, first, a pair of rollers, which seize the slat and draw it in between a series of brushes, one of which paints the upper side, another the lower side, while two more cover the edges. To keep these brushes wet with paint, two wheels beside the grasping rollers rotate partially in the paint in the tray beneath. These are so grooved as to carry up the liquid at every revolution and dash it on the brushes. The machine, we learn, will paint 6,000 running feet of lath per hour, without the aid of steam power.

SWEDISH GYMNASTIC APPARATUS.

We can express no opinion as to the therapeutic value of the Swedish movement cure, other perhaps than to consider that the exercise which it provides for the muscles may be beneficial. We can express an opinion, however, on the machines employed in the various gymnastic exercises, a dozen or more of which are exhibited in Machinery Hall. Some of these are splendidly constructed; and as pieces of mechanism involving ingenious devices for obtaining odd motions, they are well worthy of study by mechanics. Some idea of what these motions are may be gained from the following brief description of the apparatus: One machine, when its handles are grasped by the patient, twists the arms, another exercises the flexor and extensor muscles of the wrist, a third pulls the arms back, a fourth exercises the knee muscles, a fifth exercises the muscles which carry the leg outward, and a sixth exercises the ankle muscles. On the seventh the patient lies down and is shaken up so that the extensor muscles of the back are exercised. Another machine is very complicated, and calculated to excite some dismay in the patient whose "thorax" (to quote the descriptive card) "is pulled upward by means of two levers, while a pad makes a horizontal pressure on the back. The trunk is thereby elongated a few inches, and the spine and walls of the chest are stretched." There is something about all this dismally suggestive of the rack. In another machine the patient is put through all the misery of horseback riding without any of the accompanying pleasures. He is seated on a saddle, and the latter then becomes possessed of a desire to shake him off. "This," we are informed, "causes the abdominal viscera to be kneaded and rubbed together against each other and the abdominal walls." There is still another machine, consisting of a couple of wheels having peripheries of padded bars. These, when revolved, serve to warm the feet, the latter being pressed against them. Lastly there is a hammering machine, which in any household might serve as a mechanical child corrector. There are a number of vertical beaters which are set in rapid vibration, so as to hammer the patient in the small of the back or at any desired point. The reader can form his own idea of the possible condition of the sufferer after being treated by so formidable a series of apparatus.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED TUBING CHAIN WRENCH.

Orlando H. Smith, Kane City, Pa.—The object of this invention is the construction of a device whereby a section of the perpendicular tubing, such as that of oil wells, may be turned more or less on its axis, without danger of being cut, dented, bruised, or otherwise injured. The invention consists in joining together, by a reversible dog, a chain and hook; the latter, which is for the purpose of maintaining the hold of the chain on the pipe, has its point formed into an inwardly projecting claw, and is provided near the middle of its concavity with a slightly projecting blunt point. These projections form two of the bearing points against the tube over which the hook rests; the third is formed by the edge of the dog. To the free end of the chain is secured a ring, into which a lever is inserted when the device is to be used.

IMPROVED GRAIN CAR UNLOADER.

George M. Moulton, Chicago, Ill., assignor to himself and Joseph T. Moulton.—This apparatus is for unloading grain in bulk from railroad cars; and it consists in the employment of two sets of racks, so arranged that the first rack is operated by a crank placed on a shaft which receives its power from a convenient motor, the said rack giving motion to a pinion placed on a shaft which supports a larger wheel, that communicates a reciprocating motion to a longer rack supported on suitable frame work, and connected with drag ropes attached to scoops within the cars. The invention also consists in the peculiar arrangement of the supports for the guiding pulleys in the car. A hopper leads to the elevator leg, and is placed conveniently near the track, so that the grain may be readily discharged from the scoop into it. Two scoops are worked in each car, and a number of cars may be unloaded at the same time, and from both sides of the apparatus, by providing a number of sets of drag ropes.

IMPROVED BREECH-LOADING FIRE ARM.

Henry J. Altman, Birmingham, Great Britain.—This invention consists in a breech block, arranged to slide in grooves in the solid slides of the breech piece at right angles with the bore of the barrel, as it is carried up and down by the breech block holder. The arrangement of the lock lever is such that an accidental blow that might discharge the gun only pushes the lower end of the lock lever back and locks the trigger. Another advantage claimed is that, when the trigger is locked and the fore finger is placed upon it to discharge the arm, the said finger comes in contact with the lock lever, and can push it forward to unlock the trigger without being removed from the position required for firing the arm.

IMPROVED WATER WHEEL.

William H. Rector and Henry C. Black, Santa Rosa, Cal.—This invention consists of a reaction wheel of the S-shaped type, receiving water from the under side, and having a water tank or chamber on the shaft, subject to downward pressure of water to counterbalance the upward pressure on the under side. The chamber is packed watertight to prevent leakage.

IMPROVED NUT LOCK.

Thomas C. Conrad, Philadelphia, Pa.—This invention is an improved nut lock for rail joints, and other parts exposed to vibratory motion, the nut locks being so arranged and connected that the tendency of any one nut to work off tightens the other nuts, and that the expansion and contraction of the bolts, and change of position in the ends of rails by the difference in temperature, exert no influence upon the lock. It consists of a washer with recess for the nut to fit in slots in the circumference, and a circumferential recess at the back, along which a stiff locking wire is passed that is bent outwardly through the top slot, and then downwardly to the next washer, and around the same to the top slot, and so on.

IMPROVED NAIL-FEEDING MACHINE.

Frank Toepfer, Milwaukee, Wis.—This invention consists of a descending trough, in which the nails hang by the heads, points downward, arranged so as to drop the nails horizontally into a hopper in advance of the sliding driver. The driver is to be worked by a foot treadle, and, in practice, a number of drivers, each having an automatic feeder, will be connected to a cross head or slide of suitable form to work as many drivers as there are nails to be driven into one side of the box to be nailed, and the drivers will be adjustably connected for shifting toward and from each other, according as the nails are to be driven more or less distant from each other.

IMPROVED STEAM BOILER.

Robert M. Beck, Westminster, Md.—This invention is an improvement in the class of vertical steam boilers, and consists in a dome, flue head, and smoke box formed of one casting, and certain peculiarities of shape, whereby certain functional and economic advantages are attained. The invention also relates to a tapered cast iron fire box.

IMPROVED CAR COUPLINGS.

Richard A. Kelly, Manchester, Iowa.—The first of these inventions is an improvement in the class of automatic car couplings, and consists in a hook and draw bar pivoted at their rear ends to a swiveled cross bar, and suspended free at their front ends from a sway bar or lever which is pivoted to the end of the car, so that it may be tilted to adjust the hooks and draw bars, for coupling or uncoupling. The invention also includes a peculiar device for adjusting the said sway bar. The second invention belongs to the same class of automatic car couplings as the above, and it relates to certain peculiarities in the coupling whereby ease in working and reliability and safety in its operation are obtained.

IMPROVED WATER WHEEL.

Reuben D. Sayre, Westville, Ohio.—This invention consists of the buckets of an overshot or breast wheel, pivoted to the wheel rims so as to remain upright and hold the water until the center is reached at the bottom, when they are tilted by a cam to empty the water, by which the wheel retains all the water as long as it can do any good, and the weight can be applied farther from the center of the wheel by pivoting the buckets at the periphery of the wheel rims. The buckets are pivoted to the wheel rims at or near the periphery so as to remain upright and hold all the water as long as it is efficient, when they are tilted by a crank and cam and the water emptied, after which they return to the upright position again while ascending to the place for receiving the water, the cam being continued up to the top to prevent the buckets from tilting too far to come back again to the upright position. In front of each bucket is a cross bar, to prevent it from being overturned by the water falling into it from the spout. In practice the cam for tilting the buckets will be constructed so as to revolve to lessen the friction as much as possible.

IMPROVED COMBINED PRESSER FOOT AND THREAD CUTTER FOR SEWING MACHINES.

John M. Stamp, Washington, D. C.—The various forms of thread cutters heretofore applied to the presser feet of sewing machines have proved objectionable, for various reasons, chief among which are a too complicated and expensive construction, and such a location or arrangement as renders them inconvenient in use. The object of this invention is to provide a presser foot with a thread cutter, which shall be so constructed as to obviate these and certain other objections; and to this end a vertical cutter is attached to or formed on the left hand side of the presser foot, near the toe or front end thereof. The device is cheap, simple, and conveniently located.

IMPROVED AIR MOTOR.

Benjamin F. McKinley, New Richmond, Ohio.—This invention relates to a novel construction of an engine to which has been applied the name of "thermainator," the same being designed to utilize the alternate pressure and partial vacuum produced by the alternate heating and cooling of the same body of air. It consists mainly in the combination with a working piston moving in a cylinder, of a cylinder made entirely of woven wire, without a shell or case, operating consecutively with the working piston, and located in a chamber communicating with the cylinder of the working piston and between the working piston and the surface through which the heat is applied.

IMPROVED BALE TIE.

Willis Wilkinson, Charleston, S. C.—This invention is formed of a wire having a hook formed upon one end, to receive and support the other end when the band is under strain.

NEW AGRICULTURAL INVENTIONS.

IMPROVED FEEDER FOR THRASHING MACHINES.

Jesse W. Dozier, Nashville, Tenn.—This invention relates to an improvement in feeders for threshing machines by which the quantity of grain supplied to the cylinder is automatically regulated.

IMPROVED SEED PLANTER.

Peter Kranz, Arago, Neb.—This seed planter is so constructed that it may be adjusted to operate as a self-dropper or as a hand dropper, and may be adjusted to drop the hills at different distances apart, and to drop any desired amount in a hill. The frame of the rear part or carriage rides upon the axle, on which the wheels revolve, and their rims are made wide, and are concaved to adapt them for covering the seed. To the inner sides of the wheels are attached pawls, which engage with the teeth of the ratchet wheels attached to the axle, so that the wheels may be made to carry the axle with them when desired. The forward ends of the side bars of the frame are connected with the rear cross bar of the frame of the forward part of the machine by clevises and eyebolts or other suitable hinges. To the rear corners of the forward frame are attached the seed hoppers, to the bottoms of which are attached ring plates upon which a dropping wheel rests and rotates, and in the rear part of which is formed a slot for the passage of seed from the dropping wheel to the conductor spout. Through the center of the dropping wheel is formed a hole to receive the upper end of the spindle, which passes down through, and is swiveled to, the bottoms of the hoppers. When the machine is adjusted as a self-dropper, the dropping wheel must be keyed, or otherwise rigidly secured, to said spindle; but when adjusted as a hand planter, the said dropping wheel may be allowed to revolve loosely upon the said spindle.

IMPROVED COTTON CLEANER.

Amos J. Lee, Lineburg, Ala.—This apparatus consists of a kind of long trough or case, with a bottom of longitudinal slats or grates, and sides of vertical or inclined grates or slates, in which trough is a shaft having paddles arranged obliquely and in spiral rows around the shaft for beating the cotton out, and at the same time feeding it along from the end in which it is supplied to the end for discharging it, the same being a very efficient contrivance, which does not clog or twist the material; but the paddles generate a considerable amount of wind, which drives out all dust and dirt through the openings between the slats.

IMPROVED MANURE WAGON.

Jason W. Town, South Woodbury, Vt.—This wagon has its bottom formed of parallel bars arranged sufficiently closely together to prevent escape of the manure while being transported to the field, and yet at such distance apart as will allow the discharge of the manure when the bars are rotated. In using the wagon, it is loaded and drawn to the place where the manure is to be spread. A lever is then operated to throw wheels into gear, so that, as the wagon is drawn forward, rollers may be revolved to pulverize the manure and work it out through the bottom of the wagon, spreading it evenly over the surface of the ground.

IMPROVED PORTABLE FENCE.

Strander Crum, Macon, Mo.—This invention relates to certain improvements in portable wooden fences; and it consists in jointed A-shaped frames combined with bars arranged upon the outside of one of the inclined sides of the frames, so as to alternate with each other, together with a binder which is arranged parallel with one of the stakes of the frames, and upon the outside of the bars so as to hold them in place, which binder is fastened below by a pin driven in the ground, and above by a pin driven into the stake.

IMPROVED METHOD OF ATTACHING HARROW TEETH.

Christoph Schottler, Greenville, Wis.—This invention consists in fitting the tooth, which is long, tapering, and with a square transverse section, into a similarly shaped vertical groove on the side of the harrow beam. The tooth passes above and below through holes in the ends of a semicircular metallic strap, which is keyed on the side of the beam opposite the tooth by a key of the shape of half a frustrum of a cone.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED SKATE.

John A. Dodge, Amherst, Nova Scotia.—This invention is a skate so constructed that it may be easily and quickly attached to, and detached from, the boot of the skater, and when attached will be securely held.

IMPROVED COMPOSITION PASTE FOR FLY PAPER.

John Ralston, Greenville, Pa.—This improved sticky fly paper paste is put up in boxes, so that it can be spread upon paper by the user, will always be fresh, and, it is claimed, much less expensive than the ordinarily prepared paper. The invention consists in a paste, formed of flaxseed oil (but various other oils may be used), Venice turpentine, and rosin.

IMPROVED FRUIT DRYER.

Andrew M. Mortimer, Salt Lake City, Utah Ter.—This is an improved apparatus for drying fruit in the sun, so constructed that the fruit may be easily covered and protected in stormy weather. The dryer may be conveniently adjusted into such positions as will best expose the fruit to the sun's rays.

IMPROVED HARNESS PAD.

Hibbard R. Ridgley, George A. Nelson, and William H. Bushnell, Haysville, Ohio.—The rim which forms a part of the pad has an offset, provided with imitation stitches, giving it the appearance of having been stitched together.

IMPROVED HARNESS SADDLE.

P. S. Carroll, Louisville, Ky.—This invention consists in making each side of the back strap of two parts, the upper one of which is fastened to the saddle tree and flap, and to an inner stay or spring by the terret screw, which is secured inside by a nut. The two parts of the back strap, on each side, are joined by a metallic fastener provided with rivets on its under surface, and a ring on its lower end: the former securing it to the upper part of the back strap, saddle flap, and inner stay or spring, the latter for the attachment of the lower part of the back strap.

PACKING CASE FOR CRACKERS AND CONFECTIONERY.

Joseph Garneau, Sr., St. Louis, Mo.—This invention consists of a main case and a sample case, the latter being provided with a transparent side, of glass or other improved material, and being detachably connected to one side of the main case by an extension thereof at the bottom and the cover, the sample case corresponding in length and breadth with the side of the case.

IMPROVED REED ORGAN TREMOLO.

Henry L. Pierce, Easton, Pa., assignor to himself and Samuel Trumbore, of same place.—The first part of this invention consists in an arrangement of a propelling wheel having curved blades, and a governor consisting of a piston attached to a valve in such a way that the pressure of air acting on the piston controls the jet of air which propels the wheel. The second part consists in a cut-off of peculiar construction, which is rotated by the propelling wheel. The vacuum in the organ bellows is more or less perfect, according as more or fewer exertion is made on the pedals or blowing lever, or as more or fewer of the keys are opened. Under these circumstances the piston acts as a governor, maintaining a uniform rate of speed. When the tremolo attachment is in use, the entire current of air which goes into the bellows may be allowed to pass through it, or by an arrangement of stops the tremolo may be made to affect certain portions of the reeds. The cut-off breaks the current of air twice at every revolution. The advantages claimed are that the governor maintains a uniform rate of speed whether the air passes into the bellows with greater or less force. The curved veins in the propelling wheel insure a positive and uniform action. The cut-off, by stopping the ingoing current of air at small intervals, produces the tremulous effect which is so necessary to the complete rendering of certain kinds of music.

IMPROVED HEATER FOR CARS, ETC.

Milton W. Hazelton, Chicago, Ill., assignor to himself and Anson W. Eggleston, of same place.—This heater consists of two cases of metal or other suitable substance, placed one within the other, so as to form a space between them, except at the top, which is filled with asbestos or other non-conducting material, and is charged with hot balls or other form of metal, for heating the car or other room by radiating the heat contained in the said objects; and in the top of the heater is a register, and in the bottom an opening for allowing the air to flow in to be heated and be discharged at the top, by which the heat may be given off more or less rapidly, according to the volume of air allowed to pass, which can be regulated at will by the register. The register may be in the inlet passage, if preferred. The heater is designed mainly for cars and carriages; but it may also be used for heating rooms, temporarily, in hotels. The hot balls will be supplied to the cars at the stations, and may be introduced through a door in the top or side, as preferred. For street cars the heater will preferably stand on the floor like a stove; but for railway cars it may be let down from the floor, and the balls may be put in at one side or end under the floor of the car.

IMPROVED ICE CREAM FREEZER.

David J. Rogers, Bardstown, Ky.—This invention has reference to that class of ice cream freezers which consist of a can pivoted upon a step in the bottom of the tub or pail, and are adapted to be rotated to effect the freezing without any internal stirrer. The present improvements consist in the particular construction and arrangement of a rim attached to the tub, which holds the can in an upright position, and also in the construction and arrangement of the handle.

IMPROVED PEANUT ROASTER.

Jean Esposito, New York city.—This peanut roaster is provided with a hot water chamber, arranged vertically in the case above the draft passage, and between the roaster and storage chamber. The peanuts are transferred, after being roasted, directly to the storage chamber, to be sold in warm and nice state, without keeping them too long in the roasting drum, to become dry.

IMPROVED CAMP KETTLE.

Antoine Alexis Gervais, Paris, France, assignor to A. Gervais & Co., of same place.—This invention is designed, says the inventor, to remedy the defects of camp kettles in present use, which in fair weather require about three hours, at least, for making soup, and this only by a considerable expenditure of fuel, while in rough weather the fire is liable to be extinguished. By the improvement a considerable saving in fuel is insured, and much less time is occupied in cooking, whatever may be the state of the weather. A number of these kettles may be combined so as to have two, three, or more draft chimneys with a single tunnel running beneath the whole series of kettles, which are placed over a trench made in the ground.

IMPROVED BILLIARD CHALK AND BALL HOLDER.

Rafael Martinez, New York city.—This cue-chalking attachment for billiard tables consists of a little case for holding the chalk, combined with a billiard ball holder, the case having one end contrived to open and close for putting in and adjusting the chalk, and having one or more holes through the side for inserting the cue tips against the chalk. A stud or key prevents the chalk from turning while the case is closed. The case is attached to the table at any place, so that the player can at any time chalk his cue tip without taking the chalk in hand, also without scattering it on the floor.

IMPROVED POCKET KNIFE.

Amos W. Coates, Alliance, Ohio.—This invention relates to an improvement in pocket knives of the kind ordinarily used by boys; and it consists, as a new article of manufacture, in a pocket knife having a blade extended beyond the handle and formed with a knob of metal upon the end thereof to prevent accidental injury resulting from the careless or thoughtless use of the knife.

IMPROVED MANUFACTURE OF LIME AND CEMENT.

Uriah Cummings, Buffalo, N. Y.—This invention relates to the manufacture of lime and cement, so that neither too high nor too low a temperature may be employed, and consists in blowing with a force pump air and hydrocarbon into the furnace simultaneously, so as to bring them in contact with the stone when at a red heat and subsequently, thus producing a perfect combustion, a great economy of fuel, and a more uniform as well as a better article.

IMPROVED SADDLE.

John T. Gathright, Louisville, Ky.—This invention consists essentially in providing the tree of a gentleman's saddle with attachments for horns and a supplementary seat, the former fitting over the pommel of the same, and being strengthened by the necessary re-enforcements. These attachments may be so constructed as to be used with gentlemen's saddles of any shape and style

IMPROVED CORSET.

Catharine A. Griswold, New York city.—The object of this invention is to so improve the corset for which letters patent have been granted to the same inventor, under date of July 4, 1871, No. 116,585, that the same may be made available for imparting better carriage to the upper part of the body, and prevent, by strengthening the back and bracing the shoulders, the inclination to stoop and contract the chest.

NEW HOUSEHOLD INVENTIONS.

IMPROVED MOP HOLDER.

John W. Cubbage and John Alexander, Gallipolis, Ohio.—In this device the handle has a wire secured to it and bent twice at right angles, with arms that pass through holes in the ends of a plate or clamp bar. The arms of wire or clamp rod are bent inward as well as upward, and their ends are attached to a socket. Through the latter passes the end of the handle, the socket being secured thereto by a hand screw. The cloth is placed between the middle part of the clamp rod or frame and the clamp bar, the handle being then inserted in the socket or sliding head, and its end pressed down against the clamp bar. This clamps the cloth very securely between the bar and rod, while, the clamp screw being then tightened, the parts of the mop head are locked together.

IMPROVED CLOTHES DRYER.

Orlando B. Lee, Greenville, Conn.—This invention consists in the peculiar devices which are used in holding the sides of the frame together, the object being to furnish in a clothes dryer such connections for the top or sides of the parts of the dryer as will permit them to be readily attached and detached.

IMPROVED WRITING DESK.

Jerome M. Keys and Homer J. Taylor, Tecumseh, Neb.—This invention is a writing desk for business purposes, having greater capacity for the space occupied, and being more convenient for use than the desks as ordinarily made. It consists of a case of hexagonal form, or any equivalent form will do, with a writing table in each alternate side, which slides out and in, and has pigeon holes and other repositories on the back part to be brought forward for convenience when the table is pulled out for use, the said tables being closed in with circular covers. Above the case is a tower of similar form containing two or more revolving book racks, one above another, for convenience in taking down and putting away the books

IMPROVED EVAPORATOR FOR REGISTERS.

W. R. Fowler, Baltimore, Md.—This invention consists in moistening hot air as it passes into an apartment from a furnace or stove by causing it to pass through strips of absorbent material more or less saturated with water. The absorbents are endless pieces of fabric, held by opposite rolls and dipping into the water being spaced by ring grooves in the top roll. The invention is equally adapted to any form or location of register, by means of an attachment, open at bottom so as to enclose with a lid the ordinary floor register, and provided with a rear opening to correspond with that of the evaporator.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED SLED.

James L. Brannock and James A. Cleveland, Antioch Mills, Ky., said Cleveland assignor to said Brannock.—This invention is an improved runner for sleds and sleighs, which saves a great deal of the time and trouble necessary to put in the ordinary sole or runner. It consists of a separate curved front part that is connected to the main body of the runner in rigid manner.

IMPROVED EXTENSION STEP LADDER.

Wilhelm H. Bitter, Fort Howard, Wis.—In this invention, the several parts of a step ladder are made of such form that, while it may be used as a step ladder in the ordinary way, it may also be unfolded and extended, and used as an ordinary ladder. It is composed of three sections, two of which are capable of extension by sliding one upon the other, and a third section, which is hinged to one of the sliding sections, which is capable of unfolding, the whole being provided with hooks for uniting two or more ladders.

IMPROVED MACHINE FOR SAWING LATHS.

John W. Calkins, Avoca, N. Y.—This invention consists of a mandrel carrying a number of saws, separated the required distance by washers, and a frame for supporting the same, with a friction roller, placed in the table, over which the saws run. The advantages claimed for a board grooved or formed into a series of connected laths are that it may be more rapidly applied to the walls and ceiling of a building, that it produces a more solid wall and ceiling, and that it does away with sheathing.

IMPROVED PLASTERING TOOL.

Asa A. Howe, Ulysses, Pa.—This invention consists of a kind of box with open top and hinged bottoms, and also guides on two sides, the said bottom being two smooth steel plates, which overlap each other at the uniting edges, and are raised toward the upper side of the box to make a cavity in the lower side, which is filled with mortar to spread on the wall by sliding the tool along the wall, and at the same time pressing the bottom by a handle attached to one of the parts, so as to force the mortar on to the wall, and spread it smoothly as the tool moves along. The handle is adjustable along the brackets, according to the leverage it is desirable to employ in pressing the plaster on the wall.

IMPROVED SHAVINGS SEPARATOR.

Elijah Brown, New York city, assignor to himself, Eben Peek, and Gilbert J. Bogart, of same place.—This invention is for separating the finer from the coarser shavings made in planing mills and other woodworking machines. It consists of a screen hung in an inclined position upon two sets of swinging arms, and provided with a divider or frame carrying a number of cross wires a short distance above the screen. The screen is arranged to take motion from a crank driven by any convenient power, and the divider is arranged to move with the screen, but through a greater space, constantly shifting its position in relation to the screen.

IMPROVED STENCH TRAP.

John Peter Schmitz, San Francisco, Cal.—This is an improved construction of stench trap, designed more particularly for wash basins and sinks, but applicable also to general use. It consists mainly in combining with the ordinary water trap a subjacent flap trap, or weighted valve, which remains closed until its weight is overbalanced by the greater weight of water, when it opens automatically and allows the water to escape: by means of which arrangement the bubbling up of sewer gas through the water trap is prevented by relieving the water trap from the pressure of the same.

Notes & Queries

It has been our custom for thirty years past to devote a considerable space to the answering of questions by correspondents; so useful have these labors proved that the SCIENTIFIC AMERICAN office has become the factotum, or headquarters to which everybody sends, who wants special information upon any particular subject. So large is the number of our correspondents, so wide the range of their inquiries, so desirous are we to meet their wants and supply correct information, that we are obliged to employ the constant assistance of a considerable staff of experienced writers, who have the requisite knowledge or access to the latest and best sources of information. For example, questions relating to steam engines, boilers, boats, locomotives, railways, etc., are considered and answered by a professional engineer of distinguished ability and extensive practical experience. Enquiries relating to electricity are answered by one of the most able and prominent practical electricians in this country. Astronomical queries by a practical astronomer. Chemical enquiries by one of our most eminent and experienced professors of chemistry; and so on through all the various departments. In this way we are enabled to answer the thousands of questions and furnish the large mass of information which these correspondence columns present. The large number of questions sent—they pour in upon us from all parts of the world—renders it impossible for us to publish all. The editor selects from the mass those that he thinks most likely to be of general interest to the readers of the SCIENTIFIC AMERICAN. These, with the replies, are printed; the remainder go into the waste basket. Many of the rejected questions are of a primitive or personal nature, which should be answered by mail; in fact hundreds of correspondents desire a special reply by post, but very few of them are thoughtful enough to enclose so much as a postage stamp. We could in many cases send a brief reply by mail if the writer were to enclose a small fee, a dollar or more, according to the nature or importance of the case. When we cannot furnish the information, the money is promptly returned to the sender.

B. F. R. will find a recipe for marine glue on p. 43, vol. 32.—C. S. will find a description of bisulphide of carbon on pp. 306, 368, vol. 28.—W. R. will find directions for making gas from coal oil on p. 65, vol. 32.—R. W. can make sulphate of indigo by the process described on p. 250, vol. 34.—J. K., B. L., H. T., W. H. N., T. W., J. M., M. B., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) T. C. D. asks: Is not the velocity of a rifle ball greatest at the moment when it leaves the muzzle? A. Yes.

(2) C. G. B. says: In setting valves on a locomotive I differ from a master mechanic. In squaring valves, I heretofore observed (after finding the dead centers on the wheels in the usual way, and adjusting the eccentric rods with the reverse lever thrown clear forward or back, and on those points giving the proper lead) that, by hooking the lever up say to 12 inches, at times the valves do not show square at that point, and the rods may have to be changed. I still work from my center on the wheels. The master mechanic says that, on some engines, valves cannot be squared in that way. He does not use the center on the wheels at all, when the lever is hooked at 12 inches, but measures 12 inches on the guides, and there squares the valves. Working my way, the valves showed $\frac{1}{32}$ opening thrown clean forward or back, and $\frac{1}{64}$ opening hooked at 12 inches, both sides being the same. He claimed after running with steam that the valves were not square, or at least did not sound so. After squaring my way from dead center on wheels, and attempting to do it in his style by measuring on guides, the valves would show $\frac{1}{64}$ inch of opening more on one side than the other. Who is right? A. You are.

(3) C. C. G. asks: Would a gun or other strong vessel, if filled completely with water and sealed up, and then subjected to intense cold, freeze and burst, or would the water remain liquid? A. Ordinarily, it would burst.

(4) W. J. M. asks: What is the effect of the gas of burning coal upon lime or mortar? A house was recently burnt under these circumstances: A light brisk wood fire was kindled and afterwards every spark of fire was supposed to be extinguished. In an hour afterwards the house was discovered to be on fire in the upper part. One theory is that the coal gas had injured the mortar and rendered the chimney unsafe, and so the fire was communicated through the chimney thus rendered unsafe. A. If the mortar employed in the construction of the chimney were originally of good materials, it is not at all probable that it would have been injured by the constant contact with the products of combustion; the lime in the mortar, at the exposed surfaces, would under ordinary circumstances speedily be converted into carbonate, sulphide, hyposulphite, and finally entirely into sulphate of lime, which would resist further change. The real cause of the gradual disintegration and final destruction of chimneys is rather to be looked for in the constantly varying and unequal expansion and contraction of their constituent materials, caused by the heat of combustion in the furnaces and climatic changes, and aided by the occasional shocks, jars, and the almost constant vibration to which all such structures are subject.

(5) C. D. S. asks: Please give a rule for working out this problem: The chord of an arc is 120 feet, and the versed sine 1 foot; what is the radius? A. From the rule for finding the versed sine when the chord and radius are given, which is: Square half the chord and square the radius: deduct the square root of their difference from the radius, and the remainder will be the versed sine: it is easy to deduce that the radius is equal to

$$\frac{(\text{versed sine})^2 + (\text{semichord})^2}{2 \times \text{versed sine}}.$$

(6) W. M. S. asks: How can I make a lead tree? A. Nearly fill a somewhat narrow-necked bottle with a saturated aqueous solution of acetate of lead, and suspend therein, just below the surface, a small bundle of zinc wires or strips, about two inches long; cork the bottle, and allow to stand undisturbed. The lead is precipitated by the zinc, which takes its place in the solution.

(7) E. A. T. asks: If the earth's axis were inclined 30°, what effect would it have upon the seasons? A. Their length would be the same; but in all places above 23·5°, the summer would be warmer and the winter colder.

(8) L. P. S. says: A magneto-electric machine is constructed on the principle of the Gramme machine, and used in a plating room. It seems to contradict a law which I supposed was unchangeable, namely, that, when the electric current was once established in a machine of this kind, it would continue to flow in the same direction so long as it revolved the same way, and the coils were undisturbed; but this does not appear to be always the case. The inducing magnets at one end of the revolving magnets became inert, probably from disconnection of the wire which supplied the exciting current. The wire, leading to the bath from this inert half of the machine, was changed *to* the corresponding electrode on the other section, which continued to give off a current. In this condition of things the plating went on very well, but with diminished power, for two or three hours; when, to the astonishment of the workmen, the current was found to be flowing in the wrong direction. The wires were then changed so as to bring the current right, and everything worked well for an hour or two, when it was traveling the wrong way again; and I find that other similar machines have behaved in the same manner under like conditions. I am at a loss to account for this singular action, and would like to have your opinion on the subject. A. The phenomenon described is common to most magneto-electric machines. It is caused by the extra current that is generated in the wires when the circuit is broken. One obvious remedy is never to open the circuit while the machine is running at full speed. There are others, but we think this will be found very satisfactory.

(9) P. J. H. asks: Can large telescopic lenses be made of the proper shaped glass cells filled with a liquid? A. No good lenses can be made this way on account of the flexure of the material.

(10) M. M.—The curious arrangement of the air bubbles you witnessed was probably caused by the ascending and descending currents of the warmer and cooler water in contact with the metallic sides of the vessel. The surface of the water in the center would thus be slightly higher than towards the sides of the cooler, and, owing to the capillary attraction at the points where the liquid was in contact with the metal, these would also be higher: anything, therefore, floating on the surface of the water would remain at an intermediate point. Cohesive attraction, we think, would explain the rest. We do not see anything in this explanatory of the nebular hypothesis you mention.

(11) D. F. asks: How can I restore the original color of small ornaments made of white holly and other light woods, that have grown yellow from age? A. Place them in a vessel over a quantity of chloride of lime (hypochlorite of lime) to which add a very small quantity of diluted sulphuric acid, and close the vessel tightly.

(12) R. B. C. says: A young friend has an aquarium. A silver fish which has been rusticating in it over a year has suddenly changed to a gold fish. Why is this? I should mention that the water, though changed often, is strongly impregnated with iron. A. We should feel better able to give an answer if we had seen the fish mentioned. It would probably be more nearly to the point to call the animal an "iron fish," in contradistinction to his more noble fellows, as the color is probably due, at least in part, to a slight incrustation of the scales with the yellowish-brown sesquioxide of iron.

(13) C. C. B. asks: Is there not an error in your statement that the Microscopical Society's screw has 55 threads per inch? A. Yes. It should have read 36.

(14) H. Mc. says: 1. Supposing that a wheel is 20 feet in diameter, with an axle of 6 inches, how much will a 10 lb. weight on the rim of the wheel raise on the axle? A. Between 300 and 400 lbs. 2. What amount of weight would be required on one side of the wheel to be equal to an eighty horse power engine? A. This question is too indefinite. A force of 1 lb., acting with sufficient velocity, would exert the same power as the engine.

(15) C. H. W. asks: Is the intensity of radiant heat in space or ether in inverse ratio of the square of the distance from the source of heat as it is in air? A. It is considered to be so.

(16) J. F. says: I am building a grist mill to use 48 cubic feet water per second. It is estimated 600 feet below the dam, and the water is to come in a pipe underground. What should be the size of a circular pipe to feed 48 cubic feet per second without losing more than 1 foot head? I find by using M. Prony's experiments, and also Messrs. Boulton and Watt's rules, that a pipe 4 feet diameter will feed that amount of water to a distance of 600 feet, with a frictional head of 10·4 inches? A. This seems to be right. Weisbach's formula, which is perhaps better authority, gives the friction head at about 9½ inches; and as these are theoretical results, for clean and smooth pipes, it may be best to use a 48 inch pipe. 2. Would a flume near the mill be of any benefit? I think that a decked penstock in which the wheels are placed, giving the water plenty of access to them, is as good. The power of water is proportioned to the pressure: and a flume would not increase it at all, as the hight of water in it would depend on the pressure only. Am I right? A. Yes.

(17) G. H. W. says: Please tell me of some mode of renovating and killing the smell on curled hair. A. Try fumigating in a large, tight box with the sulphurous acid gas evolved from a dish of burning sulphur.

(18) P. F. asks: With what velocity will water flow into the suction pipe of a pump which is 16 feet in perpendicular hight, supposing that the vacuum is perfect. Please give me a rule for ascertaining the velocity at any hight. A. The velocity with which the water will flow is 8·02 times the square root of the effective head. In the case you have given, the total head is one atmosphere, equivalent to a column of water about 34 feet high. The lift is 16 feet, leaving 18 feet head, and from this must be subtracted the friction head, which depends upon the diameter of the pipe. Suppose the friction head to be 5 feet: this leaves 13 feet available head: whence the velocity will be about 29 feet per second.

(19) H. F. asks: How can I prevent broomcorn from breaking when worked up? A. Steep or boil the broomcorn in water, and then dry it.

(20) E. S. E. says: I am *using* a pump with connections made direct with the city water supply. I do not get a steady pressure, and find it impossible to use the exhaust steam, as the water sometimes rises, forcing the exhaust steam back and flowing into the cylinder of the engine, thereby endangering the cylinder head. What shall I do? A. Fit up a tank, which you can do very cheaply by using a hogshead, and draw your feed from that.

How can I test oils to find which is the best lubricant? A. The fact that one oil is heavier than another does not prove that it is better. You can best judge of the quality of different oils by using samples on the same bearing, and see how far a quantity of each, costing the same amount, will go.

(21) M. B. asks: Is there any internal application or other mode of preventing the very rapid destruction of pipes leading from stoves in which anthracite coal is burnt? In some cases the pipes do not last more than a winter. A. This is very probably due to the quantity of sulphides contained in the fuel. We do not know of any practical way of overcoming the difficulty except it be to use a better quality of coal, and pipes of the best Russian iron.

(22) G. S. P. says: A friend states that eggs cannot be hatched in an incubator with the heat coming from the bottom. I say they can. Which is right? A. The conditions are that the temperature should be uniform, not too great, or yet too low, and that the eggs should be turned occasionally. From whatever direction the source of heat, only provided that the above conditions are realized, we think the eggs may be successfully hatched.

(23) A. B. W. asks: What is the highest temperature that asbestos will resist without injury? A. Pure asbestos will resist the highest temperatures to which it may ordinarily be subjected; but at the temperature of the blast furnace or the oxyhydrogen jet, it fuses to an enamel-like glass.

(24) C. K. N. asks: 1. Is kerosene oil of the best grade, such as is used for illuminating purposes, likely to injure the leather or stitching of shoes when poured in to stop squeaking? A. No; but such treatment of shoes is not at all desirable. 2. What will prevent shoes from squeaking? A. Rasp, with a coarse rasp, the outsole and insole, and every other piece of leather that comes in contact in friction by the action of the foot. Then apply freely good wheat or rye paste. If this is well attended to from heel to toe, the boot or shoe will not squeak.

(25) C. asks: What is hyposulphate of soda, and has it any other name? A. You probably mean hyposulphite of soda; it is a salt formed by the combination of soda with hyposulphurous acid. We do not know that it has another name, except, perhaps, that of "hypo," given to it by photographers, who use it largely as a developing bath.

(26) T. H. P. says: We have a stream of mine water throwing 70 gallons per minute, which we would like to bring down the side of the mountain in troughs, a distance of 850 feet, with a fall of 220 feet, to run an overshot water wheel, and pump up a stream of spring water throwing 10 gallons per minute, to a point 20 feet above the starting point of the mine water. Can it be done? If so, what should be the proportions for wheel, pump, stroke, diameter of bore, and size of gas pipe required? A. It is probable that you will have plenty of surplus power, under the conditions stated, so that you may use such apparatus as can most conveniently be applied.

(27) C. A. A. says: 1. I wish to make some billiard balls out of wood. What kind would be most suitable? A. Use rock maple or apple wood. 2. How can I stain and polish the same? A. Stain with extract of logwood, and polish with a little oil and shellac in alcohol.

(28) I. R. says: 1. I want to make a few electrotype plates, about 5 x 6 inches. What will be a cheap form of battery for the purpose, and how many cells are necessary? A. One or two cells of Daniell battery is sufficient. That known as the gravity form is easily arranged. It consists of a copper disk placed at the bottom of a jar and a zinc plate or casting supported from the top. Wires for connecting the battery in circuit lead from the two metals. The one soldered to the copper disk is insulated by a gutta percha covering on that portion which is within the jar. Fill the latter about ⅔ full with water in which a little sulphate of zinc has been dissolved. Then drop a few crystals of sulphate of copper on the bottom plate, taking care that none remains on the zinc, and the battery is ready for use. 2. How must the wax mold be connected with the wire? A. Push several small wires through the wax in different places, so that the ends just show the black lead over them. 3. Is there anything that can be substituted for plumbago to coat the mold with? A. Yes, but you will get good results with plumbago, if careful. 4. How thick ought the copper to be deposited, and how long will the process take? A. That is a question to be answered by individual taste.

(29) R. E. asks: Will soap suds improve the soil, no matter what soap has been used? The suds contain sal soda. A. Yes, if the quantity used be not excessive.

(30) F. C. S. asks: 1. Please give directions for preparing a simple but good silver solution for plating by the battery process. A. Dissolve ¾ oz. cyanide of potassium in a pint of water, and hang in it sheets of silver connected with the positive pole of a battery. A porous cup, containing a like solution, and an iron or copper plate connected to the negative pole of the battery, is also placed in the jar with the silver. When a deposit forms on the plate in the porous cup, the solution will be of a proper working strength. 2. With what shall I charge a Bunson battery? A. Fill the porous cup with strong nitric acid, and the outside vessel, which contains the zinc, with water to which from twelve to twenty parts sulphuric acid in one hundred parts water have been added. 3. How can carbon plates be preserved? A. They should be placed in water after being used, and allowed to remain until the absorbed battery product has been dissolved out of them.

(31) J. H. S. asks: Can you tell me of any acid that will dissolve the oxide of iron? A. There is nothing cheaper or more effective than muriatic acid for the purpose. Dilute sulphuric acid will dissolve it, but is not nearly so effective.

(32) G. W. G. says: Ships laden with petroleum in cases (and so far as I have been able to learn, the same is true if the oil is shipped in casks) experience more or less local deviation in their compasses, varying as to the position of the ship's head and the length of time occupied in loading. This deviation is found to gradually disappear during the progress of a protracted voyage. At least this has been my experience. My theory is that it is due to a polarization that takes place in the iron contained in the packages containing the oil, while laying a long time in a ship with the head towards the north, as is usually the case with ships loading at the wharves in the East river, New York. But why should this be so much more marked with petroleum-laden ships than with ships laden with other cargoes? Many captains with whom I have conversed upon the subject are of opinion that it is the oil which affects the compasses. Can you enlighten me? A. Your theory is undoubtedly the correct one. During a long voyage the changes in position of the vessel would tend to dissipate the previously induced magnetism of the casks. As petroleum is not sufficiently magnetic to affect the compass, some other cause must be looked to for the marked deviation of the needle on petroleum-laden vessels.

(33) A. B. C. asks: Can you inform me if there is any chemical or other article, the fumes of which, when burnt, will be destructive to flies and other small insects? A. The sulphurous acid gas evolved by burning sulphur in contact with the air will accomplish this; but its bleaching properties are such that, if it be permitted to come in contact with colored woolen and other fabrics, their colors will be destroyed.

(34) F. S. A. says: I have an aquarium holding 5 gallons, which I wish to stock with salt water animals and plants; but although I have repeatedly attempted to do so, both animals and plants have died from the water becoming foul. Could I purify the water by driving air through it or by forcing the water to a hight of 5 feet and allowing it to fall back into the tank in a constant stream, ¼ inch in diameter? A. In similar cases on a larger scale, the mechanical method of aerating the water by a steady current of finely divided air forced into the water is for the most part resorted to. Where this method is employed very little vegetation should be used, and much of the light excluded.

(35) C. W. M. asks: 1. What should be the diameter of a helix whose length is 6 inches, to give the greatest lifting force? Of what size should the wire with which it is wrapped be? A. Such questions can be answered definitely only when the other relations of current magnitude, resistance of circuit, etc., are known. Three or four Daniell cells and a helix of No. 20 or 23 copper wire will charge an iron core sufficiently to lift 4 or 4 lbs. The helix should be about ½ inch internal and 1¼ inches external diameter.

(36) H. G. says: I was told by a friend that if I used a solution of common washing soda in water it would make my hair blonde. I was so foolish as to try it, and my hair is now an ugly red. What in the world am I to do? A. The application of alkaline solutions such as you employed not only removes all the natural oil from the hair, but soon weakens and finally destroys its vitality, as well as reduces to sesquioxide all of the iron salts to which was due its dark color. In fashionable society, at various times, this and even more objectionable, not to say dangerous, means have been resorted to, such as the employment of orpiment, chlorine water, sulphurous acid solutions, and even aqua regia (nitro-muriatic acid). It is hardly necessary to add that, in the majority of cases in which the hair has been thus misused, the result has been its complete or partial loss. We would advise you, as the safest and most sensible method, to have your hair cut as short as possible; this will cause the remainder to grow quite rapidly, and with its natural color. If it is very objectionable to have the hair thus shortened, a suitable dye might be employed of as near the color of the original hair as possible. Make only one application of this dye; and as fast as the hair grows, cut off a corresponding length from the extremity of the dyed capillus until all of that portion has been removed. The former suggestion is, however, much the quicker and better method. It would be well to keep the hair moist with a little simple pomatum.

(37) L. M. K. asks: I want to build a small steamboat 20 feet long and 10 feet wide, to draw as little water as possible. How shallow can I make the hull? I want the boat to run at the rate of from 7 to 12 miles an hour. A. We doubt the practicability of making a boat of this size, with the limited conditions mentioned, having the desired speed.

(38) A. C. G. asks: How can I make a spectroscope? A. See p. 261, vol. 31.

What will remove the brownish deposits in porcelain urinals? A. First wash well with a little lime and potash, rinse with water, wash again with dilute muriatic acid, and rinse finally with water.

(39) H. M. says, in reply to T. C. D., who asks what is the lowest temperature indicated in any polar expedition: *The Polar and Tropical World* says: "The voyages of Kane and Belcher have made us acquainted with the lowest temperatures ever felt by man. On February 5, 1854, while Kane was wintering on Smith's Sound (78° 37′ N. latitude), the mean of his best spirit thermometer showed a temperature of —68°, or 100° below the freezing point of water. Then chloric ether became solid, and carefully prepared chloroform exhibited a granular pellicle on its surface. The air had a perceptible pungency upon inspiration, and every one had to breathe guardedly, with compressed lips. About the same time (February 9 and 10, 1854), Sir E. Belcher experienced a cold of —55° in Wellington Channel (75° 31′ N.) and the still lower temperature of —62° on January 13, 1853, in Northumberland Sound (76° 52′ N.). Whymper, on December 6, 1866, experienced —58° at Nullato, Alaska (64° 42′ N.)

(40) J. W. D. E. says, in answer to E. H., who wishes to know why his cannon has lost its loud report: This is very common to all guns which have been long in use. The reason is that the bore of the gun, probably several inches from the breech, has become enlarged, in which case there is a vacant space between the bore of the gun and the charge; and at the instant of discharge a considerable amount of the gas escapes.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Rat-Tailed Larvæ. By R. M.

On Expansion and the Locomotive. By F. G. W.

On Lightning Rods. By W. J. C.

On Removing Shrunk-On Pulleys, etc. By T. J. B.

Also inquiries and answers from the following:

J. H. A.—H F. W.—H. D. E.—J. E. B.—J. R. A.—S. H.—H. C.—H. C.—J. E. H.—W. F. W.—H. H. L.—W. G. W.—C.—E. H. R.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who makes knitting machine needles? Who sells mariner's compasses? Whose is the best machine for drilling holes in brush backs? Why do not makers of astronomical apparatus advertise in the SCIENTIFIC AMERICAN?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL]

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MAKING CARPET LINING.—J. R. Harrington, Brooklyn, N. Y.

DESIGNS PATENTED.

9,473.—EMBROIDERY.—E. Crisand, New Haven, Conn.
9,474 to 9,477.—CENTER PIECES.—S. Kellett, San Francisco, Cal.
9,478.—NUBIAS.—J. Phipps, Philadelphia, Pa.
9,479, 9,480.—CARPETS.—A. Righter, Philadelphia, Pa.
9,481.—OIL CLOTH.—J. Robley, Brooklyn, N. Y.
9,482.—SHIRT FRONT.—S. Steinweg, New York city.
9,483.—CHAIN SWIVELS.—V. Draper, North Attleborough, Mass.
9,484.—ORNAMENT.—A. Miozzi, New York city.

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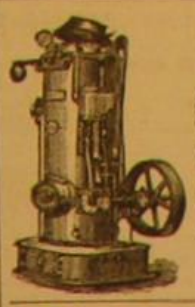

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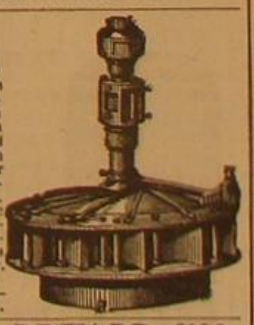

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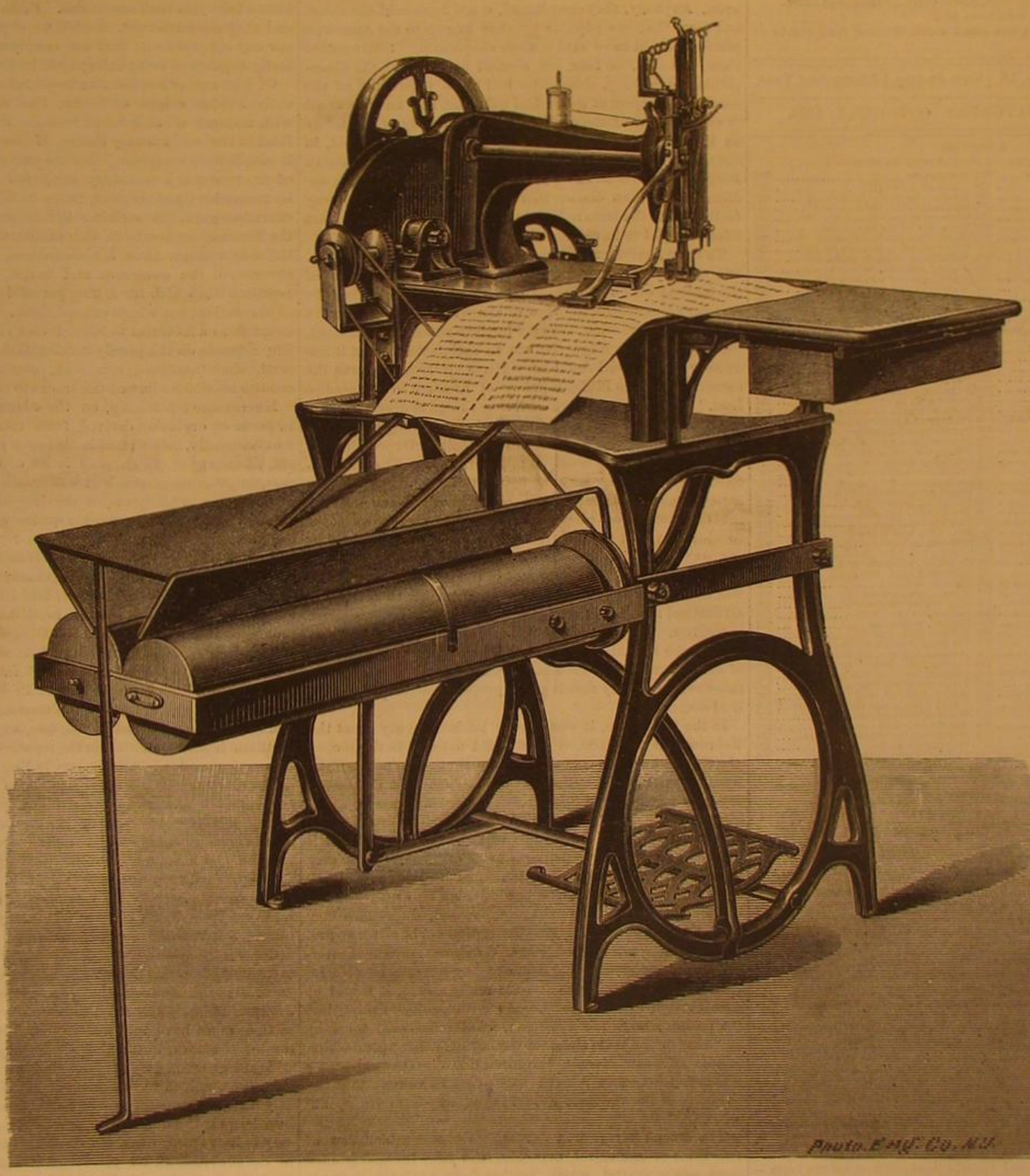
Vol. XXXV.—N . 15. [NEW SERIES.] NEW YORK, OCTOBER 7, 1876. [$3.20 per Annum. [POSTAGE PREPAID.

A BOOKBINDER'S SEWING MACHINE.

The Singer Manufacturing Company have recently adapted the principle of their sewing machine to the stitching of books and pamphlets; and we publish herewith an engraving of the book-sewing machine, in which all the parts are represented with such clearness that little explanation in necessary. The sheets of printed paper are first folded and then passed into the machine in succession. The attachment for effecting this is shown in our illustration; and it stitches the sheets, feeds them forward, cuts the thread, and conducts the sheets along downwardly inclined guides, so that they fall between two rolls, which fold and smooth them. The machine is capable of stitching sheets of any size or thickness; and however thickly the sheets may be folded, the rollers will give them the proper pressure, being united by an elastic connection which allows all thicknesses to pass through under their pressure.

The machine stitches the sheets with great rapidity; and as each sheet is stitched separately, the binder can get the sheets ready for binding as fast as they come from the printer, the sheets being afterwards collated for insertion in the covers. Much time is saved by this method, as every one familiar with bookbinding will acknowledge; and the separate threads to the sheets insure elasticity to the back, which allows the book to open easily, and so contributes in an important degree to the durability of the binding.



THE SINGER BOOK-SEWING MACHINE.

New Pavement.

A new kind of pavement has recently been laid in Newgate street, London; it has not been used for any roadway previously. About 300 superficial yards have been laid down at the west end of Newgate street. The following is the engineer's report on the material: "That the asphalt is stated to be composed of 85 per cent of fine ground granite and 15 per cent bitumen; that it is a material free from slipperiness and not affected by the atmosphere. It is laid in a heated, semi-fluid condition, two inches thick, upon a foundation of Portland cement concrete nine inches thick."

Construction of Petroleum Tanks.

Storage tanks, whether built by private enterprise or constructed in the interests of the pipe lines, are necessarily of iron. They must needs be of some such material in order to resist the pressure of enormous quantities of fluid intended to be stored within them. Their contents vary all the way from 8,000 or 9,000 to 25,000 barrels of 42 gallons each. These tanks are constructed of heavy iron, riveted together and made fluid tight in the usual boiler fashion. The first step, after the bed has been made by carefully compacting and leveling the ground on which the tank will rest, is to lay out the sheets which are to constitute the bottom on wooden horses properly arranged in the bed. These bottoms are then riveted together until a vast iron disk of the required diameter is produced: the diameter in the case of a 20,000 barrel tank, for instance, being about 80 feet. It is calculated in a rough way that the bottom of the tank, with the first ring of siding attached, is chargeable with half the cost of the whole tank. This first ring is attached to the bottom by means of a number of L-shaped pieces, to which these parts are respectively riveted. The remaining rings are attached or built up in the usual boiler fashion. At the proper time the wooden bases are withdrawn; and by means of jack screws or some similar device, the tank is let down upon its earthen bed. The roof is either of iron or of wood. Iron roofs are sometimes constructed of something akin to ordinary roofing metal, properly supported by a frame within, if the tank be small; but if it be large, the roof is generally constructed of heavier sheets, riveted together. The vast majority of tanks have wooden roofs. Out of 85 examined recently, only 18 had iron tops. Wooden roofs are generally tarred and graveled. Sometimes, instead of being flush with the top of the tank, they are set some inches below it, forming a water top intended to hold water. Sometimes they are covered with earth, in which vagrant grass seeds taking root, the roof presenting somewhat the appearance of turf. These are the earth tops.

Every roof has a manhole, generally upon the principle of an ordinary house scuttle. It affords access to the interior of the tank for cleansing and other purposes. There is a supply pipe which runs up the side of the tank and enters at the top, near the manhole. About an inch or so above the bottom, one or more drawing-off pipes are inserted. Access to the roof is secured by a wooden ladder or steps; these are generally permanent attachments. Across the roof, be it of wood or iron, a slatted or cleated wooden walk is provided, so that the roof may not be injured by being trodden upon. Sometimes, if tanks are near together, their roofs are connected by wooden bridges or plank ways, that easy access may be had to all. Sometimes the base of tank is earthed up for three or four feet with sloping banks of gravel.

Sometimes a trench two feet in depth is dug about the base, with an opening towards the downwards slope of land. When the tank is completed, it is subjected to an hydraulic test; water to its full capacity is pumped in; and if the tank bears this strain without either bursting or leaking, it will of course withstand the pressure of an equal quantity of oil. Occasionally the water pressure proves too strong, particularly if the iron has not been of a good quality. The tank, now completed, receives its contents through the supply pipe the oil coming through, it may be, miles of piping, either direct from the wells or from other tanks or from barges laden with the oil in bulk. In this way the oil-producing country is threaded with countless miles of piping, sometimes above ground, sometimes on or beneath its surface, and sometimes in the beds of rivers.

Some tanks are on the tops, others on the sides or in the hearts of mountains, others at their base. Sometimes they cluster together in particular localities by the dozen. Frequently we find knots of tanks, only from five to ten feet apart: hence all morally certain of destruction by the fire that seizes upon any one of them. On the other hand, where wiser foresight has prevailed—as on the Anchor Farm, Chestnut Hill, opposite Parker's—it is made obligatory upon tank owners to build at least 200 feet apart. There are twelve tanks upon the summit of this hill. At Mount Nebo, just south of Parker, there are ten tanks separated by distances varying from 100 to 150 feet; while at Montrose there are ten new tanks being built on the river bank, separated from each other by only fifty to seventy-five feet.—*W. S. Newall.*

Scientific American.

ESTABLISHED 1846.

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NEW YORK, SATURDAY, OCTOBER 7, 1876.

Contents.

(Illustrated articles are marked with an asterisk.)

THE SCIENTIFIC AMERICAN SUPPLEMENT.
Vol. II., No. 41.
For the Week ending October 7, 1876.

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PROFESSOR HUXLEY'S LECTURES IN AMERICA.

During Professor Huxley's recent brief sojourn in America, he delivered three lectures (the only scientific discourses given by him in this country) on "The Theory of Evolution." They were spoken at Chickering Hall in this city, on the evenings of September 18, 20, and 22, before large and appreciative audiences.

There was a shade of disappointment visible on the faces of not a few of Professor Huxley's hearers as they left the hall at the close of his first lecture. It had not been at all what they had come to hear. The absurd reports which certain of the daily newspapers had circulated with regard to Professor Huxley's attitude toward religion had led many to anticipate something startling. As the "arch enemy of Christianity," he could not do otherwise than run a-muck with Genesis, and say things very offensive to the orthodox. So, when the speaker finished his calm, straightforward, logical, and perfectly reasonable review of the three conflicting theories of the origin of animal forms, a discourse in which there had been no exciting language and no effort to say smart things, they were disappointed, and inclined to blame him for not being the sort of man they had come to see. Others, unable through lack of a knowledge of the subject in hand to appreciate the masterly manner in which Professor Huxley clove to the heart of the matter, and quietly took possession of the much contested field, missed the real point of the lecture, and came away half persuaded that somehow they had been imposed upon. Anybody, they complained, could have said the same, and more than one popular speaker known to the American platform could have said it more eloquently. Still another class, and that, we fear, not a small one, shared the disappointment, namely, those who had but a vague idea of the scope and purport of geological evidence, and no idea at all of the enormous mass of facts bearing directly or indirectly on the theory of evolution, who yet expected to be told, in course of an hour, precisely how everything came about. Judging from remarks we overheard among the retiring audience, more than one of this class must have come away feeling that the lecture had been altogether different from what it ought to have been.

To those, however, who understood the situation of affairs, and were prepared to appreciate the beauty and success of the method which Professor Huxley chose for clearing the way for an unobstructed view of the evidence bearing on the problems of evolution, to be set forth in succeeding lectures, the first evening's discourse was as satisfactory as an introductory lecture well could be. Particularly happy was the cornering of the Biblical theory of creation in "Paradise Lost." There the creation of living things is described precisely as all men read it in Genesis before geological revelations compelled theologians to vary their interpretation of the Scriptures, as occasion might require. The utter inconsistency of the "Miltonic hypothesis," tested by the geological record, both as regards the manner and the order of the origination of plants and animals, was shown most conclusively; but the lecturer declined to commit himself in any way by calling that view of creation the Biblical view. It was true that Milton's account of the six days of creation was considered to be in perfect accordance with Genesis, by all Biblical scholars of his day, and for nearly two centuries thereafter. It was true that that interpretation had most likely been taught as scriptural, in childhood, to everyone of his hearers. But Professor Huxley would not for a moment venture to say that it could properly be called the Biblical doctrine.

In the first place, it was not his business to say what the Hebrew text contained, or what it did not, and in the second place, were he to say that this was the Biblical hypothesis, he would be met by the authority of many eminent divines, to say nothing of men of Science, who in recent times have denied that this doctrine is to be found in Genesis at all. Each finds in the Biblical record just what he requires to make it harmonize with his particular scheme of geology: *day* may mean twenty-four hours, or a period as long as convenience requires; the creation of a species may be direct and immediate, or, according to the same record, the species may have been evolved from simpler rudiments by natural processes, lasting millions of years. When the accredited interpreters of Scripture could come to any agreement with regard to what the Biblical account really meant, it would be time enough to compare Genesis with geology: meantime "a person who is not a Hebrew scholar can only stand by and admire the marvelous flexibility of a language which admits of such diverse interpretations." The applause which followed this remark was evidence enough that the majority of the audience were in sympathy with the speaker.

The second lecture was devoted to the consideration of two lines of geological evidence, the first including such facts as are neutral, which neither help evolution nor are inconsistent with it; and the second, those facts which give strong probability to the theory but do not prove it. A third line of evidence—that which, being as complete as any we can hope to obtain on such a subject, and entirely in favor of evolution, may fairly be called demonstrative of evolution—was reserved for the third and last lecture.

Historically important among neutral facts are those which led Cuvier to pronounce against the theory of evolution as propounded by Lamarck. The French expedition to Egypt had brought from that country the mummied remains of many animals, mammals, birds, and reptiles. Cuvier argued that, if evolution were true, the Egyptian remains, which were certainly three or four thousand years old, ought to be measurably unlike the birds, crocodiles, and so on, now inhabiting the valley of the Nile. He found on close examination that three or four thousand years had brought no important change to the animal forms of that region, and accepted the evidence as conclusive against the doctrine of Lamarck. The progress of research since Cuvier's time has furnished far stronger cases than those which he drew from the mummified bodies of Egyptian animals. As we work our way through the geological record, we find at every age, even the remotest, animal forms scarcely distinguishable from those which now exist. We also find great groups of animals, like the reptiles of the mesozoic period, abounding in vast numbers in strata representing periods of immense duration, yet presenting no important modification from first to last. Facts like these are often cited as fatal to the theory of evolution; but they are not at all in conflict with an intelligent view of that theory, though they *are* "fatal to any form of the doctrine of evolution which supposes an intrinsic necessity, on the part of animal forms which once come into existence, to undergo modification; and they are still more distinctly opposed to any view which should lead to the belief that modification in the different types of animal and vegetable life goes on equally and evenly." There is a manifest tendency on the part of living forms to vary; but whether such variations persist and accumulate, or die out sooner or later, depends altogether upon surrounding conditions. The persistence of old forms simply shows that they are better fitted for the conditions under which they flourish than any modifications of those forms have been; and that, since their origin, the earth has not failed to furnish somewhere just such conditions. Facts of such a character, and they are numerous, furnish no objection to evolution, nor any support to it; they are simply neutral, though perfectly capable of being interpreted in consistency with it.

Of like nature are the numerous facts showing the apparently sudden origin of forms, like the permian lizards, with no trace of antecedent forms. Such facts would be fatal to the evolutionary theory, if the geological record as it stands were complete. But the exceeding incompleteness of the record is a necessary condition from the manner of its formation; and besides, there is abundant evidence of enormous gaps. A striking illustration was furnished by the Brontozoum tracks in the sandstones of Connecticut—the only vestiges thus far discovered, or likely to be discovered, of the numerous and varied order of (probably) reptilian life which for a long period inhabited the shores of the ancient sea which existed there. That we have even so much as a footprint to hint of that mysterious horizon of life depends on the purely accidental circumstance that the sand, since hardened into rock, was accumulating under conditions which allowed the tracks to be preserved.

Much more interesting, on the whole, was the evidence in favor of evolution derived from transitional forms, or, more correctly, forms standing between groups now distinct, and partaking of the characteristics of each. For the most part, the evidence of this sort was drawn from recent discoveries tending to fill up one of the largest gaps in existing animate nature, that between reptiles and birds, and hinting how the evolution of birds from reptiles may have taken place. The evidence embraced an array of facts, of a fresh and intensely interesting character, relating to the *archeopteryx*, a feathered animal, bird-like in most respects, but having clawed wings and a reptilian vertebral column, prolonged into a long slender tail fringed with feathers: to *Hesperornis regalis*, a grebe-like bird six feet high, with a long jaw thickly set with teeth; to *ichthyornis dispar*, a still more reptilian bird, with teeth in distinct sockets; and to the bird-like modifications of dinosaurian reptiles, culminating in the *compsognathus longipes*, a type, possibly, of the reptilian bipeds which made the mysterious tracks found in Connecticut and in similar strata in England.

The third and final lecture was begun by pointing out an element of weakness in the evidence presented in the preceding lecture. It was true the mesozoic rocks furnished fossil forms so completely bridging over the gaps between reptiles and birds that it would be very hard to say where the reptile ends and the bird begins. It was true that evidence of that sort is far weightier than that upon which men undertake to say they believe many important propositions. But it could not be considered demonstrative evidence, for the reason that the intermediate forms were found in contemporaneous deposits, whereas the requirements of demonstration demand that the gradations between one group of animals and another should appear in such order as they must have followed if they had constituted a succession of stages, in time, of the development of the form at which they ultimately arrive. Such demonstrative evidence has been obtained in late years in considerable and continually increasing quantity. Indeed it is somewhat surprising how large is the quantity of that evidence and how satisfactory is its nature, when we consider the exacting character of the condition of its preservation and discovery. As an illustration of that kind of evidence, the discoveries with regard to the pedigree of the horse were chosen as specially appropriate for the attention of a popular audience. The readers of the SCIENTIFIC AMERICAN are already familiar with the geological evidence on this point, as set forth in the article entitled "The Genesis of the Horse," in No. 16, volume XXX. The long and admirably sustained argument of Professor Huxley will be found in a full report of the three lectures in the current issues of the SCIENTIFIC AMERICAN SUPPLEMENT.

Having traced at great length the evolution of the horse from the four-toed horse-like creature of the eocene period, and showed that the history of the horse, as recorded in tertiary strata, is precisely that which could have been predicted from a knowledge of the principles of evolution, the lecturer said: "If that is not scientific proof, then there are no inductive conclusions which can be said to be scientific.

And the doctrine of evolution at the present time rests upon as secure a foundation as the Copernican theory of the motions of the heavenly bodies."

In closing, the speaker took the precaution to observe that his purpose had not been to enable those who had not made a study of these subjects to leave the room in a condition qualified to decide upon the validity or the invalidity of the hypothesis of evolution, but to put before them the principles by which all such hypotheses must be judged, and to make apparent the nature of the evidence and the sort of cogency which is to be expected and may be obtained from it: and he should consider that he had done his hearers the greatest service it was in his power to do, if he had convinced them that the question under discussion was not one to be dealt with by rhetorical flourishes or by loose and superficial talk, but one that requires the keenest attention of the trained intellect and the patience of the most accurate observer

A SERMON PREACHED BY THE MICROSCOPE.

The mineral polishing powder lately brought into use under the name of electro-silicon consists, as shown by the microscope, entirely of silicious or flint shells of the *diatomaceæ*, species *epidiscus*, each shell being a flat disk. We recently measured their diameters and found them to average $\frac{1}{2000}$ inch, while the thickness was $\frac{1}{80000}$ inch. Therefore, when piled up like coin (and in this way they appear in the mineral), 8,000 of these are one inch thick; while a square inch can contain more than 2000x2000, or over 4,000,000, such disks; and the number present in every cubic inch is thus more than 8000x4,000,000, or over 32,000,000,000. When we consider that the thickness of the deposit in Nevada, where this mineral is found, is reckoned in hundreds of feet, and the length by hundreds of miles, we can only be struck by the immensity of the organic creative power with which the atoms of matter are endowed, a power which forms these atom-like objects, in regular shape and in numbers to be counted, not by millions of millions, but by countless myriads. Not this alone: but this power also ornaments most of the species in the most tasteful and intricate manner: an ornamentation which is revealed only by the most powerful microscope.

When we were once visiting the cathedral of Strasbourg, Germany, an architect in our company made the remark that the artisans who cut the ornamental stones had expended just as much care in giving the utmost finish to the highest parts at the top of the spire, where scarcely ever any one had a chance to admire their admirable workmanship, as to every part of the cathedral below, where it is daily seen by the worshippers. "But," said our friend, "those men labored not so much for their wages as they do now a days (often trying to cheat in the value of their work when they have a chance); but in those good old times, every artisan labored for the glory of God; it was a species of religious enthusiasm which induced them to finish their work there as conscientiously as anywhere else, although it could only be seen by God."

Considering the discoveries of the exquisite ornamental finish of those little objects belonging to the hundreds of species of *diatomaceæ*, what is more natural than that the religious enthusiasm of the mediæval church builders is taking hold of the microscopists of our day, who really are enabled to see what God wrought thousands of centuries before it could be seen by any human creature? And these wonders have waited through all these ages before the fact could be appreciated and acknowledged; that the creative power is infinitely great, even in the infinitely small

WHY IS THE SEA SALT?

According to Professor Chapman, of University College, Toronto, the object of the salting of sea water is to regulate evaporation (see page 98, current volume). This suggestion does not answer the question: why, or by what cause, the sea became so salt; but it assumes to tell us wherefore or for what object the sea is salt. The cause of the saltness should be answered first; and if, after we have ascertained this, it is proved that the salting accomplishes a secondary ultimate purpose, the other question arises. But we believe that a careful consideration of the Professor's hypothesis will quickly expose its fallacy.

In the first place, then, the sea is salt as a simple and necessary consequence of the fact that it must contain all the soluble matter which the rains have washed out of the most exposed portions of the earth's crust, and which the rivers have carried, and are still carrying, to the ocean. And as the rivers do not carry water as pure as that which evaporates from the sea, because they all, without any exception, carry various salts in solution, which can never be raised from the ocean by evaporation, the sea has, in the course of ages, become more and more salt; and the process is still going on. Such a nice regulation of the amount of evaporation as the Professor suggests is quite unnecessary, as it is well known that the regions under the influence of the evaporation of our large fresh water lakes are not much different in agricultural value or sanitary conditions from those under the influence of salt water evaporation, the sole conditions for agricultural success being, next to the nature of the soil, a liberal supply of moisture and solar heat; while in a sanitary point of view, a moderate supply of both is more desirable.

We must, however, give credit to Professor Chapman for his experiments; he proved that the amount of evaporation of fresh water, compared with that of salt water under the same circumstances, may differ largely; so that the evapora- becomes less and less, in proportion as the relative amount of salt increases. But we would give this fact an interpretation different from that of the Professor. In the condition of things preceding the carboniferous era, when the rivers had not yet dissolved so much saline matter out of the exposed earth's surface, nor the rivers carried it to the seas, the ocean necessarily contained much less salt than at present; therefore the amount of evaporation must have been much larger. This condition of things was not favorable to animal existence but it was to vegetable life; and this may partly explain the excessively luxuriant vegetable growth which was the parent of our coal deposits. When in the course of ages the ocean became more salt, the evaporation became less; the air was not so continually overcharged with moisture, and was more favorable to animal life. If the saltness has since increased continually, and the dryness of the air has augmented in proportion, we must not be surprised that regions of the earth, once fertile and inhabitable, have become dry deserts. We know this to be the case with the lands on which Babylon, and Palmyra, and other cities, were situated, which, as well as the whole of Upper Egypt, Palestine, etc., were formerly more fertile than they now are, considering the dryness of their atmosphere. In order to become convinced of the influence of moisture on vegetation, one needs only to visit the dry highlands of New Mexico and Colorado, and compare the vegetation there with the moist southern part of Louisiana. If we take the former in summer, and the latter in winter, so as to have the same temperature in both, the difference will be obvious and remarkable.

THE SPONTANEOUS COMBUSTION OF COAL AT SEA.

An intimation of the fearful aggregate of suffering entailed by frequent losses of ships by fire at sea is given in the fate of the crew of the San Rafael, intelligence of which has just been received. The San Rafael, of Liverpool, with a cargo of coals, was bound for Valparaiso: off Cape Horn she took fire; her crew escaped in three boats, two of which, with eleven persons, were picked up by a passing vessel after a period of dreadful suffering. The third disappeared, to be heard of no more until a party of seal-hunting natives reported to a missionary cruiser the discovery of the remains of eight men and one woman on a desert island near the cape, where they had perished with starvation. The instruments and papers found with them proved them to be the missing members of the San Rafael's crew. The details of their terrible fate have been given in the daily newspapers: the occasion of it, namely, the spontaneous combustion of coal at sea, its causes, and the means that may be adopted for preventing such disasters, are what we wish to call attention to here.

The frequency of such casualties has given rise to many enquiries by boards of trade and others, who have quite uniformly recommended ventilation as the best means of prevention. But experience shows that the more and better the ships were ventilated, the more frequent were the fires. On one occasion, four ships were loaded at Newcastle at the same time, with the same coal, from the same seam. Three of the ships, bound for Aden, were thoroughly ventilated: the fourth, for Bombay, was not ventilated at all. They were each carrying from 1,500 to 2,000 tuns of coal. The three ventilated ships were totally lost by spontaneous combustion; the fourth brought her cargo safely to port.

Repeated occurrences of this sort could not but shake the faith of shippers and underwriters in the saving efficacy of ventilation. A royal commission, made up of men like Dr. Percy and Professor Abel, was thereupon appointed to enquire into the matter, and their report, recently laid before Parliament, amply demonstrates the impolicy of ventilating cargoes of coal, especially for long voyages across the tropics; and points out clearly the conditions which lead to spontaneous combustion. Prominent among these is the development of heat due to chemical action, arising from the oxidation of substances contained in the coal. The best known of these are the combinations of iron and sulphur called iron pyrites. Moisture in the air facilitates this oxidation, which is accompanied by the development of heat, often intense enough to set the coals on fire. Obviously any increase of ventilation serves only to increase the vigor of the chemical action, and too often to ensure the destruction of the vessel. Another source of danger lies in the capacity of finely divided or porous carbon for absorbing and condensing within its pores large volumes of oxygen and other gases, with an attendant development of heat; moreover, the tendency to oxidation, which carbon and certain of its compounds possess, is favored by the condensation of oxygen within its pores, whereby the closer contact of the carbon and oxygen particles is promoted. Hence, the development of heat by absorption and the setting up of oxidation occur simultaneously; and as the heat increases, oxidation proceeds more and more energetically until the carbon is heated to the igniting point. The breaking up of the coal before and during shipment, by rough usage, favors this process.

The risks of spontaneous combustion are largely increased by the length of the voyage and the bulk of the cargo. For the most part fires occur in vessels carrying over 500 tuns, bound for the West Coast of South America, San Francisco, and Asiatic ports beyond the Mediterranean and Black Seas. Of such shipments four per cent were lost in 1874; and though they amounted to only 1,181 out of a total of 31,116 coal shipments to foreign ports, more than five sevenths of the fires occurred among them. There were seventy casualties of the sort in all, of which only ten occurred in shipments to European ports. The excess of fires by spontaneous combustion on long voyages seems all the more striking when we contrast the bulk of the European shipments—over ten and a half million tuns of coal—with the shipment of less than three million tuns to Asia, Africa, and America. And, as already remarked, the best ventilated vessels suffered most from these disasters.

Properly the conclusions of the commission are averse to ventilation in the cargoes of coal ships. They also point out that certain coals are intrinsically dangerous for shipment on long voyages: also that it is dangerous to ship pyritic coals wet, and coals much broken up in mining and transportation.

In the course of the enquiry, a curious and unexpected circumstance was revealed, showing the far-reaching effects of social changes and improvements. Arthur Helps would have been charmed with it. No two things would seem to to be more remote and independent of each other than the increase of schools among the poor and the increase of fires at sea: yet the latter seems in a measure directly due to the former. In this way: The presence of iron pyrites in coal is one cause of spontaneous combustion in coal cargoes. At the mines, boys were formerly employed to pick the "brassy lumps" out of the coal. The first effect of the Education Act was to withdraw those boys from the coal chutes and send them to school. The pyrites were no longer picked out; and straightway a remarkable increase occurred in the burning of coal ships at sea!

THE YELLOW FEVER EPIDEMIC.

Telegraphic reports from Savannah, on the 23d September, state that over two thousand people are stricken with yellow fever in that city, and eight thousand more are appealing to the country for relief and for means of preventing the spread of the infection. The disease has broken out in Charleston, and it is feared that it will extend its ravages to other Southern cities. Several cases have already occurred in Baltimore. There is a widespread feeling of concern lest, before the autumn frosts, the malady will gain a foothold in the more thickly populated cities of the Middle States. The probabilities and known features of the disease, however, all tend to remove, in this last respect, the ground for alarm. Yellow fever is not contagious from person to person, and its occurrence serves only to mark the presence of its special cause, which is generated outside the human body. The conditions for its existence must be such as are favorable to the germs which develope after being received into the system. The germs, however, are capable of being transported in infected vessels, clothing, and merchandise, and herein lies the chief danger. Militating against this are the rigid quarantine regulations which will be enforced, and the fact that the first frost to which they are subjected instantly destroys the organisms. On the other hand the disease, even when imported out of its indigenous region, is greatly promoted by auxiliary causes, such as overcrowding, defective drainage, filth, and similar negligence in sanitary precautions. It will be seen, therefore, that the prevention of the epidemic is even more in the hands of the people individually than in those of the authorities; and the importance of every person assuring himself that his immediate surroundings are in clean and healthy condition is evident.

We have so frequently pointed out the way to avoid filth diseases that it is difficult to write anything other than repetition of previous advice. We have before us the latest and best work on the subject, "Filth Diseases and their Prevention," by Dr. John Simon, F.R.C.S., and beyond all else the author states that impure water is the "chief way by which filth infections get entry into the human body." Shallow wells in thickly populated regions, he mentions as especially dangerous; and wells adjacent to privies and other filth deposits are the chief means by which enteric fever spreads in such neighborhoods. Old moldy dust heaps, wet house refuse awaiting removal, the filth of ill kept streets, leaky drains, and traps not gas tight and not freely ventilated, are other prolific causes of disease. The best disposition of house refuse, swill included, is to burn it; and carbolic acid, chloride of lime, copperas, and other cheap disinfectants should be freely employed in privies, cellars, stables, and outhouses. Filtering bad water is of little avail; where there is none other to be had, boiling with a lump of charcoal in the vessel is a good precaution.

The suffering in Savannah is augmented through lack of money to provide for the care of the sick, and there is an urgent demand for prompt assistance. Subscriptions are being raised by many organized bodies in this and other Northern cities. We trust that the call will meet a most generous response. Money may be transmitted to Hon. W. H. Wickham, Mayor of New York city, who will forward it to the Savannah authorities. We appeal to all who can afford it to do something for the sufferers, and to do it at once.

Wood Preservatives.

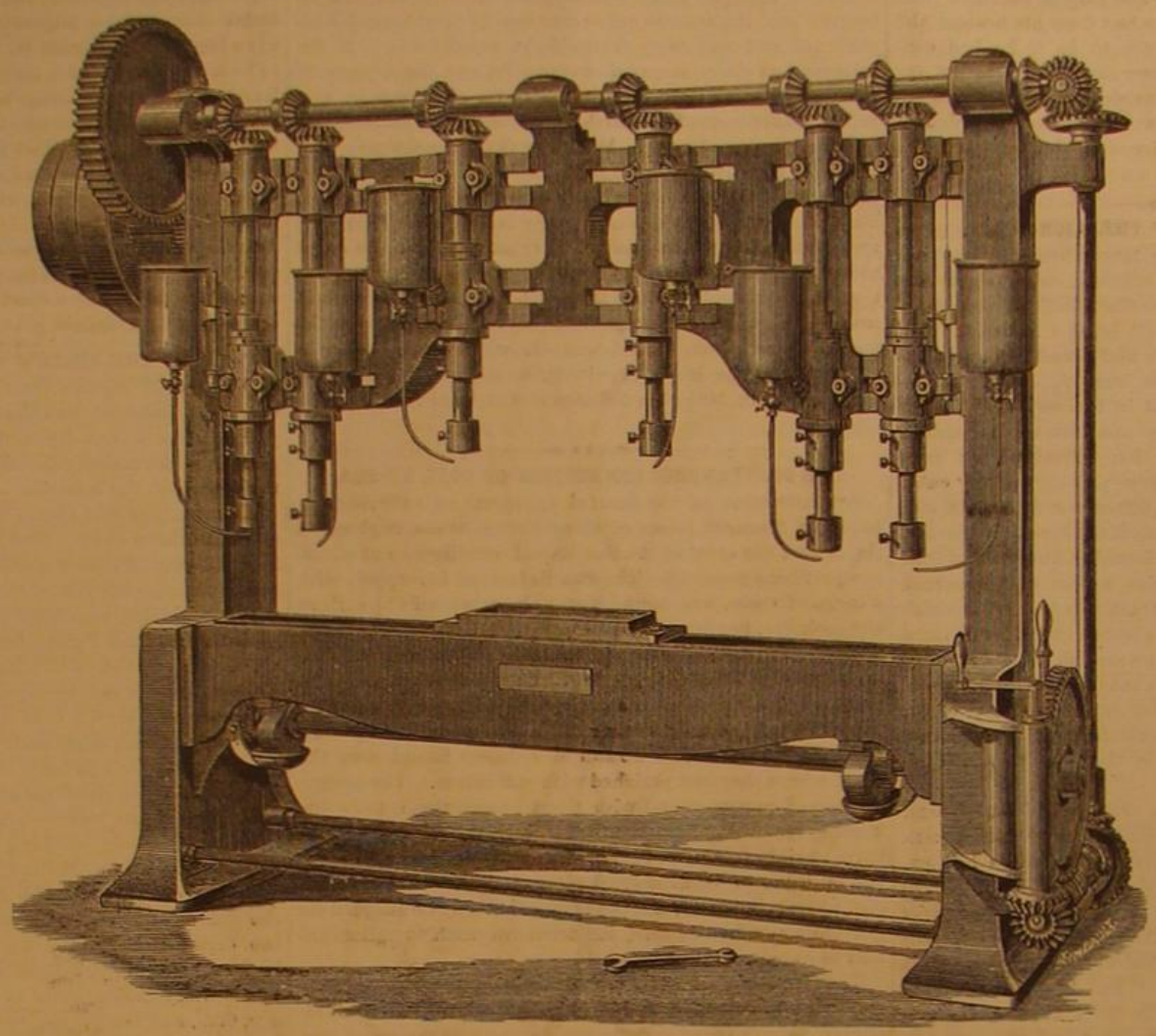
According to observations made on a railroad in Germany, the proportion of renewals was, with oak sleepers (not treated) after 12 years of service, 74·48 per cent; with oak sleepers, treated with chloride of zinc, after 7 years, 3·29 per cent; with oak sleepers, impregnated with creosote oil, after 6 years, 0·09 per cent; with pine sleepers, impregnated with chloride of zinc, after 7 years of service, 4·46 per cent. The practice of this railroad, since the year 1870, has been to employ only oak for sleepers, which are impregnated either with chloride of zinc or with creosote oil.

MR. C. K. WOOD wishes us to state that he intended to write that Professor Airy's clock gained 2½ seconds, not 27½ seconds, in his letter on the weight of a body inside a hollow sphere, published on page 196 of our current volume.

A GOOD acid-proof cement is made by mixing a concentrated solution of silicate of soda with powdered glass, to form a paste. This is useful for luting joints in vessels exposed to acid fumes

CAR TRUCK FRAME DRILLING MACHINE.

We illustrate herewith a special tool manufactured by Messrs. W. B. Bement & Son, of Philadelphia, Pa., for drilling at one operation the different holes required in car truck frames. The frame to be drilled is laid upon the table shown, and held there in position, the table, with the frame plate upon it, being then fed up to the drills. This table can be raised either automatically or by hand through the gearing shown. The drills are mounted on an upper frame, at the standard distance apart, and are driven by gearing from the coned pulleys. The drill spindles slide in the vertical holders, which are tubular, and they can be locked in any desired position by the set screws at the ends of the holders. The drill spindles can be adjusted on the cross frame to different distances apart so as to suit different patterns of car frames. The tool is well designed; and where a number of frames have to be drilled to one pattern, it is a very useful one, and capable of turning out a great deal of work.—*Engineering.*



CAR TRUCK FRAME DRILLING MACHINE.

The Moon and the Weather.

A writer in *Blackwood's Magazine* derides the popular error that the moon produces any effect upon the weather, as follows:

The notion that the moon exerts an influence on the weather is so deeply rooted that, notwithstanding all the attacks which have been made against it, it continues to retain its hold upon us. And yet there never was a popular superstition more without a basis than this one. If the moon really did possess any power over the weather, that power would be exercised in one of these ways: by reflection of the sun's rays, by attraction, or by emanation. No other form of action is conceivable.

Now, as the brightest light of a full moon is never equal in intensity or quality to that which is reflected towards us by a white cloud on a summer day, it can scarcely be pretended that the weather is affected by such a cause. That the moon does exert attraction on us is manifest—we can see it working in the tides; but though it can move water it is most unlikely that it can do the same to air, for the specific gravity of the atmosphere is so small that there is nothing to be attracted. Laplace calculated that the joint attraction of the sun and moon together could not stir the atmosphere at a quicker rate than five miles a day. As for lunar emanations, not a sign of them has ever been discovered. The idea of an influence being produced by the moon is, therefore, based on no recognizable cause whatever. Furthermore, it is now distinctly shown that no variations in weather at all really occur at the moment of the changes of quarter, any more than at ordinary times. Since the establishment of meteorological stations all over the earth, it has been proved by millions of observations that there is no simultaneousness whatever between the supposed cause and the supposed effect. The whole story is fancy and superstition, which has been handed to us uncontradicted, and which we have accepted as true because our forefathers believed it. The moon exercises no more influence than herrings do on the government of Switzerland.

The Largest Machine Belt.

The New York Belting and Packing Company have recently made a rubber belt, 331 feet long and 4 feet wide, weighing 2 tuns, for use in the New York Central and Hudson River Railroad Company's elevator at foot of 60th street, North river, in this city. The driving power to be carried by this belt is estimated at 500 horses. It is believed to be the largest belt ever made.

Wooden Spoons.

In a work describing the present condition of the domestic industries of Russia, M. Weschniakoff states that not less than thirty millions of wooden spoons are annually made in that country, the industry having its great center in the district of Semenow. Poplar, aspen, maple, and box are the woods used for this purpose, and the cost of the spoons varies from about $5 to $20 per thousand.

SWIMMING A HORSE.—On reaching deep water, the rider should relieve the horse of his weight, by sliding into the water beside the horse, grasping the mane near the withers with one hand, thus requiring the horse simply to tow the rider, the latter assisting him in this, by using his legs and free arm in the same way as in swimming. In crossing rivers with rapid currents, the rider should take the down stream side of the horse.

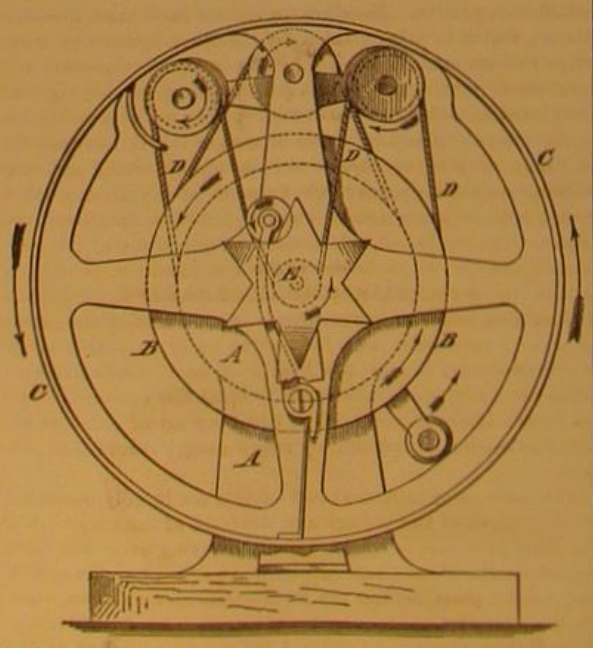
Manganese.

The important studies made of late years in chemical science have given manganese great importance in many arts and industries, and 50,000 tuns per annum are now imported into Great Britain, although a considerable quantity is raised from her own soil. It is used largely in the manufacture of bleaching salts (chloride of lime), in glass making, in the preparation of Condy's fluid (permanganate of potash), a disinfectant which, when mixed with water, sets free ozone in perceptible quantities; and in the manufacture of steel, it is rapidly becoming an ingredient of the highest importance.

The principal supply comes from Spain and Portugal, where it is found near the surface—seldom deeper than 90 feet. It generally occurs in pockets, and is of very uncertain occurrence, the miners proceeding generally by a kind of instinct rather than by any scientific rule. The ore is picked out from the pieces of rock with which it is mingled, washed, and sorted as to quality; then it is carried, generally in baskets on mules' backs, to the nearest railway or seaport. The miners, sorters, and washers are but poorly paid, even for Spain; and the discovery of manganese deposits in California, Virginia, and New Zealand is likely to limit the demand for this very useful metal in Spain and Portugal. Experiments are, however, being made in Belgium for the purpose of bringing it into use for making illuminating gas, for which it is likely to be extremely valuable.

A NEW GEARING.

There is now on exhibition at the Centennial Exposition,



in Machinery Hall, an exceedingly ingenious and novel mode of gearing, which will doubtless find many utilizations in cases where a high speed in revolutions is required, but where any extended system of cog wheels or other multiplying gear is neither desirable nor economical. The invention is illustrated herewith, and we purposely omit the calculations relating to the speed transmitted in order that the reader may solve for himself the neat mechanical problem which the device affords.

The construction is as follows: A is the standard; B is a grooved pulley rotated in the direction of the arrows by the crank, the end of the handle of which is shown below and to the right. C is a large balance wheel, loose on the shaft of B. D is a grooved stationary pulley formed on or attached to the standard; and E (dotted lines) is a small pulley outside the balance wheel, but attached to the end of an auxiliary shaft which supports the star-shaped piece, which may be a saw or other implement which it is desired to revolve rapidly. The order of mechanism on the line of the central shaft is, first, the crank handle; second, the standard third, stationary pulley; fourth, driving pulley; fifth, loose balance wheel; sixth, and on auxiliary shaft, small pulley; seventh, standard; eighth, driven pulley.

On the balance wheel and near the rim are secured three small pulleys as shown. There is also a tightening pulley attached to said wheel by an arm near the center. The belt or chain is then rove as follows Beginning on the driving pulley, B, then over the first small pulley of the three on the balance wheel, then down and over the small central pulley, E, then up and over the third pulley on the balance wheel, down and around the stationary pulley, back up to the middle pulley on the balance wheel, down around the driving pulley to the place of beginning, the belt being endless. The proportion between the driver and driven pulley is as 1 to 12; that is, the former in one revolution would produce twelve turns of the latter if simply belted or geared thereto; but by this device one revolution of the crank handle determines eighty-four revolutions of the driver pulley, so that the gearing augments the speed just sevenfold, without requiring any more room than would be occupied by the simplest mechanism. Theoretically, and friction neglected, there is apparently no limit to the number of revolutions which might be produced by properly proportioning the different pulleys. Of course the device can be used with gearing in lieu of belting. How the combination produces the sevenfold augmentation, and what must be the proportions of pulleys leading thereto, we leave our readers to puzzle over. The specimen at the Centennial is located at C 8, pillars 62 and 63. The inventor is Mr. Jonas Hinkley, of Norwalk, Ohio.

SUCCESS OF THE HELL GATE EXPLOSION.

The great mine at Hell Gate has been exploded. Soundings over the reef are not yet finished as we go to press, so that the present depth of water cannot definitely be stated; but judging from the extent of the visible result of the blast and from the fact that a large Sound steamer has already passed fifty feet nearer the shore than ever before, it is probable that the work is a grand success. Despite the assurances of General Newton, the effects of the concussion of the 52,000 lbs. of explosives were greatly feared, and for miles around windows and doors were thrown open, while people abandoned the houses near the mine. At precisely 2.51 P. M., the finger of General Newton's little daughter pressed the key, and the current exploded a torpedo which in turn broke the sustaining cord of a heavy pin-studded plate. As this fell, battery connection with the mine was established. Then a hundred vast fountains leaped into the air at once. Above these pure white columns, perhaps sixty feet in hight, shot a mass of dense black smoke mingled with flying mud and timbers. The explosion lasted three seconds. The concussion was very slight, but was perceptible at Springfield, Mass. Throughout New York city a dull rumble and muffled boom were noticed but no shaking of the earth was remarked.

We can add our hearty congratulations to those which General Newton is receiving from all quarters. The credit of the plan, however, belongs to A. W. Von Schmidt, who destroyed Blossom Rock, San Francisco. After the U.S. engineers had exhausted their resources in devising means to remove this formidable obstruction, Mr. Von Schmidt proposed substantially the same system of coffer dam and tunnels employed at Hell Gate; and he staked his fortune on success, for he asked no pay until the dangerous reef had given place to 24 feet of water. On the 23d of April, 1870, the 43,000 lbs of gunpowder packed in the submerged tunnels and headings was fired, and Blossom Rock ceased to exist. The country is indebted to Mr. Von Schmidt's genius for the magnificent results obtained both at San Francisco and Hell Gate: to General Newton, for the engineering skill with which seven years of continuous and most arduous labor have been brought to a grand and befitting end.

MEDIÆVAL IRONWORK.

The accompanying engraving shows a beautiful specimen of the renowned wrought ironwork of the middle ages. It is a lattice or grille for a window, and is a graceful and elaborate piece of work, wrought out entirely with the hand hammer. It is of German workmanship, and is to be seen at Botzen, a city of the Tyrol, one of those ancient cities to whose workmen we moderns are indebted for countless examples of what skill and taste can do in making our homes, churches, and streets beautiful, and the influence of whose works is now to be found in all parts of the earth.

A MEDIÆVAL WINDOW GRILLE.

Improved Hospital Construction.

We are indebted to Mr. John R. Niernsée, a well known architect of Baltimore, Md., for copies of sketches of various descriptions of wards suggested by him for the John Hopkins Hospital, in the above named city; also for a copy of his own review of the various complete plans submitted for the construction of that institution. In the sketches, the adjuncts of the wards are isolated from the latter by placing a connecting closed corridor between them in the basement only. The isolating vestibule connecting the buildings on the main floor has ventilation of its own, thus preventing any contaminating intermixture of air currents. By this system the architect proposes to obtain virtually all the advantages of the detached pavilion system of the lately completed great hospital in the city of Berlin, Prussia. The drawings exhibit five differently shaped common wards, with diverse arrangements of their adjuncts or service buildings, but all based on the principle of effectual isolation of the common ward

The New Thames Tunnel.

The new subway between North and South Woolwich, which was lately commenced in London, is estimated to cost $375,000, and will consist of an iron tube in segments 9 feet high, with a breadth sufficient for four adults to walk abreast. It will be lined with white glazed pantiles and be lighted with gas, and will possess an efficient system of ventilation. The entrance at the south side of the Thames will adjoin the North Woolwich station of the Great Eastern Railway, and on the north side will adjoin the Woolwich pier. The charge to casual passengers will be two cents each way, but to workmen going to and fro books of tickets will be issued at a considerably reduced rate. The new tunnel is being constructed chiefly for the accommodation of the workmen engaged at the St. Katherine's Dock Extension Works, where 3,000 men will be employed for three or four years to come, the Beckton Gas Works, where 2,000 stokers are at work, Henley's telegraph works, Silver's india rubber works, Foster's wine stores, etc., numbering altogether some 8,000 men, who at present have little or no house or food accommodation within easy access of their work, North Woolwich being a dismal swamp unsuited for residential purposes. The new docks, which will materially increase the dock accommodation of the Port of London, will reclaim twenty acres of marsh land, and convert North Woolwich into a comparatively healthy island.

Liquid for High Temperatures.

It is often necessary to surround the pipes of heating or evaporation apparatus, and hot air apparatus, ovens, stoves, etc., with a boiling liquid at a temperature above 212° Fah.; it is also necessary to make use of water baths producing high temperatures. The liquid employed for this purpose is simply water in which sea salt has been dissolved. Oil baths, etc., are also used. Messrs. Grimm and Corvin propose, instead of these various agents, to make a solution of chloride of lime in glycerin, a solution which does not boil below 572 or 626° Fah., and has the further advantages of never attacking metals nor congealing.

Manufacture of Clouds.

The stage of Wagner's theater, at Bayreuth, required 3,247 gas jets. The rising mists and gathering clouds needed for scenic effects were produced by two large engines placed at a short distance from the theater, whose steam was carried by pipes to reservoir, from which it could be distributed by a network of tubes over the whole stage. In the corner towers of the theater are two cisterns, each holding about 1,200 gallons, from which water can be obtained at a very high pressure in case of need. The gas and water works of the theater have cost $30,000.

Ozone an Active Poison.

The eminent French chemist P. Thénard writes as follows in regard to the effect of ozone, or active oxygen, on the animal system. "I believe," says he, "that it is high time that the attention of the public, and even of the learned, was directed to the widely spread errors in regard to the action of ozone on the system. Far from being a remedy, it is rather one of the most energetic poisons that has been prepared in our laboratories, and the serious accidents which have occurred in my own leave no doubt of it. I will not enlarge on its physiological action, since A. Thénard will soon publish an article on that subject; but will only give prominence to the fact that, under the influence of ozone, even when greatly diluted, the blood corpuscles rapidly contract and change their form, the pulse become slower, so much so that a guinea pig with a normal pulse of 148, after being kept 15 minutes in a weak ozone atmosphere, had the pulse reduced to one thirtieth. At the present time, when an accurate method of measuring temperature is of great assistance in medicine, ozone may possibly prove a means of preventing too great a rise of temperature; but inconsiderately to disseminate ozone in inhabited places, in the delusive hope destroying a miasma, would be very dangerous. If our strongest poisons furnish in certain cases our best remedies, we must first learn how to use them, so as not to make a mistake in the time of giving or in the dose. Then, is it certain that ozone does exist in the atmosphere? Its presence there is proven by means of colored paper, the color of which changes more less in contact with the air. But who knows that there is not some other substance present in atmospheric air, which can modify this paper in the same manner as ozone? Wittmann passed a stream of air through the flame of a glassblower's lamp, and obtained a kind of air which acted upon the so-called ozonometric paper (starch and iodide of potassium) just as ozone does; but while this air disinfected badly smelling water without making it acid, ozone does not disinfect and does make it acid. Moreover, it is well known that ozone cannot exist at a temperature of 392° Fah. (200° C.), while this modified air of Wittmann's was exposed to a temperature at which glass softens."

It will be seen that there is still much to be desired in the discussion of this question, although it would be considered over-hasty to deny the possible presence of ozone in the air, or to assert that it is never used with profit in medicine.

AN ORNITHOLOGICAL ORNAMENT.

There is one distinction which the student of the superb

exhibits of China and Japan, at the Centennial Exposition, finds himself called upon to make on comparing the respective displays. And that is that: while the Japanese impress us by their remarkable progress, by the wonderful celerity with which they are adapting themselves to Western ideas, habits, and customs, and with the admirable neatness and artistic beauty of their handiwork: still one may look in vain for the evidences of that tireless patience which, reinforced by skill transmitted from father to son for ages, results in the production of the marvelous work in ivory, in wood, and in porcelain, which abounds in the Chinese department. The Japanese bronzes exhibit the perfection of delicate labor; the Chinese carved wood ornaments show the same characteristic, but in addition indicate labor carried on over very long periods of time. The essential feature of every thing Japanese is ingenuity and skill; of everything Chinese, patience; and nowhere throughout the Chinese exhibit is this last characteristic more prominently displayed than in the case of ivory goods in which the curious ornament represented in the annexed engraving is found.

In this case are the famous Chinese balls—hollow sphere after sphere being carved one within the other out of a solid lump of ivory, and yet each sphere is exquisitely carved and ornamented. Here also are superb sets of ivory chessmen, valued at over four hundred dollars per set; models of Chinese junks with every portion a marvel of delicate filagree work; fans reminding one of petrified lace and grotesque statuettes in ivory, in forms such as only originate in the Celestial mind. The ornament we illustrate is a large bird's head, the bill being made out of ivory, richly carved in groups of men, houses, and trees on its upper side. At this point also the bill is stained or rather clouded a deep red. The head proper is covered with feathers attached in some incomprehensible way, but so naturally that one would suppose, did so gorgeous a bird—not to mention a creature with an ivory beak—ever exist, that they grew there. The feathers above are of a deep peacock green; as the eye is approached, an exquisite shade of light blue is contrasted with a golden yellow, and a few light crimson feathers stand prominently forth from those of softer hue Beneath the bill the feathers are of a rich brown flecked with black. The combination is one of surpassing beauty. The head rests on a base of ebony carved in intricate designs, and this in turn on an ornamental pedestal.

Flax Manufacture in America.

The commencement of a new manufacturing industry in this country is exemplified in the successful establishment of a small linen factory at Manchester, N. H. Some enterprising parties secured some land, sowed it to flax, gathered the crop, and prepared it for spinning, hired a Scotch flax finisher, procured spinning machinery and one loom, and worked up the flax carefully and slowly, until by easy steps the business was thoroughly understood and mastered. The amount of money risked was small, and in case of failure the loss would have been trifling. But it is precisely such ventures as this, and so conducted, that succeed, and this experiment has become a success. A linen manufactory is about to be put into operation with a certainty of its being practicable and profitable. It was in this way that the cotton manufacture began in the Southern States, where it is now a grand success. Woolen manufacture began similarly in the West, where it is now firmly established, and we are well convinced that it needs only to be begun in this careful manner for flax manufacture to become also an established business in the West.—*Bulletin of the American Iron and Steel Industry.*

Jacquard, the Inventor of the Figure Loom.

The Italian proverb, *chi dura, vinc*, is so true that the world has often had to lament the interruption of useful labors by the too early death of those who have begun them; the projector fails, and his half-executed projects fall back into formlessness. Jacquard, tried by fortune with a severity exceptional in the history of inventors, did at least last long enough to perfect his invention and know its success. The story of his life and an historical account of his world-famous loom are contained in a handsome quarto from the pen of Dr. Kohl, lately published.

Born at Lyons in 1752, the son of a journeyman silk weaver, young Jacquard grew up without more formal education than the reading he snatched as an apprentice in a bookbinder's shop. His energetic spirit was but disciplined by his difficulties; yet to have been able to have a share in advantages, now at hand's reach of every mechanic, would have been of priceless benefit to him, and, probably enough, of advantage to ourselves, the heirs of his successes. His mother died while he was yet young; when he was twenty his father died, bequeathing him a little house and a hand loom. Jacquard quitted his bookbinding for the loom, seeing the time come to carry out his improvements in it, which he had long been revolving. He married a woman who endured many years of privation with him; their first born was not many months old before poverty came upon him; he sold his little patrimony; and destitute, with wife and child, faced about to fortune, fighting necessity with a quick brain. Inventing, contriving, improving, he fought his way on till the thirty-seventh year of his age, when the revolution broke out.

He now became a soldier in the non-figurative sense of

the word, and remained in the army till 1795, when his son, a lad of sixteen, was shot down at his side. In 1796 he came back to Lyons: the shade deeper in his large, melancholy eyes, his face graven by thought and sorrow into the sad patience shown so well in his portrait. He now devoted himself to the making practicable his figure loom, hoping thereby to reduce the tediousness of the work of the children employed in the weaving shops. He received sufficient support to enable him to realize his plans, and in 1801 exhibited at Paris his inventions, which won for him a bronze medal, and were immediately taken up by the Lyons master weavers. In this, as in later inventions, Jacquard retained no right of profit.

The next sight we have of him is at Paris, where he had brought a model of a machine to compete for a prize offered for a mechanical method of making fish nets. Introduced to General Bonaparte and his adjutant Carnot, the latter roughly asked him "if he were the man who professed to do what God himself could not do?" The general came to the aid of Jacquard, and, with characteristic insight, approved both invention and inventor, dismissing the latter with encouragement to experiment further.

In 1804 the Society for the Encouragement of Industry became Jacquard's patron, and gave him a post in the *Conservatoire des Arts and Métiers*. This was perhaps the fairest part of the inventor's life, and invention after invention surprised the world with his fertility. It was in the few months that he kept his post here that he recreated Vaucanson's spinning loom. Unluckily for himself, he received and accepted an invitation from Lyons to superintend a factory there, and left Paris before he had been in it a twelve month. In 1806 the Prefect of Lyons received an imperial order to pay Jacquard a pension of $600 a year, on condition that the latter conceded to the city of Lyons all the right and profit in the use of his inventions, binding the inventor to watch over the same and give his whole time to them. The far-sighted and very capable Emperor acted exactly as many a rascally overseer in a factory does by a clever subordinate, who, at the cost of a little inexpensive distinction, is flattered out of the fruits of his brain. From this, the highest moment of his fortunes, began their decline. Public opinion in Lyons turned against him, his models were used without compensation, he engaged himself in contracts in which only his own side was kept to, his machine was slandered as a plagiarism of Vaucanson's. The weavers were accused of purposely spoiling their goods to bring the Jacquard loom into discredit; and their hatred to their benefactor, expressed in often repeated threats of murder, culminated in their breaking up and burning, in the Place Terraux, models and machinery together—scenes, the horrors of which flashed up again only too vividly when Jacquard was an old man and came to die. Only inventors and benefactors know the innermost bitterness of moments such as these.

Little by little the Jacquard loom came into universal use, and at length, in 1840, the Lyonnese, aided by foreign subscriptions, set up in honor of their great citizen a bronze statue, with the inscription:

A. JACQUARD
LA VILLE DE LYONS RECONNAISSANTE
MDCCCXL.

The inscription must have been written by a foreign satirist. Jacquard died on August 7, 1834, in the 83d year of his age.

The sketch which Dr. Kohl gives of the life of the inventor is followed by the fullest details of his inventions in the order of their development. An atlas of mechanical plates, beautifully executed, complete the very perfect monograph, to which a last interest is given by its German authorship.

Correspondence.

Rat-Tailed Larvæ.

To the Editor of the Scientific American:

I wish to call your attention to something I found recently at a neighbor's. The curiosity consists of larvæ, about ¾ inch in length and ⅛ inch in diameter, of cylindrical form, having usually six feet on each side, and covered by a transparent skin through which the internal viscera can be distinctly seen; but most remarkable of all, the posterior end of the body terminates in a caudal appendage of about the same length as the body, and presenting to the eye the same appearance as the tail of a mouse or rat.

One thing that attracted the attention, of the gentleman at whose place I found these specimens, was the fact that the water in which they were found had contained the carcasses of four or five drowned rats; and when they were thrown out of the barrel in which the water was contained, the bodies of two of the rats were filled with these rat-like worms! Upon the water, which was quite stagnant and foul, were several hundreds of these larvæ, some alive and squirming and crawling up the sides of the vessel, but a majority dead; but all had the tails.

I am not much of an entomologist, but have given the science some attention; and in all my reading, and in such search as I have been able to give the matter, I can find no authority for maggots with tails like rats, which these undoubtedly are. They are new to me, although they may be familiar to you. Will you please let me know where they belong? R. M.

Emporia, Kan.

[The curious "rat-tailed" maggots, so graphically described in the above letter, are the larvæ of a large two-winged fly belonging to the genus *eristatis*.

They may be found not only in stagnant pools, but also in water-soaked rotten wood, and are quite common in salt vats. Our correspondent may rest assured that, singular as was the resemblance which struck him so forcibly, between these larvæ and the rats that were found drowned in the same vessel with them, it was a mere coincidence and not in any sense a case of mimicry or inheritance. The larvæ of *eristatis* being aquatic or amphibious, the tail-like appendage is in reality a respiratory tube, provided at the tip with two stigmata which may be protruded above the surface of the water for the purpose of inhaling air while the larva remains concealed beneath. These larvæ are further characterized by the seven pairs of well developed prolegs or leg-like tubercles: the young of no other species of *diptera* possessing so complete a set of locomotive organs. When ready to transform, they leave the water and burrow into the ground, changing to coarctate pupæ, of which the tail still forms a conspicuous part. The flies are frequently seen hovering about flowers in the spring or buzzing loudly against our windows in autumn. One species has large, bright copper-colored eyes, and a stout body of metallic green color, the thorax ornamented with five gray stripes. Some are gaily banded with black and yellow, and, except by a careful observer, might be mistaken for wasps. Others again have hairy bodies and legs, and more nearly resemble bees.—EDS.]

Expansion of Locomotive Boilers.

To the Editor of the Scientific American:

I notice that some builders of locomotives still persist in fixing the side bars or framing of their engines rigidly to the boiler, notwithstanding their knowledge of the expansive qualities of metals. Under ordinary changes of the weather, all iron structures of much extent, if designed for durability, must have provision for easy play of this resistless and ceaseless action caused by change of temperature. How much more important is it that careful provision should be made for the free expansion and contraction of a locomotive boiler, subject as it is to vastly greater changes of temperature!

It has been found by experiment that the quality and condition of a metal determines the percentage of its expansion. For instance, tempered steel expands more than untempered, and soft forged iron more than common commercial bars. The expansion varies slightly also with different qualities of the same metal, so that there can be no fixed formula by which to predetermine the exact amount of this change by temperature.

It may be stated generally that zinc will expand 0·0029, lead, 0·0028, tin, 0·0028, copper, 0·0019, silver, 0·0019, brass, 0·0019, gold, 0·0015, wrought iron, 0·0012, steel and cast iron, 0·0011, of its length by the addition of about 175° to its normal temperature. In other words, a rod of zinc 25 feet long will lengthen ¾ of an inch, lead and tin 1 3/8 inch, copper, silver, and brass ⅝ inch, gold and wrought iron 7/16 inch, steel and cast iron ½ inch.

It will be noticed that copper and brass vary much more than wrought iron: hence the unfitness of these metals for any part of an iron boiler, either for tube sheets or tubes. The expansion of steel being somewhat less than that of wrought iron, it would doubtless be good practice to use steel both for fire boxes and tubes in iron shells, on account of the more direct and intense heat in contact with these parts, which would compensate for the less expansive quality of steel.

One of the present long locomotive boilers, under the high pressure at which they are worked, will expand from five to seven sixteenths of an inch probably, depending somewhat upon the age of a boiler, and the quality and condition of the iron. Who can estimate the great strain thus imposed, and its effect upon the boiler and machinery when the side bars are rigidly fixed to the boiler? We only know that the boiler soon becomes leaky, and that the machinery does not retain that perfect linage in which it was first placed by the painstaking machinist, and which is so essential to the durability and economy of an engine.

It is true that most locomotive makers provide partially for the expansion of the boiler by elongating the screw holes in the feet of the brackets and braces that rest upon the side bars, and more recently by loops which embrace the side bars along the sides of the fire box; but there are some builders who still persist in fixing a central girder rigidly both to the boiler and side bars. I refer to the girder which sustains the rear end of the crosshead guides. I am partial to the looping principle, and this central girder and the feet of all braces attaching the side bars to boilers should simply embrace the side bars in the form of a loop nicely fitting the side bar; and the rear ends of the crosshead guides should slip into the central girder so as to allow of a slight lengthwise play.

But the saddle casting, to which the cylinders are attached, should of course be most rigidly and thoroughly fixed both to the boiler and side bars. Then the office of all the other fastenings which hold the side bars to the boiler would be simply to keep the guides and machinery in perfect line without obstructing in the least the free lengthwise play of the boiler. It is excellent practice to cast half of the saddle with each cylinder, and then bore and fit the cylinders together, so that they lay perfectly parallel with each other, of course both vertically and laterally, and then fit them to the boiler as a single casting. In getting up a pattern of this kind, the pattern maker should be familiar with some of the intricacies of molding; if he be not, he should consult an intelligent molder.

Worcester, Mass. F. G. WOODWARD.

MR. MERRICK BEMIS' address is New London, Conn., not New Haven, Conn., as stated on page 177, current volume.

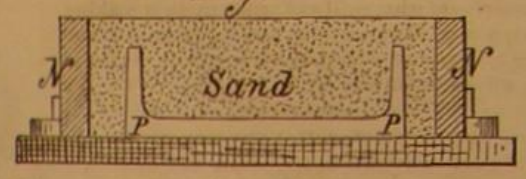
PRACTICAL MECHANISM.

BY JOSHUA ROSE.

SECOND SERIES—Number XI.

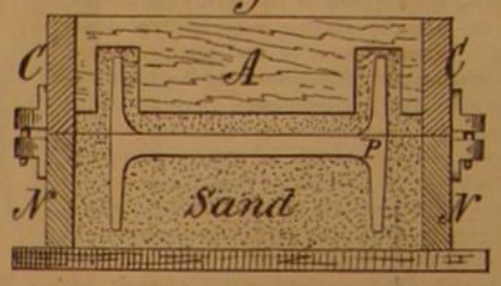
In Figs. 76 and 77, we have another example of flask molding, but for a pattern of different shape to our previous

Fig. 76.



one. The pattern is, in this case, not made in halves, its flanges on one side being left loose. In Fig. 76, one half of the pattern is shown on the molding board, and the nowel placed thereon and rammed with sand; while in Fig. 77 the

Fig. 77.

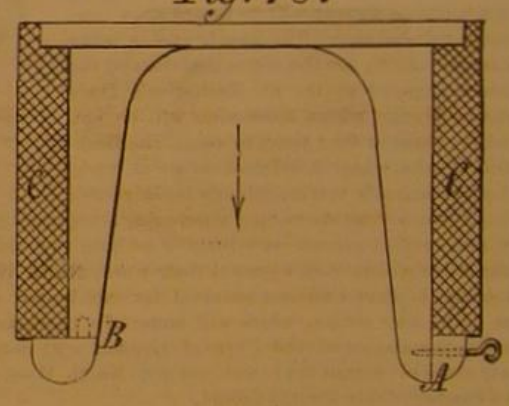


pattern is shown molded and ready to have the cope taken off, A representing one of the crossbars fitted into the cope and following the outline of the pattern.

CORES

are projecting bodies of sand, either left in the mold by the pattern itself or else made in a separate device called a core box. They are placed, after being dried, in position in the mold. The purpose of a core of the latter description is to leave a hole or recess of such a peculiar shape or in such a position that it is impracticable to make the mold of the necessary conformation by the use of the pattern alone. The use of these cores also permits us to modify the shape of a pattern that would otherwise be difficult to mold. For example, Fig. 78 represents a plate of such length that it is necessary to mold it in the direction indicated by the arrow; as the pendants, which are long and narrow, with their

Fig. 78.



projections at the extremities, would lock the pattern in the mold. Three methods present themselves whereby to overcome the difficulty. First, we may make the projection loose, the vertical line, A, being the joint; and it is held in position by vertical dovetails or by horizontal wires, as shown in Fig. 78. In the latter case, the molder, when ramming the sand, withdraws the wires; and when the pattern is withdrawn from the mold, the two different projecting pieces are left in the mold, and are subsequently retracted horizontally, and then lifted out. It is obvious that this can only be done when there is sufficient space to accommodate the projecting piece as it is withdrawn from its recess in the sand, and to admit of its being raised to the surface. To this method there is the objection that the recess left by the projecting piece in the mold cannot be, in many cases, either inspected or dressed if any reparation is required. A second plan would be to make the projecting piece join the pattern at the horizontal line, B, in Fig. 78, but separable from it; but in this case a three-part flask would have to be used, entailing double work for the molder. The third method is to affix the core prints, C C, to the sides of the pattern, leaving those sides smooth and even; and the pattern will then draw easily out of the mold. If we then core away all we have added to the pattern, as shown by the dotted lines in Fig. 78, the casting will retain the correct shape of the pattern. To effect this coring away, we make dry sand cores of the shape of the core prints, C C, and place them in the mold. Ordinary dry sand cores are composed of a mixture of sand and flour moistened with water, and they are molded to the requisite shape in the core boxes already mentioned. They are then baked, becoming sufficiently strong to handle; but previous to the baking they are so weak that they cannot be handled without being in some way supported. It is, therefore, as great a consideration to the pattern maker how the core is to be taken from the box as it is how a pattern shall be drawn from the mold. We may divide cores molded in a core box into three classes. First, those that lie as they are made; second, those that require turning over; and third, those that not only require

turning over, but require also a bed of sand made for them to lie upon during the process of baking. Figs. 72, 73, and

Fig. 73.

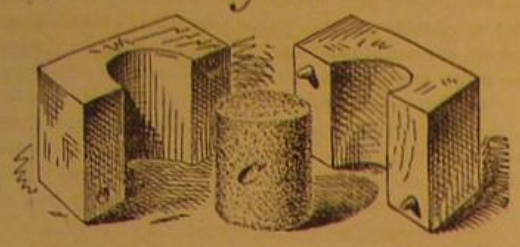


Fig. 72.

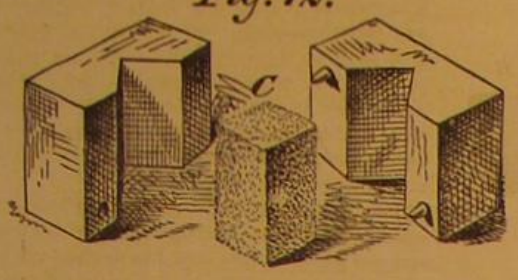
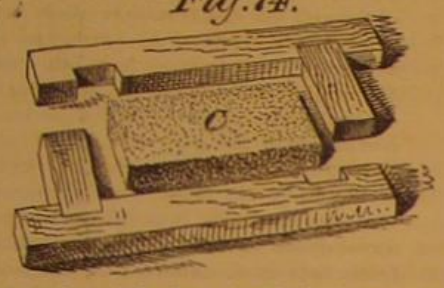


Fig. 74.

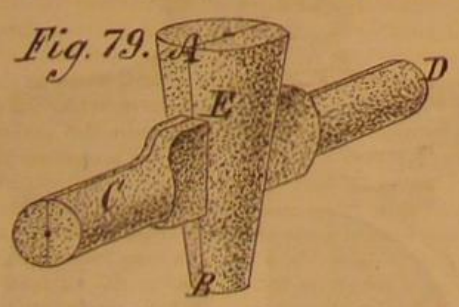


74 are examples of the first, in which the cores are represented by C. The core boxes, being made in halves and loose at two of the opposite corners, can be drawn away from the cores, C, leaving them standing, just as they were made, on an iron plate ready for removal to the oven. In a core box made as in Fig. 74, it is necessary to bore in the ends a couple of small holes for the insertion of wires to effect ventilation. In cases where sufficient draft or taper can be allowed on the core, the core box need not be made in halves, but may be made solid, as shown in section in Fig. 75.

Fig. 75.

While it is the aim of the pattern maker to form his core boxes to work in the simple manner illustrated in our examples, there are very large classes of cores with which such easy methods are impracticable. This, for instance, is the case with all round cores that are of such length that they are not able to support themselves on end, and with those having branches, as shown in Fig. 79, which represents a core for

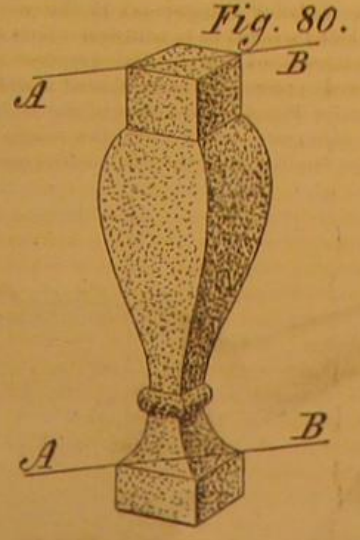
Fig. 79.



a straight faucet. If it were attempted to make this core in a vertical position, its overhanging branches would fall away immediately after separating the two halves of the box; hence it is made horizontally, and generally in separate halves, which, after being baked, are pasted together and again dried, thus forming the full round core. In cases, however, where great numbers of such cores are required, as in steam fitters' work, they are usually lifted from the box whole; but it is a delicate operation, involving much practice. We need not, however, go into this, the subject only being mentioned to show how a pattern maker decides whether he shall make a full core box or only half a one; for if the halves of the core are to be made separate, and one part is exactly similar to the other, then a half core box is all that is necessary. Suppose, for instance, the core of a faucet, shown in Fig. 79, to be alike at the branches, C and D; then, it being made in two halves meeting in a point represented by the line, A B, the core box may be made to mold the half, E; and two of such halves, pasted together as described, will form the whole core. In this particular example, however, there is yet another way of making the core, providing the branches, C and D, are parallel in diamter, and that is to punch holes in the main part of the core, through holes provided in the core box, using a piece of wood for the purpose.

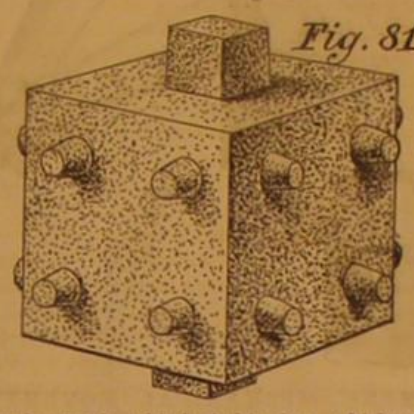
Fig. 80 is an illustration of a square core for a baluster; its four sides being curved, it is necessary to make it in separate halves, dividing it diagonally across the corners, as denoted by the lines, A B.

Fig. 80.



We have now to give an example of the third class of core, which will not stand on end and does not present a flat surface on any of its four sides, neither can it be readily divided, as in the former case. Fig. 81 is an illustration of

Fig. 81.



probably the simplest kind of this class, which will require a core box that must part in all directions in order to enable us to extract the core, which will require, in addition to this, what is called a turnover box. Fig. 82 is an end sectional view of this core box, having four jointed sides and a bottom, with holes cut in them where the projections are to be formed on the core. The top, in this case, is simply two bars that cross the box where the projections occur; and holes are cut in these bars to form the projections. The box is retained together and kept in position by the taper pegs shown at the junction of the sides. The ends of the box are recessed to receive the sides, but all is removable. In using this box, after ramming up the top, the crossbars are removed and in their place is mounted the turnover box,

Fig. 82.

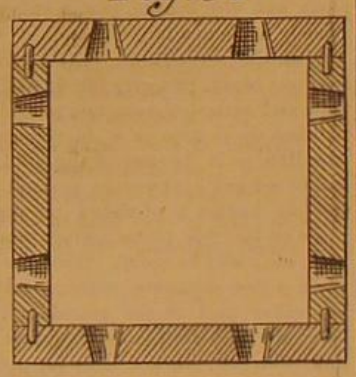
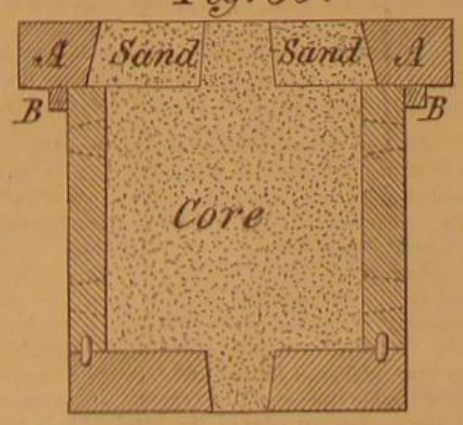


Fig. 83.



shown in section in Fig. 83, at A, which is a simple square frame, made taper. It rests on the outer edge of the core box, so as to give a bed of sand somewhat larger than the core itself. Small blocks nailed to the underside, B B, keep it in position. The frame is then carefully filled with ordinary molding sand, so as not to disturb the projecting parts of the core, and the sand on the outside is then struck off level. An iron plate is then placed on the top of all, and the whole is turned upside down. The bottom of the core box, which has now become the top, is first removed, and then the sides and ends. Thus the turnover box affords a bedding of sand, on which the core may rest without suffering injury from its own weight.

It would be a costly matter to make core boxes for long ylindrical cores, such as are used for pipe and similar castings; hence, for such purposes, a core is made as shown in Fig. 84, in which C represents a core for a pipe, having a socket at one end. It is prepared as follows: Upon the two tressels, A A, is mounted the long tube, D D, which is perforated throughout its entire length with numerous small holes, and which is provided at one end with a crank handle, by means of which it may be revolved as it rests in the two rude V bearings, provided in the top of the tressels, as shown. Upon this tube a layer of rudely twisted straw rope, sufficient to make its diameter assume, from end to end, nearly the required diameter of the core, is coiled. Outside the straw rope, there is then applied a coating composed of a mixture of loam and other material, sufficient to increase the diameter from end to end, somewhat above the finished size. To round up the core even, and make it of the necessary size, the core or loam board, B B, is employed. It is simply a board ranging in thickness from seven eighths inch upwards, according to its length. One of the edges is cut to the conformation of the required core; and all but about three sixteenths of an inch of the thickness of this edge is beveled off at an angle of about 30°. This board is laid upon the tressels with the beveled edge uppermost, and is held in position by weights placed upon it over the tressels. The core is then revolved by the handle in the direc-

Fig. 84.

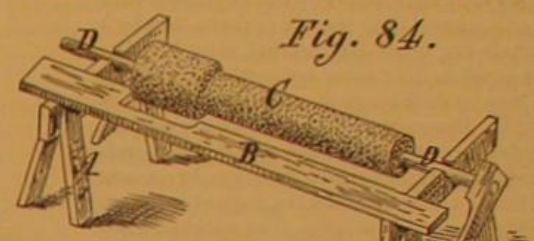
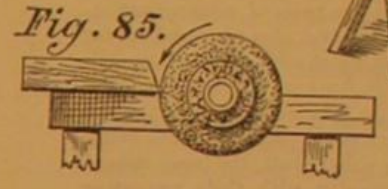


Fig. 85.



tion of the arrow, as shown in Fig. 85, in which A represents the tube, B the straw rope, C the loam coating, and D the board. It follows that, as the loam is added, the board will level it off, leaving the surface round and true, and to whatever shape the edge of the board may be made. It is customary to mix, with the coating of loam, horse dung or a substitute therefor, the object of which is as follows: It will be readily perceived that it is a difficult matter in a long casting to give vent to and permit the escape of the air and the gases formed in the mold by the molten metal; but by mixing in with the loam a combustible material, the latter becomes consumed during the baking of the core, leaving the latter porous, so that the air and gases can pass from the mold through the loam coating and thence through the straw rope, and find exit through the hollow tube upon which the latter is wound. We are now, however, verging upon the work of the loam molder, a subject of great importance to the pattern maker, and which will therefore demand some extended observations after the simpler examples of pattern work have been explained.

Naval Items.

The United States steamer Vandalia was subjected on September 8, on the eve of her departure for the European station, to a speed trial over a carefully measured course of three nautical miles in the Hudson river, under the superintendence of a special board of naval officers. She made four runs, two up and two down, over this course. She was fully armed and equipped for a cruise, laden down to her deepest draft. The following are the results of the trial, which was pronounced highly satisfactory, as well in regard to the working of the machinery as to the developed power and speed:

Draft of vessel during trial: Forward, 16 feet 10 inches; midships, 17 feet 3 inches; aft, 17 feet 8 inches. Area of midship section at that draft, 516·6 square feet; displacement of vessel at that draft 2,130 tuns; average steam pressure during trial, 76·3 lbs.; indicated horsepower developed, 1,176; average speed of four runs, 12·06 knots per hour; force of wind, 1; water, smooth; tide, last of flood, slack water, and first of ebb.

The Vandalia is a new sloop of war built at the Boston navy yard, and has a pair of compound engines designed at the Bureau of Steam Engineering of the Navy Department. She was completed and put in commission in the early part of the spring of this year, and has since done service at different parts of our coast. The following are the principal dimensions of the vessel and of her machinery:

Length of vessel on load line, 219 feet; extreme breadth, 39 feet; diameter of cylinders, 42 and 64 inches respectively; stroke of pistons, 42 inches; area of grate surface, 240 feet. She has a four-bladed screw, of 15 feet 6 inches diameter and of 21 feet pitch.

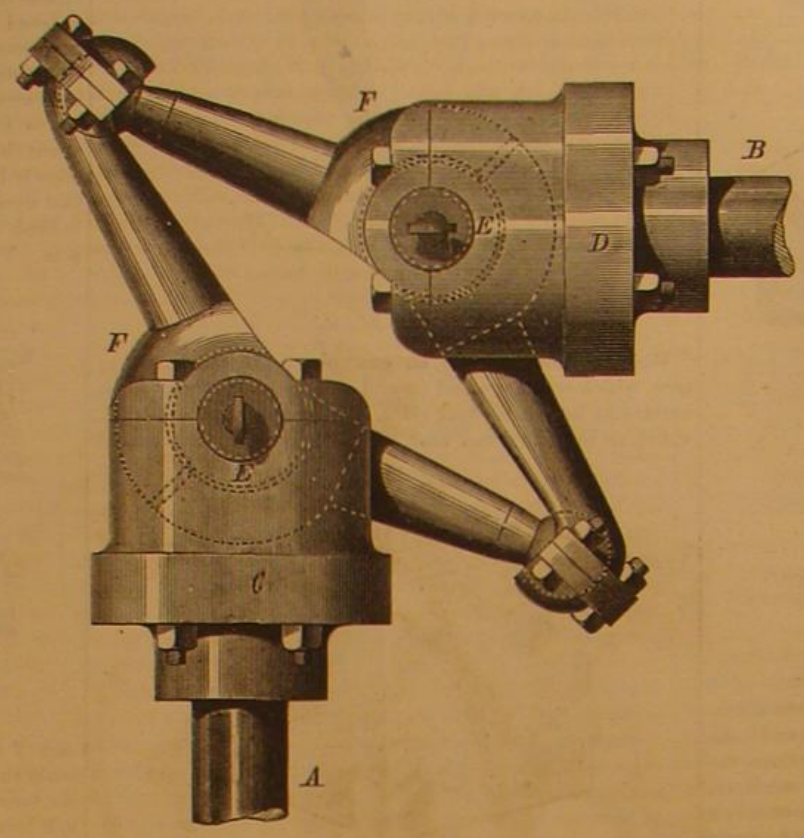
The above trial differed in some essential particulars from the "measured mile trial" of English naval vessels. Their dash over the short course of a single mile is made under exceptionally favorable circumstances, namely with a special force of carefully trained firemen, the best picked coal, and not unfrequently a forced draft: the object of the trial being a test whether the different parts of the machinery are properly proportioned to one another and to the hull. It is evident that the trial of the Vandalia, made under the conditions of ordinary service and over a three times longer course, affords a much closer estimate of the actual capabilities of her machinery.

A NEW MECHANICAL MOVEMENT.

The annexed engraving illustrates a new mechanical movement for transmitting rotary motion, in substitution of bevel gears, the invention of Mr. Melville Clemens, now of Philadelphia, Pa. The apparatus is so constructed that absolutely the same angular velocity of the driving shaft is transmitted to the driven shaft, with positive exactness and avoidance of back lash; and the joint makes a self-adjusting, flexible coupler, enabling the placing of the connected shafts at all desired angles of deflection, from a straight line up to and beyond a right angle.

Compared with bevel gears, especially for heavy work, the present device offers the advantages of being noiseless and of possessing greater strength, durability, and safety, besides its complete range of shaft divergence.

The engraving shows sections of two shafts, A and B, connected at right angles by the coupler; on said shafts are fixed, concentrically with their axes, the like cylindrical heads, C and D, each of which are slotted transversely, forming like jaws, on which journal caps are attached by bolts. Journal bearings are formed through the jaws, at right angles to and concentric with the axis lines of their respective shafts, in which journals are fitted like journal pins, E. The four equal coupler arms are carried in pairs in the jaws, by their hinge-jointed hubs, on the pivot pins, E. The outer ends of the arms are coupled together by two like ball-and-socket joints, each joint being formed by a ball turned up on one arm and fitting a take-up socket box, formed on its connecting arm and Babbitted. The weights, F, on the arm hubs, preserve the balance and uniform momentum of the two pairs of rotating and vibrating arms. The pivot pins are cored out for oil reservoirs, from which oil is supplied, through holes plugged with leather, both to the journal bearings and to the ball joints, making the apparatus self-lubricating. Motive power being applied to rotate either shaft, the inner ends of the arms will revolve with their respective shafts, while the outer ends of the arms will revolve in their diagonal circle of rotation, which compound rotary movements cause the arms to vibrate, both on their pivot pins and at their ball joints, with equal pivot movements: the arcs of vibration at each pivot being, in each revolution of the shafts, equal to the angle of deflection of the coupled shafts. The angular velocities of the two shafts are evidently the same at all points of a revolution of them, when we consider the arms of each opposite pair as equal levers in all their positions during a revolution.



CLEMENS' MECHANICAL MOVEMENT.

Mr. Clemens has secured patents in this country on his invention, bearing dates November 2, 1869, and April 23, 1872, and has also received patents in several foreign countries. One of his shaft couplers for one hundred horse power can be seen at section C 9, Machinery Hall, Centennial Exhibition, in connection with the exhibit of Mr. George V. Cresson, of the Philadelphia Shafting Works.

Parties desirous of ordering the shaft couplings for the Middle States and Ohio, address George V. Cresson. For orders and territorial rights for the Western and Southern States, address the inventor, Melville Clemens, care George V. Cresson, 18th and Hamilton streets, Philadelphia, Pa.

IMPROVED LINK BLOCK FOR LOCOMOTIVES.

We illustrate herewith an improved adjustable link block,

Fig. 1

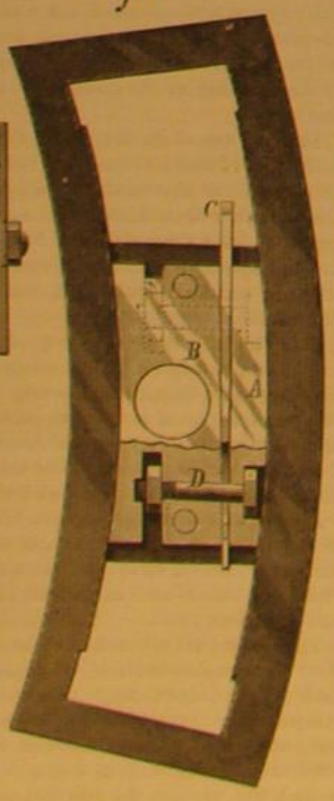


Fig. 2

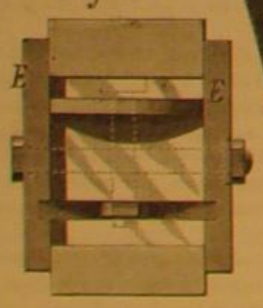


Fig. 3

claimed to fit tightly in the link and to wear it equally. It has other advantages, which will be found fully described below.

The block is not constructed in one solid piece, as is ordinarily the case, but is composed of two longitudinal parts, A and B, the adjoining sides of which are made with suitable inclination to receive the wedge piece shown at C, Fig. 1, and separately in Fig. 3. Screw bolts, D, connect both parts, the heads being countersunk in the recesses of one part while their threaded ends with screw nuts are adjusted by a wrench introduced into the slotted recesses of the other part. The wedge piece is suitably slotted to slide along the connecting bolts. Fig. 2 is a top view of the device, in which E E are the face plates which guide the blocks.

All who are familiar with the link, and its operation with the present style of solid block, know that it is the concussion of the block in the link that causes the link to wear so unevenly; that there is no effectual way of taking up the lost motion; that as soon as it occurs it accumulates very rapidly, causing unnecessary wear on the link and all connecting parts, and the engine to run at a great disadvantage. To remedy matters a large amount of work is required.

With the present improved link block, the inventor claims that one block, properly fitted, will wear the link perfectly true and outlast the engine, providing only the lost motion is taken up as soon as it is perceptible, and not left to accumulate as in the case of the solid block. That the valves can be set and kept square without losing lead. That when the lost motion is obviated, no appreciable wear can take place on the side plates, while much of the wear on rods, pins, etc., will be saved. That the lost motion can be taken up in a few moments without taking down or disturbing any other part of the machinery. That the necessity of using the piece link is avoided, and the solid case, hardened link, which is allowed to be far preferable, can be used to the greatest advantage, and that the device is not costly. The block can also be used as the ordinary old style block to advantage. When, after being used, the links need grinding out and new blocks fitted, all that is needed is to lap out the pin hole, insert a liner between the key and block, or fit in a thicker key, and a block equal to new is gained at a very trifling cost.

Patented through the Scientific American Patent Agency, June 23, 1874. For further information address the inventor, Mr. W. A. Alexander, P. O. box 130, Mobile, Ala.

Carbon Bisulphide as an Antiseptic.

Herr P. Zöller publishes the statement that, in an atmosphere containing a small quantity of the vapor of carbon bisulphide, animal and vegetable matters are effectually preserved against decomposition or putrefaction.

The author affirms that a few drops of this substance is sufficient for the purpose; and since it volatilizes at ordinary temperature, the employment of heat is rendered unnecessary. In this manner, he adds, bread, vegetables, fruit of every kind (and fruit juices), and meat may be preserved for a considerable time in closed vessels. Upon opening the vessels, the unpleasant odor of the bisulphide is very apparent; but upon airing the substances treated for a few minutes, it disappears entirely by volatilization. In the case of meats, the flesh, after having been submitted to the above treatment for several weeks, is in no wise unpleasantly affected.—*Deutsche Industrie Zeitung.*

American Meat in Europe.

The exportation of fresh meat in Europe seems destined to attain more importance than its promoters originally expected. It is but a little time since the steamship Abyssinia took the first shipment of fresh beef from New York—the dressed carcasses of 120 head of New York and Western cattle—contained in an iron refrigerator having an air exhausting apparatus. Now fresh meats form an important feature of all outgoing cargoes.

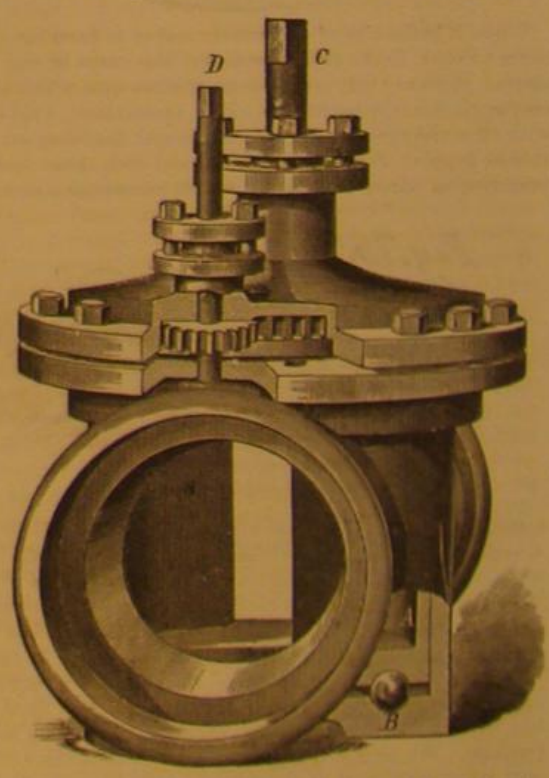
IMPROVED STOP VALVE.

The invention herewith illustrated is an ingenious and novel appliance designed as a substitute for the valves principally employed in water and gas mains. The common valves are usually mere diaphragms moved by a screw either inside or outside of the valve chamber. Outside screw valves are at present most employed; but owing to the length of the screw and its consequent long travel in order to open the valve, the latter is placed on its side. This avoids the deep excavation otherwise required, but still necessitates a long narrow vault, which must be bricked and otherwise finished, and the construction of which, in rocky ground such as is constantly found in many New York streets, we are informed, may cost, for a large valve together with the gearing necessary to work the valve, as high as a thousand dollars. The outside screw, moreover, is liable to rust, and therefore needs constant oiling and attention to keep it in working order. The inside screw, while not subject to the last mentioned difficulties, is easily bent and rendered inoperative; and in case of its fracture, the valve falls across the pipe, and is extricated only with considerable trouble and expense.

The present inventor, who has had a long practical experience in the laying of both water and gas pipes in this city, has devised the valve illustrated herewith on an entirely different principle, and he claims that it will altogether obviate all the disadvantages above noted. It consists of a cylinder, A, having an opening cut through it and placed in a valve chamber. By turning the cylinder on its vertical axis, either the aperture or the solid portion is carried in face of the pipe connections, and thus the water is allowed free passage through, or is shut off by, the valve. The cylinder rests below on rubber balls, B, so that its motion is always free on its seat, while its weight is thus firmly supported. Above, it is flanged so that no water can pass up over it into the bonnet. It has a central stem, C, to which the tool for turning it may be directly applied. In valves of large size, on the upper portion of the cylinder is a gear wheel, and in this meshes a pinion on an auxiliary shaft, D; so that by turning the latter the cylinder can, when desired, be rotated with less power than when operated directly by the central stem.

This valve, being practically but little larger in diameter than the pipe itself, requires no vault, and can be inserted anywhere. In places where pipes mingle, rise above, or cross each other, where it is generally impossible to work the ordinary screw valve, the apparatus shown in our engraving is inserted without difficulty. All its parts are covered so that they are not liable to stick; there is no screw to strip; the cylinder cannot fall, nor is there any portion to become out of order. We understand that the invention is already in successful use in many localities in this city It is applicable to all purposes.

Patented through the Scientific American Patent Agency,



August 29, 1876. For further particulars address the inventor, Mr. J. D. Keegan, 240 West 31st street, New York city.

Railroads in the United States.

Railroad building in this country is progressing with much more rapidity than in 1875. *The Railroad Gazette* for September 8 states that 1,388 miles of new railroad had been completed in 1876 up to that date, against 678 miles reported for the same period in 1875, 984 miles in 1874, 2,408 mile in 1873, and 4,264 miles in 1872. The Los Angelos Division of the Southern Pacific Railroad has been completed, and the Cincinnati Southern is now the only other long line in the country now under way. It will be completed in 1877

VINES FOR WINTER DECORATION.

It may at present seem to be early to be preparing floral ornaments for indoor decorations; but six months beforehand is hardly too soon to commence setting out vines and cuttings for this purpose.

It is a matter of course, says the *American Garden*, from which we select the engraving published herewith, that pots should be used, and then the plants need not be disturbed in the fall. The best of soil, fine dark leaf mold from the woods, should be used; if it be mixed with sand, your plants are sure to thrive with ordinary care. If leaf mold cannot be obtained, use garden loam mixed with sand; but in this case water the plants freely with liquid manure. If started early, your vines will have made a good growth by autumn, and be ready with the best of their foliage and flowers when brought into the house. Be sure that they are not exposed to frost, for the slightest touch will check their growth, and make them miserable and sickly all winter.

In choosing plants suited for this purpose, select only those species which will succeed with ordinary accommodations and treatment. It is useless to spend time and strength on delicate plants that can only be brought to perfection with greenhouse heat and moisture.

Ipomea coccinea, which we illustrate, is a very rapid climber, of the same family as the morning glory, though much more delicate in flowers and foliage. It is excellently suited for window ornamentation, as it is a very rapid grower: it will usually begin to bloom in four to six weeks after planting the seed. The flowers are small and star-shaped, of a brilliant scarlet color, and produced in great profusion. Many who fail with almost everything else succeed in growing this plant.

IPOMEA COCCINEA.

Saw Flies.

Mr. F. Smith, in a recent paper before the London Entomological Society, says: "This *nematus gallicola* is one of the commonest species of saw fly found in Europe; it is the maker of the well-known red galls, so plentiful on leaves of different species of willow. The galls are, as Mr. Cameron observes in his communication to the *Scottish Naturalist*, somewhat local, but they are extremely abundant in many situations. I have on many occasions collected large quantities of leaves, more or less covered with galls, and have bred many hundreds of the flies—all proving on examination to be females. Mr. Cameron observes, in the paper alluded to: 'The male is quite unknown to me, and this appears to have been also the case with Hartig.' Last spring I collected, in the London district, a quantity of the galls, placing them in a large flower pot half filled with garden mold. The larvæ soon quitted the galls and buried themselves in the mold for the purpose of undergoing their transformations. About a month after this the flies began to issue forth, probably to the number of from five to six hundred; among this number I had the satisfaction of finding two males. This sex closely resembles the female, but has a narrower body, longer antennæ, and the tip of the abdomen is pale; the abdomen is also narrower, and not, as in the female, widened toward the apex. This season I have repeated my experiment, and have obtained a single male out of several hundreds of flies.

"Mr. Cameron further observes: 'In all probability they, like *cynips* (*lignicola*) *Kollari* and other *cynipidæ*, propagate without the aid of the male sex.' This observation was undoubtedly made in ignorance of the discovery made by Mr. Walsh in 1868. In the *American Naturalist* for that year, the author records the fact of having himself bred both sexes of *cynips spongifica* from the galls of the black oak of North America. These galls resemble those of *cynips Kollari*, being globular, rather larger than the European galls, but of the same hard woody consistence externally, and of the same spongy substance inside. Mr. Walsh adds: 'By the fore part or middle of June, both male and female gall flies eat their way out of a certain number, say about one fourth part; the remainder are not developed until about two months later.' In a private communication from Mr. Walsh, I learnt that he had, like myself, bred hundreds of the gall flies from galls collected late in the autumn, all these proving to be females, and that it was not until he made collections of galls in summer, when a partial develment of flies takes place, that he obtained the male, this sex being as one to many hundreds of females. At length he bred three males, one of which he kindly forwarded to me, and which I exhibited at a meeting of this Society. Following up Mr. Walsh's method of collecting the galls of *cynips Kollari* early in the season, that is, just at the time when they are becoming hardened, and before any flies have escaped from the fresh galls, I have tried, but hitherto without success, to obtain males of *cynips*; but I advise all who are interested in the matter to pursue the same plan, always remembering that these mysteries of nature are only unfolded at intervals, and then only to favored votaries.

"With respect to the obtaining of males of *nematus gallicola*, I believe that any one may collect, even early in the season, thousands of the galls of that insect without obtaining a male; but in all probability, by persevering season after season, his efforts will, as in my own case, be crowned with success; but I feel assured that unless the galls are gathered before any of the flies have escaped, he will have little or probably no chance of success"

Foundations for Woodworking Machines.

The following practical information is extracted from Mr. J. Richards' new work on "Wood Conversion by Machinery." The subject divides itself into two branches; one pertains to machines with reciprocating motion, and the other to machines with rotary motion only.

In respect to reciprocating machines, such as frame saws, jig saws, mortising machines, and so on, earth foundations resist vibration mainly by the inertia of their weight; that is, an iron machine frame, when firmly bolted to a mass of masonry, becomes part of a whole, consisting of the foundations and the superstructure. A machine frame of one tun weight, bolted to five tuns of mason work, is in effect much the same as though the same machine frame contained six tuns instead of one tun of iron. It is, therefore, not the earth attachments which give solidity and firmness to machinery set on stone foundations so much as it is the weight which is attached to machine frames, and such a proposition at once suggests certain conditions, in constructing foundations, which are often neglected. Presuming a foundation to be an integral part of a machine, the value of such a foundation will be as its solidity, and depend upon how firmly it is bound together, and how near the whole mass, including a machine frame, approaches a solid.

To excavate a hole in the earth, and fill it with loose stones, will not make a foundation; and to attach holding down bolts to pieces of timber buried beneath masonry is to provide elasticity where rigidity is required. Anchor pieces for holding down bolts should be made of iron, and in all cases be placed beneath masonry, so that the whole mass will be bound together. Such anchors require considerable surface, and should never be narrow pieces of wrought iron, but broad castings of sufficient strength to ensure against their breaking with the utmost strain which can fall on them. Such suggestions by no means relate alone to the difference between good and bad foundations. First class foundations are often prepared with holding down bolts to embrace but a part of the masonry, and no attention is given to binding the stone work together.

In cases where such rigidity leads to the destruction of bolts, bearings, and so on, and when some degree of elasticity is essential, it is obviously wrong to place the elastic medium, whatever it may be, between a machine frame and its foundation, or to provide for the elasticity in a foundation; the proper place for introducing a yielding or elastic connection in such cases is between the crank shaft bearings and the machine frame. In this way the desired result is attained in a more effectual manner, and the evil results of jarring and vibration avoided.

When any reciprocating machine, such as a frame saw or mortising machine, has its reciprocating parts balanced—that is, when a weight equal to the reciprocating parts is attached to the opposite side of the crank—the vibration will be changed from a vertical to a horizontal plane; if the reciprocating parts are not balanced, vibration will fall mainly in a vertical plane.

From this it follows that, if the vibration of a reciprocating machine can be changed at discretion from a vertical to a horizontal plane, and *vice versa*, the counterweighting of such machines should, in all cases, have reference to, and be arranged for, the kind of foundations or attachments employed in erecting the machines.

In experiments conducted some years ago by the writer, to determine the most effectual means of resisting vibration in a peculiar kind of sawing machines, driven at from 1,000 to 1,500 revolutions per minute, it was found that a heavy crank wheel gave good results. This in effect was employing the inertia of a heavy mass to resist rapid reciprocating motion, the effect of vibration not being permitted to pass through the crank shaft bearings and be communicated to the machine frame. The experiments were such as to induce a belief that if, in designing deal and log saw frames, a portion of the metal put into the framing were transferred to the cranks or fly wheels, a higher speed could be attained. The introduction of an elastic medium, such as a spring or block of wood, between the bearings of a crank shaft and a machine frame, although seldom done, is one of the most effectual means of avoiding jar and vibration in reciprocating machines.

To sum up the means of avoiding vibration in reciprocating machines we have: (1) Solid foundations, the machine framing rigidly attached so that the whole becomes in effect one mass, to resist vibratory strains. (2) Counterweight arranged with reference to the plane in which vibration can best be resisted. (3) An elastic medium placed between the bearings of crank, shafts, and machine frames. (4) Heavy crank or fly wheels, with the crank pins inserted at or near the center of percussion.

With a proper attention to these several conditions, and by reducing the weight of reciprocating parts to a minimum, it is safe to claim that at least one third can be added to the speed of ordinary reciprocating machines, such as are employed in wood manufacture.

The main argument in favor of strong foundations for rotary machines is found in the manner in which their frames are usually constructed; the object in many cases seeming to be how many separate legs can be provided, and how long a foundation base can be secured. It adds to the apparent stability of a machine frame to have a long base, and no doubt it has such effect if a foundation is considered immovable; but it is evident that, with foundations not immovable, and such as a great share of wood machines have to be set upon, any settling or change of the foundation is communicated to the machine frame, which is thereby warped and strained out of truth in proportion to the weight of the foundation and the power of resistance which the frame offers; in this way a machine frame, instead of being supported by, may be said to support, a foundation. It is not unusual to see machines with four, six, or more legs, fastened down at as many points to upper floors, or other foundations which yield from unequal loads and from settling; tenoning machines are especially affected by being fastened in this manner, and their carriage ways get out of truth, and the frames warped.

A remedy for this difficulty is to mount machines on three bearing points, instead of four or more, a matter which every one understands, and a plan of construction well adapted to many, if not most, wood-cutting machines, yet for some reason not adopted. A machine with three legs may require more rigidity in its framing than if four or more legs were employed, that is, if we are to consider the theoretical conditions under which strain, jar, and so on are resisted; but in so far as keeping a machine in truth, and without settling strains, its performance will, in most cases, be improved by reducing the number of legs or supports.

Rough cutting is the result of imperfect balancing, loose bearings or spindles, or cutters so weak as to spring and bend, and is rarely caused by a movement of machine frames or their foundations.

So important, indeed, are balancing, stiff spindles, strong cutters, and true bearings for wood-cutting machines, that in those countries where the highest efficiency has been attained, in constructing and operating such machines, we find that massive frames and foundations are regarded as matters of secondary importance in the attainment of good work, and that the most perfect English woodworking machinery is constructed with frames of moderate weight.

There is no purpose here for arguing against strong foundations, nor even against heavy frames for machines, when there can be anything gained by either; the object is to explain that many machines which are thought to require masonry foundations can as well be operated on upper floors, as on earth foundations, and great convenience be thus attained in many cases, besides avoiding useless expense in preparing special foundations.

It is, moreover, believed that, in arranging wood factories and machine foundations, there is a want of a proper understanding as to the difference between reciprocating and rotary machines, all being looked upon as the same, and as requiring similar foundations and supports. "Have a good foundation for the planing machines; mortising machines and sweep saws can go on the upper floors," is not an uncommon remark to hear in arranging a wood factory, and a very correct one, considering the general course in a factory but it is bad to place rotary-acting machines on earth floors, and reciprocating machines on upper floors.

CENTENNIAL NOTES.

THE BELGIAN MINING APPARATUS.

A system of apparatus, devised by M. Chandron and designed for sinking the shafts in coal mines, is exhibited in Machinery Hall. The machines are of colossal size and form, the most prominent feature of the vicinity. There is a trepan weighing 15 tuns, which is made of forged iron, and fitted with cutters secured by taper keys, so as to make a cut six feet long. The trepan is raised by steam power to a hight of three feet, and dropped. It is turned at each elevation so that a circle, six feet in diameter, is cut. The advance in soft sandstone is said to be three feet per day. The trepan being withdrawn, a massive iron bucket is fitted into the hole to remove the *débris*. After the first tool has penetrated about 30 feet, a second trepan, much heavier than the first and having a central guide working in the opening made by the first, is used, and, in the stone above mentioned, it progresses at the rate of about a foot per day. A grapple for recovering broken rods, and a sweep to catch the sections of lifting bars, are also exhibited. There is, besides, a grapple for stones, etc., which is an ingeniously constructed pair of double lazy tongs arranged so that the arms extend to the sides of the hole as the device is being lowered, and scour the bottom as it is being lifted.

When the cutting is finished, circular plates are let into the opening, the bottom plates or cylinder sliding inside of a second ring, and being surrounded with a moss gasket compressed between the flanges. This keeps the water out of the bottom. The second ring is convex beneath and floats on the accumulated water. Then, as ring after ring is added, the water is allowed to escape, the rings sinking gradually. Guides prevent the casing from tilting until it is secured to hard impervious strata, when the shaft is pumped out and is then ready for use. This machinery and tubing has, already, we learn, been applied to 48 deep mining shafts in Europe.

RUSSIAN RHODONITE.

We have already noted the magnificent display of malachite and *lapis lazuli* from Russia. With the malachite objects are two card receivers of a very peculiar red stone, the nature of which puzzles most people. It is rhodonite, the name being derived from the Greek work for "rose," in allusion to its color. Chemically it is a silicate of manganese, and it is found in iron mines in Sweden and in various parts of Russia. Professor Dana, in his "Mineralogy," states that it has been met with in various parts of New England, and mentions a large bed as existing in Maine. Diamond dust is needed to cut it, a fact which at once accounts for the price of the articles exhibited, $2,000 each, which will probably deter enterprising New Englanders from seeking the precious mineral in their own vicinity

RUSSIAN FURS.

Not the least interesting portion of the Russian display in the Main Building is the superb exhibit of furs, which, individually as well as collectively, are well worth studying. For example, there are some black fox skins which are so extremely rare as to be worth $300 each. No furs known are more expensive, with the single exception of the pelt of the sea otter. The color is a glossy black, usually with a silvery grizzle on the forehead and flanks. When this grizzle occurs the price falls, the pure black skins only costing such high figures. Some of the skins of Russian sable exhibited are valued as high as $125 each. This renders them, when size is considered (each skin would little more than cover a good sized rat), nearly as costly as the black fox fur. The darker the skins, the greater the value. But few such fine skins as are exhibited at the Exposition reach foreign markets, as they are monopolized by Russian royalty and nobility. It is stated that only about 25,000 sable pelts are yearly captured.

Besides these famous furs, superb skins of the ermine, squirrel, mink, fitch, seal, etc., are displayed, both in crude state and made up into robes, muffs, and garments. One robe of sable is valued at $2,000. A cloak lined with Thibet goat skin, a fine silky wool, pure white and glossy, is offered for $328. Fur rugs and carpets, almost unknown here but largely used in Russia, are also exhibited. We noticed one exquisite rug, made, we were told, of 2,400 small pieces of fur, of every kind and color arranged in tasteful designs. For the labor manifested in its execution the price asked ($250) seems small. The peculiarity of all the Russian furs is the skill shown in their dressing. Every particle of substance that can possibly be removed is scraped off the inner side of the hide, leaving the thin skin which holds the hair as soft and as fine as a kid glove. The method of preparation is also such as to render the furs moth proof, and even prolonged soaking in water has no effect on their pliability.

THE SPANISH FIBERS.

Spain and her colonies contribute a collection of vegetable fibers, which are applied to a multiplicity of useful purposes. The well known manilla is shown, crude in ten feet lengths, and manufactured into ropes, twines, carpets, and artificial "switches" for ladies heads. The pina fiber is a beautiful production, as soft and as fine as raw silk. The filaments are not taken from the stalk or leaf, as in the flax and similar plants, but are thrown out from the center of the flower. A large case of fabrics from this material is exhibited in the Main Building. The cloth resembles silk, and is superbly embroidered. There is a curiosity in the millinery line, near the same case, in the shape of a rather gaudy lady's hat, interesting, however, because made from the "peel of the common daisy." Several other plants, notably the *banot, taloto, corteza de colías, de nabo, palma de buri,* and others, yield fibers of varying degrees of fineness, which likewise are exhibited, either suspended so as to show their greatest length or wound into skeins.

TWO AUSTRIAN CURIOSITIES.

An opal, said to be the largest in the world and valued at $25,000, is exhibited in the Austrian section. It is an irregularly shaped flat stone, perhaps two inches in its greatest diameter, and comes from the mines in Hungary, whence some of the finest opals produced are obtained. Another curiosity in the Austrian section is a large chandelier made of hundreds of pieces of the finest amber. It is valued at $8,000.

THE SMALLEST STEAM ENGINE IN THE WORLD.

On the platform of the Corliss engine is, perhaps, the smallest piece of steam machinery ever constructed. It is an engine made of gold, steel, and platinum, so minute that it has for its foundation a twenty-five cent gold piece, while many of its parts are so tiny that they cannot be seen without a magnifying glass. It has a regular steam gage; and though complete in every particular, the entire apparatus weighs only seven grains, the engine alone weighing but three grains. The flywheel is three fourths of an inch in diameter, the stroke is one twenty fourth of an inch, and the cut-off one sixty-fourth of an inch. The machinery, which can all be taken apart, was packed in films of silk. The constructor is Mr. Levi Taylor, of Indianola, Iowa.

VEGETABLE TALLOW AND CINCHONA.

The leaves, fruit, and wood of the *tingkawang* tree, also the pulp, from Borneo, are exhibited in the Netherlands section. The produce of this tree is known as vegetable tallow, and is obtained from the fruit.

The tallow, carefully prepared, is used by the natives for cooking purposes. A common article, prepared with less care, is used for lamp oil, for lubricating machinery, and other purposes where fats are required. The roots of the tree are successfully applied in healing wounds, and the wood is a very good timber.

In a large case on the west side of the pavilion is exhibited an herbarium, illustrating cinchona cultivation in Java. The danger that the cinchona tree would be extirpated in South America led to an attempt at its cultivation in Java, which has been entirely successful. In 1852, cinchona plants and seeds were sent to Java, and their cultivation was commenced on a large scale. At the end of March, 1875, the government cinchona plantations contained 2,020,810 plants, of which 1,819,710 were planted in the open air and 201,100 were kept in nurseries.

There are seven plantations, having together an area of about 1,500 acres. The trees from which the bark is to be taken are cut off about eight inches from the ground and stripped of their bark, which is dried in the sun. From the base of the stems which have been cut, a number of shoots spring up, of which one or two are left, which will grow in seven or eight years to a tree that may be again cut off. The herbarium contains samples of the bark and wood, both rough and polished, showing the section both lengthwise and across the grain, the seeds and leaves of the plant and specimens of quinine, cinchonidine, quinidine, cinchonine, and a namorphous alkaloid, made from the Javanese cinchona tree.

THE DUTCH AGRICULTURAL EXHIBIT.

In Agricultural Hall, the Dutch contributions comprise a remarkably large variety of animal and vegetable products. Among the grains we notice a prepared flour so treated as always to keep fresh in the hottest climate. It is put up in hermetically sealed cases, and has we learn, been successfully subjected to the severest tests. Yeast cakes, made from corn meal and oil pressed from corn, are likewise a novelty. There is an interesting display of beet root sugar, produced by the centrifugal process. Beekeeping is represented by a few straw hives of the ancient pattern, and a dress for apiculturists consisting of a bonnet and cape of wire cloth. A large exhibit is made of canned goods, some which, the descriptive card states, were put up in 1852 and have made several voyages to India and back, remaining in excellent condition. Cod liver, rapeseed, linseed, and other well known oils are represented by samples of much clearness and purity. Dutch flax, hand-scutched and mill-scutched, is shown, the fiber being from three and a half to four feet long. A specimen from New Zealand is almost as white and as glossy as silk fiber. Especial attention is directed to the white blossom linseed, which is exported from America to be manufactured into oil. The fiber of this flax is coarser than that of the blue blossom; but it is said to be superior in value. A very marvelous piece of work, partly the handiwork of nature and partly of art, is shown in a lattice or screen, the meshes of which are about six inches square, and formed of interlaced twigs which have grown into each other at the intersections. The lattice is about 8 feet high and 5 feet broad, and the rods are 1¼ inches thick.

TROPICAL WOODS.

Over 1,500 specimens of woods from the Philippine Islands are shown in the Spanish Government building. The specimens are about eight inches square, one side of each being polished and the other plain, and one end is shaved down in a bevel to show the grain. The bark is also left on the block. Among the more valuable of these woods is the narra, a reddish brown timber resembling walnut, and sometimes showing a bright red color, which variety is more highly esteemed. It is in demand for cabinet work. A large plank of this wood, which is 7½ feet wide and 11½ feet long, is on exhibition. Very many varieties are marked as valuable ship timbers. These are tough, close-grained woods, and oak and teak, the latter resembling live oak or black walnut.

In this collection of woods is shown a mahogany log from Cuba, about 25 feet long and 18 inches square. The value of this timber for veneers may be appreciated from the fact that the Commission has been offered $2,000 for this stick. Other woods from Porto Rico and Cuba are also exhibited with that from the Philippine Islands. The prices at which these woods are contracted for, cut, at the province Tayabas, as a principle producing center, are for the narra timber, 1 foot square and 30 feet long, $5 in gold, and the same for the molave timber.

In the same building is a piece of rattan 550 feet long and only 1¼ inches in diameter at the butt. It is coiled up like a cable.

RAMBLING NOTES.

NUMBER I.

WATER WHEELS AND THEIR MAKERS.

"I saw Root last week for the first time in three months. He has a first rate mill site out on the Pappillion, and has just finished his mill. He expects to start up next week. In speaking of the wheels he had purchased, he brought forcibly to my mind a business principle well worth considering.

"He had his own prejudices regarding wheels, as every mill man has, but before ordering he sought and received my advice on the subject. I may state here that I have my prejudices on the water wheel question as well as he, and I will further state that he ordered three wheels, neither his own pets nor the ones I had recommended. When he first spoke to me about the matter, I recommended a certain wheel and at the same time gave him the addresses of all the wheel builders in the country. Last week, at the meeting mentioned, he told me his story. He had written similar letters to all the builders, stating the case and soliciting terms, financial and dynamical. He received many courteous replies and gorgeous catalogues. The respondents explicitly stated that in the last seven years they had sold such a number of wheels—had replaced such a number of So-and-So's wheels—have 200 wheels running in the State of New York alone—'a wheel of our make was placed in the mill of Mr. Sample in New Jersey, under circumstances identical with those named in your letter, and performed perfectly satisfactorily—have several wheels in your county and enclose you addresses of users who will speak for them—send you herewith names of 1,000 users of our wheels, which list speaks for itself of their merit—think three of our new forty inch wheels will suit you—call your attention to our prices—call your attention to the fact that all the wheels in use in our own county are of our make—enclose you Mr. Emerson's report of test of our wheels—advantage of turbines over overshot wheels no longer a question,' and numberless more such items. But one concern wrote as follows: "Three of our forty-two inch wheels, placed as you state, will do the work specified in your letter. Would be pleased to receive your order with that understanding." Now here is a party not afraid to say 'will,' and the banks say Y. 18. Of course the wheels were ordered from these last parties, who seemed to know something about what their wheels will do, as well as what they have done. Root says he cannot lose, even if the wheels fail. The concern furnishing them is responsible, and under the circumstances the price does not become a matter worth consideration.

'There may be a moral to Root's story worthy the attention of manufacturers of the solid order. I mean, of course, solid capital behind solid merit in the product."

THE WASTE OF COAL BY SMOKE.

"From my office window I can see a paper mill chimney of imposing hight. Night and day for two years, that chimney has not ceased to belch out its solid volumes of smoke, solid enough apparently to hold up the chimney if the positions were reversed. That smoke must cost the mill owners a great deal of money; and a great deal of it finds its way into my office in the form of palpable soot. The fact is that this whole smoke business is an abatable nuisance and a sign of waste. Furnaces constructed especially for the economical consumption of fuel are required, on general principles, to burn the smoke. It is not found difficult to so construct a furnace as to attain this end. Smoke is composed of carbon which is visible, and hydrogen which is invisible. Had these products, when first set free in the furnace, been supplied with exactly the proper amount of oxygen, they would have turned into carbonic acid and have been consumed. The proper adjustment of the combination of these gases forms the basis of design for smoke-consuming furnaces.

"But plenty of furnaces are now in use in places where it is desirable to burn the smoke, without entirely reconstructing the furnace or going to any such expense. Many ingenious contrivances have been invented, intended to be a simple attachment to the ordinary furnace and to answer the purpose of originally designed smoke consumers. They consist generally of peculiar dampers or peculiar doors, of air holes behind the bridge wall, or of some arrangement of steam jets in the furnace. The behavior of some of these affairs is remarkable. Some fail entirely, some succeed perfectly, while some burn the smoke, but at great expense.

"Any ordinary coal-burning boiler furnace may be made to consume nineteen twentieths of its smoke, and to effect some slight saving in fuel, without any alteration, and without a penny expense, by proceeding as follows: First,

if you have been in the habit of using a poker, trade it off for a hoe. Next fire as usual, and, if it is not raining too hard, go out and take a look at the top of the chimney It is bound to be smoking. Now with the hoe push all the burning coal a little back, so as to leave a foot of the front end of the grate bars uncovered. Now throw in fresh coal on this clear part, quite a lot of it. It will now burn from its inner edge, which becomes coked, the escaping gases passing over the glowing coal further in the furnace. The process of firing consists in pushing these coked portions back into the fire, and putting fresh coal on the side of the heap nearest to you. You will notice that by this plan of firing you never put any coal into the fire at all, but into what may be called a coking oven, and you burn only coke. All coals, clinker, etc., are moved inward, and as a consequence the clinker will all have to be taken out at the back end of the grates. For this purpose a door in the side wall, level with and at the back end of the grate, will be found more convenient than engineering the clinkers around to the front door again. This method of firing is almost universal in England, where municipal law fines a smoking chimney. One objection to the process is that the charges of fuel, being light, must be pushed forward frequently, keeping the furnace door open a great deal. Notwithstanding this fact, the plan will be found very satisfactory.

SHAFTING, HANGERS, AND PULLEYS.

"Dixon has recently been replacing one of his line shafts. He has been telling me for the last two years that the thing was annoying him. He has made a clean sweep this time, and I hope he is now at peace. He bought that shaft, with its hangers, couplings, and pulleys, in Boston when he first started his shop. It was his main line then. It was only one and fifteen sixteenths in diameter, and the pulleys had wretchedly gotten-up set screws in them. He says he bought the stuff with his eyes shut, and I believe him. About a year ago the receiving pulley on this shaft slipped a little and gouged a couple of rings in the shaft. Last month the shaft twisted off at that place, which is the best thing that ever happened to it, for it made Dixon mad and he superannuated the whole thing. Even the pulleys he laid aside for other purposes. The hangers, when lying on the floor, look as though they had a world of drop, but in reality it was only ten inches, and they had been put up with nine inch wooden blocks to lower them. They had a fearful lot of metal in them, for they dropped about two feet and then turned up again. That's what made them look so imposing when on the floor. They were fancy-looking affairs, all the orders of architecture having been called into play in their design. Dixon threw them in his scrap pile. The shafting was not at all nice, being very irregular, and the pulleys were poor fits. The couplings were of the modern taper sleeve variety, and looked first class in every way, but were always troublesome. They were all right when the shaft was in perfect line, and they were all right when the shaft was very much out of line, as was the case once when a new Daniels planer was put in the pattern shop above. But when the shaft was just a little out of line, as most shafts are, those couplings would squeak and "chaw" the shaft, and work off. Nothing could be done for them but lining up the shaft, which seemed to be the only thing which ought to be done; but the floor above was not substantial, and it would disarrange the shaft in a very short time. In putting up his new shaft, Dixon has stiffened this floor as much as possible, and put up hangers with twenty inches drop, with solid cast iron boxes and glass oilers. The old boxes were self oilers, but gave trouble. He has enlarged a portion of this shaft, as ought to have been done at first, and put on all the pulleys in halves. He says it cost him fifteen dollars every time he put a new pulley on the old shaft, or changed the order of hose already on. He has put on the ancient style of flange coupling, which looks very much like retrogression; but my own experience has been about like Dixon's, and I expect I should have done about the same thing. His couplings are provided with an outer sleeve a foot long, which covers the bolts. Without these sleeves I believe these flange couplings to be the most murderous pieces of metal about a shop. His pulleys are the neatest I have ever seen. Most of these two-part pulleys look very clumsy.

SELF-OILING BOXES.

"Speaking of self-oiling boxes, I was told of a Cincinnati firm who sold a complete mill outfit, with all boxes on the self-oiling plan. The customer reported trouble with the boxes, and further inquiry elicited the fact that no oil whatever had been supplied to them at the trial start. The self oiling feature had been depended on for supply as well as regulation." LEFTWICK.

THE FAIR OF THE AMERICAN INSTITUTE.

Despite the existence of the Centennial Exposition, the present Fair of the American Institute is likely to be as interesting, in point of novelties displayed, as any of its late predecessors. The same, we think, will be found true of other local exhibitions. Both from the size of the Centennial and from the limited time which most visitors thereto have at their disposal, to the foreign exhibits is given the greatest share of attention; and many home contributions, which in smaller collections would be narrowly scrutinized, are there overlooked, or at least but cursorily examined. Local fairs, therefore, viewed as domestic advertising mediums, really offer superior advantages to the great international display; and the recognition of this fact, by manufacturers and others, doubtless accounts for the non-diminution of the usual number of entries in the American Institute building. On the part of the Fair managers, it is evident that exertions have been made to render the show more attractive, both to exhibitors and to the public. New decorations, quite tasteful in their way, a new and handsome fountain, an attractive-looking, though poorly stocked, Japanese bazaar, and various other improvements have been added. The general arrangement of the hall, however, is the same as during former years; and we can dispose at once of a large share of the miscellaneous exhibits by stating that they offer a like similitude. As at every recurring fair there is some one prominent contribution of especial interest, so there is to this one, in the shape of

THE POTTERY DISPLAY.

Visitors who are familiar with the exquisite ware of France and England will see, doubtless, little to admire in the two neatly arranged exhibits of the Union Porcelain Works of Brooklyn and of a New York manufacturer; but on the other hand, those who have watched the progress of the pottery industry in this country will see, in the ambitious attempts at majolica ornaments, Parian statues, and like objects hitherto only imported into the United States from Europe, an advance both rapid and full of promise for the future. We have before us a French journal in which one of the French artisans, who had been sent to this country to examine the Centennial Exposition and who has returned, warns his trade publicly that the competition of the United States in the manufacture of fine pottery is greatly to be feared. Probably the best we can do in fine porcelain is that shown at the American Institute Fair. The taste displayed in ornamenting is sometimes questionable; but the work is there, and there is plenty of artistic ability in the country to supply the needs when once its attention is directed to the subject. In the Brooklyn factory's display, quite a handsome vase is exhibited, commemorative of the Centennial year. Scenes from the national history are executed in bas relief in panels around the base; on the sides are medallions of distinguished men, and the handles are bisons' heads. The painting is appropriate and tasteful, and as a piece of pottery it is of excellent fineness. There is also in the same exhibit a commemorative cup, showing some fine modeling work which is worth examination.

THE MACHINERY DEPARTMENT

is now a chaos, but we are promised a host of new things. The driving engines are three in number; an 80 horse power Wheelock, a Brown engine of similar size, both models of admirable workmanship and finish, and a Hampson & Whitehill 40 horse power machine. There is the inevitable and omnipresent Baxter engine in its various sizes, possessed of a new interest through being attended by a lady engineer. A new yacht engine, said to be of 5 horse power, built by Harsen, of Greenpoint, is a neat, compact, and very small machine, which seems excellently suited for small boats. The cylinder is vertical and inverted, and there is a new and simple reversing gear, which consists of a rod moved to and fro in an inclined slot in an eccentric, thus changing the latter to one side or the other, and so, through the eccentric rod, controlling the motion. The device, which might be termed a single link, works excellently. Celluloid emery wheels, composed of a mixture of celluloid and emery, are exhibited at work. They seem to have the advantages of not glazing, they run with little noise and few sparks, can be used with water, and the wheel at the Fair has cut a clean square-edged notch in an old file, a good piece of test work.

Of course the band and jig saws are out in full force, and the popularity of the Chinese puzzles and toy frames and furniture which they manufacture shows no sign of waning. We notice a new tool interesting to woodworkers, called a friction feed cut-off saw. The friction feed is obtained by passing a strap, which connects the treadle and the vibrating saw carriage, over a friction pulley which is always revolving when the saw is in motion. By pressing lightly on the treadle, the band is tightened over the pulley, and the latter thus pulls the saw forward to its work. There is also a new gage and measuring attachment, placed transversely across the front of the table, consisting of a perforated plate and sliding stops thereon, which last is connected with a pin and knob by a rod. In using, the pin is placed in the hole on the plate corresponding to the length to be cut, and the stop is thus moved to the exact distance from the saw indicated in inches by the scale. This is done very quickly and so saves time. A new gear wheel is exhibited in model (why, we fail to perceive, as opportunities might easily have been afforded for showing full sized wheels at work), made after a new process, the V-shaped teeth being forged or pressed by the action of a die revolving in contact with the heated blank wheel, which likewise rotates. Advantages claimed are absence of flaws, accuracy, strength, no back lash or lost motion, etc. Veneered pulleys are novelties, and seem to be a cheap and fair substitute for ordinary wooden pulleys. The peripheries are made of three layers or veneers of ash. The pulleys run true and easily. They are not visible in actual use, and hence no further opinion is possible. Exhibitors fail to consult their best interests when they show devices idle, which can easily be displayed in operation. This is becoming a too common error at the American Institute Fairs. The mechanical public, the interest of which it is hoped to enlist, is not at all inclined, under such circumstances, to accept assertions of advantages on faith.

Handasyde's Composition for Boilers.

Messrs. C. H. Handasyde & Co., Dunleith, Scotland, have recently established an agency at 24 Broadway, in this city (see advertisement on another page), for the introduction of their anti-incrustation composition for stationary boilers and locomotives in this country. The composition has been tested on the railroads and in collieries and ironworks to a great extent in England and Scotland; and we have before us a long list of the names of the most extensive manufacturers abroad who are using the article at the present time. Mr. G. C. Campbell, the agent in this country, has instructions from the manufacturers to make no charge to users of the composition unless it accomplishes all that is claimed for it; and they modestly state in their circular that they "refrain from claiming for their composition any advantage over others of a similar nature, but ask for a fair and unprejudiced trial, so that its real worth may be ascertained."

The Patent Business of Great Britain.

In the year 1875, the applications for patents made in Great Britain and Ireland numbered 4,561, being 69 more than in 1874. The increase is less by 129 than that of the previous year, and this diminished rate of growth is fairly attributable to the depression of trade.

The British patent statistics enable us to form an idea of the proportions of inventions in that country that have any substantial value. For instance, in the year 1875, 1,173 patents were not carried further than the six months provisional protection, which is the preliminary period for which patent is granted; and as a rule, only 28 per cent of British patents survive their third year, and 10 per cent their seventh. Small as this business appears in our eyes, the considerable fees exacted from patentees realize altogether a very large income, the year 1875 yielding a revenue of over $550,000 in gold after all expenses were paid. This sum is about the average amount; and since the office was remodeled in 1852, over $6,150,000 has been paid into the public exchequer. The claims of Science are now being urged upon the Government; and it is to hoped that, in consideration of the large revenue yielded by the patent office, the proposed Science Museum may be established. A site on the Thames embankment has already been suggested for the purpose, and a plan for the institution is published in the Patent Office Report for 1875, recently issued.

DECISIONS OF THE COURTS.

United States Circuit Court--Northern District of Ohio.

HARVESTER PATENT.—HENRY F. MANN VS. EDWIN BAYLISS.

[In Chancery.—Before Emmons, C. J.—April Term, 1876.]

EMMONS, J.:

In this cause complainant's bill recites that he is owner of letters patent of the United States, dated February 28, 1871, being a reissue and extension of letters patent No. 15,044, dated June 3, 1856, said reissued letters patent being numbered 4,281, for an improvement in harvesters, complainant having been one of the original patentees, and having acquired the interest of his co-patentee, Jacob J. Mann, by an assignment from said Jacob's administrator.

The improvement consists, in brief terms, in having an elevated side delivery of the cut grain in the straw, by means of an endless apron, whereby the grain is discharged into a stationary receiver, of concave form, from whence by means of a revolving rake, the teeth of which describe a circle nearly coincident with the circle of which the concave receiver forms a segment, the grain is gathered into gavels of suitable size for binding into sheaves or bundles. The bill prays answer, account of profits and damages, and injunction in the usual form.

The answer denies originality and novelty of the invention, as also infringement, in that whereas by complainant's device the grain is discharged into a receiver which is "concave" in form, the machines constructed by defendant discharge their grain into a receiver which is "flat and horizontal," from which it is taken by the binder without the use of the revolving rake.

On the hearing the question turned mainly upon the 4th claim of complainant's patent, which is in these words:

"4. The stationary concave receiver I, having a continuous surface, arranged as described at the side of a harvesting machine, having an elevated side delivery so as to receive the cut grain from the elevating and delivery apparatus, and collect the same into gavels preparatory to their being discharged from the machine."

Held, that the device employed by the defendant is essentially different in form from that employed by complainant, as described in said 4th claim, and does not constitute an infringement as charged in the bill.

Complainant's bill dismissed with costs. Notice of appeal to the Supreme Court.

The opinion of the court in this case was delivered orally, and was not reduced to writing, and this report is made by the clerk.

[*Geo. H. Christy* and *Wm. Bakewell*, for complainant.
S. A. Goodwin, for defendant.

DECISIONS OF THE COMMISSIONER OF PATENTS.

IMPROVEMENT IN SHUTTER HINGES.—HARVEY LULL.—EXTENSION.

[In the matter of the application of Harvey Lull, for the extension of letters patent of January 2, 1854, No. 10,477.—Decided July 27, 1876.]

DOOLITTLE, Acting Commissioner:

This application for the extension of the above named patent was made under the authority of the Act of Congress, approved April 28, 1876. It was once extended for seven years, from the 2d day of January, 1868, which term expired the 2d day of January, 1875.

From the *Congressional Record*, in which the proceedings relating to the act above cited were printed, it is shown that this case was very fully discussed in both Houses of Congress. No opposition was made there, or has been made before this Office, since these proceedings commenced. Over sixty prominent manufacturers in various large cities signed the petition that applicant made to Congress.

The invention consists in the construction of a shutter hinge with projections and bevels, so that it may lock itself automatically when opened.

The Examiner imports the invention to be novel at the time of the grant of the original patent, and proof shows that no self-locking hinge made at an earlier date has been introduced into the market to any considerable extent. Nor does it appear that any similar invention patented since that time has superseded it. The proof also shows that the invention is valuable and important to the public to the extent of many hundreds of thousands of dollars, that less than $10,000 profit has been realized by the inventor from the sales of the article, and that nearly all of that has been consumed in litigation.

The Examiner reports, and the proof substantiates his statement, that these hinges have been sold in quantities sufficient to fit 2,160,000 windows; and it is estimated that the public has been saved in breakage, wear and tear, and extra fastening, to the amount of $840,000. The inventor is now very old and poverty-stricken, with a wife and several children depending upon him for support.

It is also shown by numerous affidavits and other evidence that the effect of the proposed extension upon the public interest will be good, inasmuch as it will prevent the manufacture of cheap, lightly constructed wares, and will continue the manufacture of a valuable hinge in the hands of those who will construct it in proper shape and of durable material.

The applicant has fully complied with all the requirements of the law and Office practice entitling him to the extension of his patent. Very rarely has a more meritorious case been presented, and it is without hesitation that the extension applied for is granted.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED CHIMNEY FLUE CLEANER.

James Grimes, Portsmouth, Ohio.—This invention consists of spring acted wing sections of the cleaner brushes, which are locked to the stem until the same is carried up in the chimney by means of jointed links. The wings are released by a cord running down along the stem.

IMPROVED WATER ELEVATOR AND PURIFIER.

Conrad Hartzell, St. Joseph, Mo.—This invention causes a current wheel located on a float to operate a pump, which draws its water through a submerged tube, at the bottom of which is a filter. The object is to afford a constant supply of pure water.

IMPROVED BALANCED THROTTLE VALVE.

Hubbard Hendrickson, Red Bank, N. J.—In opening the valve, the movement of a stem first moves small additional valves, which are easily moved and admit the steam. The latter passes to the other side of the main valve and equalizes the pressure so that it can be moved freely.

IMPROVED PAPER-CUTTING MACHINE.

James Harding Brown, Porter's Mill's, Wis.—This consists of a lever fixed to swing horizontally around a vertical axis in a fulcrum standard over a cutting table, and carrying two roller cutters. The latter are adjustable for cutting wider or narrower strips. There is also a roller gage for pressing on the sheet of paper to hold it in place.

IMPROVED RAILROAD CAR TRUCK.

Laban B. Lyons, Chillicothe, Ohio.—This invention relates to the construction of the metal side frames of the truck, to the means for connecting and suspending the brake beams, and also to the form, construction, and arrangement of other parts. For particulars, see patent.

IMPROVED TIRE UPSETTER.

Edward W. Holt, Corinna, Me.—In order to easily and quickly upset the tires of wagon wheels without changing the form of the tires or cutting them apart, this inventor provides a pair of arc-shaped jaws, with fluted cams, that engage with fluted lugs on the jaws to clamp the tire. One of the jaws is fixed to the bed piece, and the other is capable of being moved in ways in the bed by an eccentric pivoted to the bed and bearing against a roller in the movable jaw. The jaws are forced together to upset the tire.

IMPROVED ROAD SCRAPER.

Addison Shanklin, London, Ohio.—This invention has reference to such improvements in road scrapers that the handles may be locked securely to the scraper bowl by bolts, which may be readily lengthened when worn, so as to keep up the reliable locking of the parts.

IMPROVED STEAM VACUUM PUMP.

William V. Dubois, Covington, Ind.—This relates to the construction and arrangement of the working chambers, air chambers, and valves, and particularly to the contrivance of the valve for changing the admission of steam to the working chamber, and to a vacuum chamber for relieving the jar at the foot valve in the end of the pipe in the wall.

IMPROVED RAILROAD SWITCH GUARD.

Frank B. Peace, Maryville, Tenn., assignor of one third his right to Elijah Walker, same place.—This invention consists of guard rails, with projecting parts or heads pivoted at both sides of the switch rails. The engineer is enabled to see readily, by the projecting guard rails, whether the switch is set or not, and has time to slacken speed and put on brakes, so that the catches or heads serve as stops to the train without throwing the same off the track.

IMPROVED MACHINE FOR STRIPING PAILS.

Samuel R. Henry, Stillwater, Minn.—This invention consists of a chuck for holding the pails, striping rollers, a roller for supplying them with paint from a paint box, carrying and guiding rollers, and a contrivance for raising and lowering the chuck to facilitate the application and removal of the pails.

NEW HOUSEHOLD INVENTIONS.

IMPROVED FOLDING TABLE.

Wilber F. Bartholomew, St. Louis, Mo.—The legs of this table slip into standards, and are supported therein by spiral springs. They thus may be, by spring catches or like devices, adjusted so that the table will remain at any desired hight. With this construction, it can readily be raised to a convenient hight for use as a cutting table, and, when in use for ironing or sewing, can be owered and drawn over the lap.

IMPROVED NURSERY CRIB.

William H. Thompson, Columbus, Ohio.—This is a crib having two sides hinged to bottom, two sides hinged to the corner posts, and two divisions hinged at the bottom. This allows of the device being folded into small compass.

IMPROVED FLAT IRON HEATER.

Franklin A. Powell and Susanna L. Robinson, Pontiac, Ill.—The body of the sadiron has an angular socket which receives the lower portion of the handle. The part of the handle that attaches to the iron is made to fit the socket, and is cut down to allow a latch to swing over it and under a hook attached to the iron.

IMPROVED WASHING MACHINE.

Micajah D. Martin, Marietta, Iowa.—This is a novel lever contrivance to a rocking rubber pivoted in the axis of a tub. The object of the lever is to enable the operator to work the rubber by an easy purchase, and, at the same time, to stand sufficiently distant from the tub to avoid the steam rising up from the soapsuds.

IMPROVED HANGING SPITTOON.

John C. Winton, Muddy Creek, Tenn.—The object of this invention is to provide a spittoon, so constructed as to adapt it to be suspended upon a wall or other vertical support. The device consists of a saliva box or receptacle of suitable form, provided with or attached to a plate extended upward, and having a flange around its edge to prevent the saliva ejected against the plate from escaping over its edge and to guide it into the aforesaid receptacle.

IMPROVED STARCH BOILER AND STRAINER.

William H. Whitlock, New Albany, Ind.—This device admits of the starch being strained instantly after boiling without being poured into another vessel, dispensing thereby with straining through a cloth, and burning of hands. It consists of a vessel with interior strainer, sliding therein by a bale. When the starch is ready for use the strainer is placed into the vessel and bushed to the bottom of the same, so that the liquid starch will flow through the strainer, while the lumps will be carried to the bottom of the boiler.

NEW AGRICULTURAL INVENTIONS.

IMPROVED HAY LOADER.

Caleb Loader, East Pennard, England.—This relates to certain improvements in that class of hay raking and loading devices in which the frame which carries the endless elevator is made jointed, and with an upper movable section; and it consists in the means for operating the said jointed section. Said section is adjusted as required through arms, by means of cords and pulleys, worked by a handle. The section is also arranged in connection with a suitable elevating device.

IMPROVED FLOOD FENCE.

Wiley C. Barber, Rockmart, Ga.—In this device an eccentrically pivoted log, with a number of upright pins or stakes, forms a rack that gives readily for the passage of drift wood, and readjusts itself automatically.

IMPROVED POULTRY COOP.

Markus Ehlbert, Greenville, Ala.—This inventor arranges the bars or grating forming the sides and top of a coop in such a way that they may be folded compactly together. The object is to provide a coop which may be used for shipping poultry, or a crate for other articles, which may be folded in small compass for reshipment.

IMPROVED WHEEL HOE.

Rudolph Vampill, Mullins, S. C.—This consists of a pair of hoe plates secured in a diamond-shaped frame. At the forward end of the latter a wheel is journaled. The wheel may be adjusted to cause the hoes to work at any desired depth in the ground. A suitable handle is attached to the frame.

IMPROVED ADJUSTMENT FOR HARVESTER PLATFORMS.

Samuel Noxon, Jr., Ingersoll, Ontario, Canada.—The novel feature in this device is a simple arrangement of a lever and gearing which serves to lower the grain table, thus adjusting the cutters to any desired hight.

IMPROVED SEED PLANTER AND FERTILIZER DISTRIBUTER.

John C. Fooshe, Greenwood, S. C.—This relates mainly to the construction of the hopper, the bottom of which is made in sections, which are caused by suitable mechanism to rise and fall. The effect is to work the guano out of the hopper and also to crush all lumps. The material is afterwards guided to the ground by a suitable guide plate.

IMPROVED CIDERM ILL.

John Thomas Griffin, Grant, Tenn.—The essential features here are a perforated crib, resting on a platform, in which the juice is expressed from the crushed fruit by a follower, operated by a lever hooked under a yoke, and prevented from driving the yoke together by a bar.

IMPROVED PLOW.

Stephen M. Harris, Forest Grove, Oregon.—The new feature here is a clearer for preventing the clogging of the colter or standard, where it is connected with the beam, with stubble, weeds, and the like. The said clearer is a kind of shovel blade fixed on a spring support over the beam. The support couples with a wheel fixed so as to roll along the ground and work the clearer forward and backward.

IMPROVED PLOW.

Robert C. Traweek, Blanco, Tex.—The plows are attached to bars which may be turned on their pivots so that the plows will always be equally distant from each other, and will be square with the line of draft. The bars may also be adjusted to any desired angle with the beam, and are held securely in place when adjusted.

IMPROVED PLOW.

Judson S. Hartzell, Addison, Pa.—This plow is so constructed that the parts most subject to wear can be readily detached when worn, and replaced with new ones, and when in use will be held firmly to their places. A flange is formed upon the standard and mold board, and recessed upon its inner and outer sides to receive the two parts of the landside, which are bolted to each other and to the flange.

IMPROVED CULTIVATOR.

John C. Bannigan, Dunleith, Ill.—This includes a variety of new mechanical devices. By means of one, the draft may be attached in such a way as to protect the plants from being injured, by another the plows and beams may be adjusted, and by another the driver's seat is caused to balance the forward draft.

IMPROVED HORSE HAY RAKE.

Henry H. Hathaway, Clockville, N. Y.—This invention is a horse hay rake, so constructed that it may be used for heavy raking, and for light raking or gleaning, may be easily dumped to discharge the collected hay, will adjust itself to uneven ground, and will not scratch or catch upon the ground. The novelties here are all in mechanical construction. The rake is susceptible to a variety of uses including heavy as well as light raking or gleaning. The revolution of the wheels acts to cause the teeth to drop collected hay. Devices are provided whereby the machine adjusts itself to uneven ground, and the hay is prevented from rolling or twisting in the rake.

IMPROVED LAND DRAG AND CLOD CRUSHER.

John M. Crockett, Dallas, Texas.—This invention is an improvement upon the clod crusher and drag for which letters patent No 177,476, were granted to the same inventor, May 16, 1876. In that implement a series of flat metal bars are secured, in ranks or rows, to front and rear wooden crossbars, each of said metal bars having two curves so arranged that they alternate in position with the curves of the contiguous bar or bars, for the purpose of more quickly reducing the clods to a pulverulent condition in passing over them. The object of the present invention is to simplify the construction, reduce the cost, and increase the efficiency of the drag. The metal bars are divided into two parts, and each part curved and attached separately to a crossbar.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED SPOKE SOCKET.

Henry Oldendorph, Waterloo, Ill.—This invention consists of plates provided with shanks, and so formed as to fit upon the side of a felly and spoke, to fasten said spoke when broken off at the shoulder of its tenon.

IMPROVED GATE.

George W. Calkins, Milton, Wis.—This gate is so constructed that it may be opened and closed by a driver without his leaving his seat in the vehicle. A slotted lever receives a pin attached to the lower part of the gate, and passes through a space between the parts of one post and is pivoted to said post. The upper end of the lever passes through a slot in the upper bar of the gate frame and is pivoted to a bar that slides thereupon. To the sliding bar, toward its ends, are attached the ends of two cords, by pulling upon one of which the gate will be opened, and by pulling upon the other the gate will be closed.

NEW MISCELLANEOUS INVENTIONS.

COMBINED GLOVE STRETCHER AND HAND MEASURE.

Moses Greensfelder, Harrisburg, Pa.—This consists in the combination of a hand measure with a glove stretcher, the measure being so arranged within the handle of the stretcher as to be capable of being drawn out for use. It is caused to regain its position in the handle by means of a suitable spring.

IMPROVED REVOLVING SHOW STAND.

Orange P. Gould, Lewisburg, Pa.—Three spider frames are mounted on a spindle at suitable distances apart, for holding shelves, on which the goods are to be placed. The said frames are made of cast iron, and made to revolve on shoulders of the spindle, which keep them in their respective positions. Arch bars are provided for connecting the spider frames outside the shelves, and are arranged with loops and pins for that purpose.

IMPROVED ARTIFICIAL MARBLE.

Richard Guelton, New York city.—This is a process for imitating fine black marble without veins, and also for reproducing artificial incrustations on the marble. A cement is mixed with animal black, and after it is set the pores are filled with more cement, previously colored. Then follows the application of nitrate of iron, etc., and polishing. There is an ingenious method for imitating veins, and a process for rendering the marble acid-proof.

IMPROVED METHOD OF TANNING.

Alpheus M. Barnes and William F. Yocom, Weston, Mo.—The hides, after being limed, are bated in a mixture of soft water and corn meal. They are then strained out and are ready for the dress liquor, which is prepared of soft water, salt, sulphuric acid, sulphate of potash, and buttermilk. After handling, the hides are placed in a tan liquor, prepared by adding to each 100 gallons of extract of bark liquor, suitable quantities of salt, sulphate of potash, and sulphuric acid. Then follow strengthening, scouring, soaking in gambier liquid, and lastly preparing in sumac liquor. The invention also includes a process of tanning hides with the hair and fur on, by subjecting them to the action of a dress liquor, and then treating them with a composition of half-strength lye.

IMPROVED ADJUSTABLE ARM REST.

Moses Shoemaker, Plattsburg, assignor to himself and Charles J. Nesbit of Platt City, Mo.—This is a device for supporting the aam when writing upon the lower part of the page in large, thick books. It may also support the side of the book in a level position when writing upon the thinner part of the book, or upon a page of a book so bound that its sides will drop or incline when said book is opened.

IMPROVED CARBURETER.

Martin Schmidt, Houston, Tex.—This invention is an improvement in that class of carbureters in which air or gas is forced through a chamber filled with absorbent material that has been saturated with hydrocarbon. By a novel arrangement, by opening a stopcock, more or less gas will pass to the burners without passing through the carbureter. By opening it fully, none of the gas will pass through the carbureter; and by closing it fully, all the gas will pass through the carbureter.

IMPROVED LARD OIL LAMP.

John Roemer, Champion, Mich.—This invention consists of pipes for receiving the heat of the flame, and conducting it down into the oil chamber for warming the oil: the object being to make lard oil lanterns capable of use in very cold weather.

IMPROVED ELLIPSOGRAPH.

Henry C. Root, San Francisco, Cal.—This is an ingenious instrument, excellently suited for the uses of architects, engineers, and others. By turning a crank the pen will describe an ellipse, with the long axis coinciding with the face of one standard, and the short one in similar relation to the face of a second standard. By adjusting the centers so as to coincide, that is, one above anothef, a true circle may be struck. The size of the figure described by the pen may be closely regulated.

IMPROVED BARREL STAND.

David Scott, Olney, Ill.—This device furnishes a storage place for barrels, protects them from dust, etc., and is so constructed as to allow of their being tilted easily. The barrel can be adjusted to any desired hight for drawing off its contents.

IMPROVED ADJUSTABLE POCKET BOOK FASTENING.

Daniel M. Read, New York city.—This consists of top and bottom plates, having each a corrugated channel, in combination with a face plate, having a catch on both sides. The shoulders of the channel receive the catch between them, so that the catch can have no lateral movement, and cannot slip out from between the plates.

IMPROVED HITCHING POST.

Charles F. Roth, Winterset, Iowa.—This invention consists of a bell-shaped metallic case, in which a vertical bar, slotted at its upper end for the attachment of a halter or bridle, is retained by a spring catch bar; the latter being released from the vertical bar by means of a key so constructed as to press when turned on its upwardly inclined inner end. A spiral spring surrounds the lower end of the vertical bar, and presses it up, exposing the slot when the spring catch bar is released from it. The hitching bar has a rounded hemispherical head, which, when the device is closed, rests upon the bell-shaped case.

IMPROVED MACHINE FOR STRINGING TOBACCO LEAVES.

Louis Strasser, Columbus, Ohio.—This consists essentially of a needle lying on a bed, so arranged and being so confined that a vibrating pusher, worked rapidly by a foot-power mechanism, is made to push the leaves on the needle and along it to the string attached to the head, and also along over a rod or wire, from which the leaves are to be hung, half from one side and half from the other. The arrangement is such that the leaves can be strung as rapidly as two persons can present them from opposite sides in front of the needle.

IMPROVED BRIDLE.

Daniel T. Van Antwerp, Prophetstown, Ill.—This is an improved attachment for bridle headstalls, to enable the horse's head to be raised or lowered, as desired, and to enable an unruly or vicious horse to be more readily controlled. The invention consists in adjustable straps attached to the headstrap of a bridle headstall, and in overdraw straps which are drawn together at their middle parts, their lower ends being secured to the bit rings. The overdraw straps have gag runners attached to their ends to receive the check rein.

IMPROVED BUSTLE.

Mrs. Alwilda Swallow, Shelbyville, Ill.—This consists of a bustle, made of one piece of spring wire, and bent to form two bows, of which one is larger than the other. Said bows are arranged at a suitable angle and connected by coiled springs, to which the belt is attached. The bustle has no sharp edges to cut the clothing, and is light, cool, and strong.

IMPROVED BALE TIE BUCKLE

Thaddeus Bunker, Cuero, Tex.—This consists in half-ring bars, having small half-ring hooks formed upon their ends in the opposite direction, which secure the ends of a bale band by clamping the inside end of the band edgewise, in a manner not to cut or strain the band, but to make it an impossibility to slip or give way.

METHOD OF TIPPING AND PATCHING BOOTS AND SHOES.

David T. Cooper, Jackson, Mich.—By the old method of putting on tips or patches, the tip or patch is retained by sewing through the outer sole all around, which presents an unfinished appearance, while requiring a great deal of labor. By the present method a tip, patch, or foxing may be put on the shoe in a few moments, and without ripping up the heel seat. The invention consists in doubling up the edge of the tip, patch, or foxing, inserting a wire into the folded part, and fastening the wire by forcing the ends through small awl holes of the outer sole, and by intermediate wire clips, which are drawn up tightly, twisted, and clipped off or clinched on the outside of the sole.

IMPROVED TOBACCO STICK HOLDER.

Thomas A. Eanes, Leesville, Va.—This is an implement for holding the stick on which the tobacco leaves are hung after cutting, saving thereby the labor of the hand required for holding the stick while the cutting hands hang the tobacco. The invention consists of a metallic post, driven in the ground, with retaining fork or foot piece, and top bracket and clamp, to support the tobacco stick.

Notes & Queries

R. K. will find directions for tempering rock drills on p. 202, vol. 31.—W. F. will find that greasy cotton waste is very liable to spontaneous combustion. See p. 26, vol. 33.—M. S. will find a recipe for purple ink on p. 315, vol. 33.—J. N. W. can nickel plate his iron castings on p. 235, vol. 33.—C. S. will find a recipe for preserving timber on p. 265, vol. 33.—W. F., J. R. C., W. M., J. C. W., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) B. J. H. says: What will restore the skin to its natural color after being tanned by exposure to the sun? A. Use a paste made of precipitated chalk and glycerin, and avoid exposing the skin to the influence of strong sunlight or winds.

(2) J. B. H. asks: What will remove the tar of tar weed from woolen cloth? A. Try benzine or naphtha.

How can I make my clock run slower? A. Lengthen the pendulum.

Can you give a simple process for making potato starch? A. Convert the potatoes into a pulp by means of a scraping knife or an instrument similar to a nutmeg grater; throw the pulp upon a fine linen cloth in a large funnel, and allow pure cold water to run through the mass slowly for several hours. By this means all of the minute starch granules may be washed through the cloth; and on allowing the water to stand for some time, these will settle to the bottom, and may be removed by decanting the water and straining.

(3) A. B. asks: How can I stain basswood to imitate Spanish cedar? A. Use logwood.

(4) A. H. asks: Which is the most approved kiln for burning charcoal? I hear that, around Lake Superior, retorts resembling those for gas or pyroligneous acid are used, the object being solely production of charcoal. Is charcoal burnt in retorts equal to that burnt in kilns? A. The finer qualities of charcoal are made by distilling the wood in closed retorts such as you mention. By this method several other valuable products, such as illuminating gas, creosote, pyroligneous acid, etc., are obtained.

(5) J. S. says: I have been using cowrie copal, which dissolves readily in alcohol. I now wish to use Zanzibar copal, which will not dissolve in alcohol. Can you tell me what will dissolve it? A. Zanzibar copal is soluble in ether.

(6) H. B. M. asks: 1. Is it not a fact that carbonic acid gas under certain compression becomes heavier than sea water? A. No; liquid carbonic acid is lighter than water. 2. If a pressure of thirty-six atmospheres will liquefy it, does not that degree of pressure exist in the deeper portions of the sea? A. Yes; but the acid would speedily be dissolved by the water, and gradually escape to the surface. 3. Does pressure arrest decomposition or chemical change? A No. 4. If carbonic acid gas be generated at the bottom of the ocean under a pressure which will render it heavier than water, can that liquid rise through the water to the surface? A. Yes. 5. Should chemical action in the depths of the ocean set more gas free than the undisturbed water above can absorb, is it not possible that below a certain depth the ocean rests upon a sub-ocean of liquefied carbonic gas, and may not the fact, noticed in the deep sea soundings, "that material brought from the bottom is strongly charged with carbonic acid" be attributable to the imprisonment of the gas by the pressure of the water above it? A. This is not at all probable; when the water has been taken from great depths, it has, in some instances, been found to be heavily charged with carbonic acid. 6. If investigation should prove the existence of a large body of carbonic acid gas beneath the ocean, might not the fact of its known electrical affinity throw further light upon the action of the tides and other terrestrial phenomena? A. We do not see what possible influence this could have on the tides, etc. 7. Would affirmative proof of the above justify the conjecture that the absence of tides in the lakes might be due to the want of sufficient depth to compress the gas to a sufficient specific gravity? A. No.

(7) H. C. asks: Please give me a recipe for extracting the mildew and shop stains from fine kid gloves. A. Draw the gloves over suitable wooden hands, and treat with a little putty powder and benzole.

(8) H. & L. say: Please tell us of a cheap plastic cement that can be used as a substitute for lead in lining wooden tanks to hold sulphuric acid. A. We do not know of such a cement that can be recommended.

(9) J. E. T. asks: How can I clean tallow? A. Digest it for some hours with dilute sulphuric acid; the pure tallow will separate and rise to the surface. The application of chlorine, which you suggest, is not necessary.

(10) C. C. asks: If I make a pump by taking 4 pieces of plank 6 inches wide, 1½ inches thick, and nail them together, and leave the hole square and work a wooden rod in it, having valves at the bottom of the pipe, can I raise water 112 feet without bursting the pipe? A. If you fasten it well, with bolts or straps, it will answer.

How is the horse power of boilers rated? A. Makers generally rate the horse power of a boiler by the amount of heating surface, and consequently by the size.

(11) H. F. L. asks: Can you tell me of a solution and process, which is a cheaper substitute for $AgNO_3$, in printing from a negative, which will give as good a print as silver? A. No.

(12) P. R. says: 1. What is the highest degree of heat that water can be raised to in a boiler ⅔ full? A. With sufficient temperature in the furnace, the limit would only be reached at the melting point of the material of which the boiler was constructed, provided, of course, that the boiler was of sufficient strength. 2. Can steam be raised to a greater degree while in the same boiler, and what degree will steam attain by separating it from the water and superheating it? A. The steam can be superheated in either case, to the same limits as before. 3. Is the top or boiler head of a steam boiler ⅔ full of water any hotter with 100 lbs. pressure than with 10 lbs. pressure? A. Yes, because the temperature increases with the pressure.

(13) W. H. R. asks: What is the best way to mix paint for the red staff to staff millstones with, water or oil? A. We think oil is generally preferable.

(14) N. W. J. says: 1. I am using a force pump located over a well, with 24 feet of suction, and force the water 25 feet up into large tubs. The suction pipe is 2½ inches in diameter, the discharge pipe 3 inches, running on a level with the pump 70 feet, then up through the bottom of the tub, without a check in the pipe. The pump has a 12 inch valve. When running, the valves and pistos thump heavily. How can I remedy it? A. Air vessels should be employed. 2. Does a pump in working form a vacuum? A. Yes, if it lifts water.

Will ice transmit the rays of the sun, so as to affect the thermometer? A. Yes.

(15) C. A. D says: I want to build a boat, with flat bottom, to be propelled with a wheel behind, with a one horse power engine. Of what size should the boat be? A. You can use a boat 15 feet long and of 3½ or 4 feet beam; but the engine is rather too small.

(16) W. R. P. asks: How can I wind up a line 60 inches long with a uniform tension of, say, 1 oz., without interposing a fusee? A. You can do it by means of clockwork actuated by a weight; or if you wish to use a spring, it should be quite long, and the clockwork should have an escapement with a pendulum or balance wheel. In other wards, the problem that you have proposed is precisely the same as occurs in the manufacture of clocks and watches.

(17) A. L. B. asks: What is the hight of the tallest mast of a sea-going vessel? A. The Three Brothers, said to be the largest sailing vessel in the world, has a mainmast 99 feet 10 inches high. If there are vessels with higher masts, probably some of our readers will be kind enough to send particulars.

(18) W. A. P. says: 1. I have a small engine with two oscillating cylinders 3½ inches long and 2 in diameter, with a 3 inch stroke. I wish to put it in a small side wheel steamer. Please give me the dimensions of which to make the boat and the paddle wheels. A. Boat 18 to 20 feet long; wheels, 2 feet in diameter. 2. I want to make a boiler for the above. Of what dimensions should it be to furnish steam enough? A. Make it 2 feet in diameter and 3½ or 4 feet high. 3. What would such a boat cost without the engine? A. From $20 to $50, according to character.

(19) L. D. B. says: I have a well that affords about three fourths enough water for my boiler. Can I turn my escape pipe into the well and condense the steam by means of a pipe to run water from my reservoir into the well over the end of the escape pipe, shooting it out in fine spray? A. The plan does not seem very promising, as it requires several times as much water, as a given volume of steam was formed from, to condense that steam.

(20) J. O. H. Jr. says: 1. I have an engine and boiler. Size of engine cylinder is 4½ x 8 inches; the boiler is a double flue, 6 feet 4 inches long and 2 feet 4 inches in diameter. What size of flat-bottomed boat could I run with such an engine, running the engine 5 revolutions to 1 of the wheel? A. Boat 30 feet long and 6 to 7 feet beam. 2. Of what size should I make the wheel? A. Propeller 20 inches diameter, 3½ to 4 feet pitch. 3. What speed would the boat make against a current of 4½ miles per hour? A. You might realize 3 miles an hour.

(21) A. T. asks: What is the best metal for lining the sides of a box in which the plunge of a tile mill works, in order to wear the least? A. We think you will get very good results by using Bessemer steel.

(22) L. B. asks: 1. Is there any danger of an explosion in making soldering fluid, that is, by throwing pieces of scrap zinc into a glass jar containing muriatic acid? The jar sometimes gets heated to 120° Fah. A. There is no danger provided the gas (hydrogen) which is evolved is allowed to escape into the air without contact with flame. 2. Is it very injurious to health to inhale the fumes of the acid, while boiling? A. The acid vapors are poisonous. 3. Can you inform me as to a safe and proper way of making it? A. The operation should be conducted in the open air, in a large wide-mouthed porcelain or stoneware jar. To avoid the first violent action it is better to dilute the acid with thrice its volume of water.

(23) F. E. J. says: I want a cement that will resist dilute sulphuric acid and carbonic acid gas. I need something equal in strength to plaster of Paris or sealing wax, sufficiently strong to hold a light vessel in place. Can you aid me? A. Try paraffin, plaster of Paris soaked in melted paraffin, or solution of caoutchouc.

(24) D. C. D. says: You give a description of a baroscope, made by placing a glass tube in a bottle partly filled with water, and blowing a column of water up the tube, when the hight of the column of water will vary with the pressure of the atmosphere. What cement can I put around the cork to make it airtight and hold up the column of water? A. A rubber stopper is best for this purpose; it should be well greased with a little cerate, and forced in as tightly a possible. Where it is not possible to obtain a suitable rubber stopper, choose a good cork one, immerse it for a short time in melted paraffin, and, when the pores are well filled, force it into the neck of the bottle tightly and hold it in position until perfectly cool.

What cement will cement hard rubber and glass together and resist the action of ordinary writing inks? A. Melt together in an iron pot equal parts of pitch and gutta percha. This may be kept liquid under water.

Will nickel resist the action of ordinary writing inks as well as silver? A. No.

(25) H. C. N. asks: What will dissolve tin, bismuth, and lead (both severally and together), without acting upon copper or silver? A. We do not know of such a reagent.

(26) O. O. W. asks: How can I compute the amount of heat generated in an air pump at, say, 100 lbs. pressure, with thermometer at 65° Fah.? A. By using the following formula: T=absolute temperature of air before compression; t=absolute temperature of air after compression; V=volume of air before compression; v=volume of air after compression; P=pressure of air before compression; p=pressure of air after compression. Then $\frac{t}{T}=\left(\frac{V}{v}\right)^{0\cdot408}=\left(\frac{p}{P}\right)^{0\cdot29}$. This equation can be most readily solved by the use of logarithms, thus: $\log.\left(\frac{t}{T}\right)=0\cdot408\times\log.\left(\frac{V}{v}\right)=0\cdot29\times\log.\left(\frac{p}{P}\right)$.

(27) J. H. P. says: 1. I wish to prepare a plaster of Paris mold for making bee comb foundations. How can I harden the mold so that it will not break or crumble under pressure? A. Mix the dry plaster with a solution of alum in water in place of pure water. 2. Beeswax in thin sheets is very frail and breaks easily when cold. What can I add to it to toughen it? A. Try fusing the wax with a little resin.

(28) W. C. T. asks: Is there any material, of which soft, pliable gloves can be made, that will stand hot water and be durable? A. Gloves of leather and of Macintosh cloth (cloth filled with caoutchouc solutions), etc., have been used for this purpose, but were soon discarded. We do not know of anything that would be an improvement upon these.

(29) J. E. A. asks: How can I remove kerosene oil stains from a marble slab? A. A paste made of soda, pumicestone, and chalk is recommended, after the application of which the marble is to be washed with soap and water.

Can steel or chilled iron balls be turned perfectly spherical? A. It is better to grind them.

How are what are called rephotographs produced? The photographs seem to be first transferred to glass by some method, and then touched up on the back with oil paints. Will you give me a description of the *modus operandi*? A. See p. 359, vol. 31.

(30) C. W. T. says: J. C. J. can lower the tone of his tuning fork by filing the tines thinner close to the handle.

(31) A. H. & S. G. ask. 1. What is the best rail for railroad purposes, namely, for strength and safety, irrespective of cost? What should be its length, size, and weight? A. A committee of the American Society of Civil Engineers recommend a steel rail weighing from 52 to 56 lbs. per yard; hight from 4 to 4½ inches: head 2⅝ inches wide, 1¼ inches deep: top of head curved to a radius of 12 inches; thickness of stem $\frac{7}{16}$ to ½ inch; width of base 4 to 4½ inches; thickness of base at edge $\frac{3}{16}$ inch, rising at an angle of 14°. 2. What is the effect of cold on the best rail? A. The committee think that rails break in winter because they are weaker, and the road bed is less elastic. Other prominent engineers do not think that the rails are weaker in cold weather, and believe that good rails are no more liable to break in winter than at any other season. 3. What is the nature of the strain upon a rail by the passing over it of a train of cars? Is it tension or impact? A. A rail is subjected to tension or compression because it acts as a beam between supports. It also has to resist blows or impact, and the imposed weight tends to crush it, in addition Besides this, its section is reduced by wear.

(32) C. C. asks: In a first class condensing engine, cutting off at one sixth, what is the pressure in cylinder at the end of stroke, supposing that in the boiler to be 60 lbs.? A. About ⅓ of the pressure at point of cut-off.

(33) H. P. says: There is a spring, affording water enough to fill a 6 inch pipe, 400 rods from and 70 feet above the village. To bring water from this spring to the village with force enough to throw to the tops of buildings, what size of pipe will be necessary? A. Unless you use a very large main, the head will be so much cut down that the hight of discharge will be quite small. It would probably be cheaper to use a smaller main, and have a pump and standpipe in the town.

(34) J. M. says: I make a fluid from galls, sulphate of iron, and sulphate of indigo; when I neutralize the sulphate of indigo with marble dust, there is a violet-bluish film on top of the ink; filtering does not remedy it, as the film soon collects again. What is it, and how can I get rid of it? A. Your solution after filtration is probably too concentrated. Add a little more water

(35) L. L. T. asks: How can I color russet leather red and white? A. For red, use an alcoholic solution of aniline red, not too strong. We do not know of any method of coloring the leather white, except it be by the superficial application of some light-colored pigment, such as zinc white (oxide of zinc) and finely ground barytes (sulphate of baryta), rolled in with gum arabic solution.

(36) C. R C. says: In Fowne's "Chemistry" it is stated that picric acid is also one of the ultimate products of the action of nitric acid upon indigo and numerous other substances, as silk, etc. The way to produce it from indigo is given in detail. Will the same method answer for silk? A. Yes; but the quantity of the acid obtainable from this source is small, and difficult to isolate from the numerous other products of the decomposition. Its presence among these products is, therefore, only a matter of scientific interest.

(37) C. Roggenkamp, of Appingedam, Holland, asks: 1. What is quicklime? A. It is the anhydrous oxide of calcium. It is commonly prepared from limestone or marble (calcium carbonate) by ignition in a kiln. The carbonic acid is thus driven off, together with the moisture. 2. What is plaster of Paris? A. It is the anhydrous sulphate of lime ($CaSO_4$).

(38) J. C. M. asks: How can I make ferrotartaric acid? A. Dissolve pure sulphate or chloride of iron in distilled water, and add to this a strong aqueous solution of pure soda (or carbonate of soda) in excess; heat nearly to boiling, filter, wash the precipitate thoroughly with hot water, and dry. Then add to this an equal weight of citric acid, and about 20 times its weight of pure water, and allow to stand at a temperature of about 170° Fah. for 24 hours in a covered vessel. Dilute a little if necessary, filter, and evaporate the filtrate (which contains the acid tartrate of iron) to dryness over a water bath.

(39) E. W. W. asks: How can I take bluing stains out of a red and white crumb cloth? A. If ordinary bluing were used, boiling in a little hot water should remove the stain. If not, let us know what kind of bluing was employed, and in what way.

(40) C. H. H. asks: What is the best method of generating carbonic acid gas for use in soda fountains? A. The materials commonly employed are dilute sulphuric acid and coarse marble dust. Use marble dust 10 lbs., water 30 lbs. (about 4 gallons), oil of vitriol 15 lbs.

(41) H. T. D. asks: 1. How can I coat metal with hard rubber? A. Cover the parts well with gum rubber, and then heat in melted sulphur until the degree of vulcanization desired is reached. Experience will best teach you the proper conditions. The efflorescent and adhering sulphur may be removed by hot solutions of potash or soda. 2. What shall I use for covering a rack for holding work in a plating solution, to prevent deposit, and also to resist the action of soda or potash lye? A. Try successive coatings of solution of caoutchouc. It would be better to make a rack of glass, or glass and hard rubber (ebonite).

(42) J. J. W. asks: What is a good brown dye for straw hats? A. Try the following: First dry the straw thoroughly, then steep for a short time in a strong solution (neutral) of sulphate of copper. On removing the material from this, dry again, and immerse for about five minutes in a weak solution of ferrocyanide of potassium.

(43) H. J. asks: I have a set of rabbit furs. They are soiled by the hair. How shall I clean them? A. We do not know of a less objectionable method than that of the application of benzole (not benzine) and some absorbent material, such as paper pulp (dry and warm) or pipe clay.

(44) P. R. H. asks: 1. Please give me an analysis of the purest Lake Superior native copper? A. It consists, generally, of pure copper, but often contains both silver and mercury, sometimes as much as 7 or 8 per cent of the former. 2. Of what are the ridges on copper implements composed? A. They are probably points that have been covered with organic or other unchangeable material, that has offered more or less protection to the metal beneath. The non-corrosion of the metal at these points may also to some extent be attributable to the small masses of silver which are sometimes found with the copper. 3. Can copper be cast? A. Copper may be cast, but the castings are, for the most part, useless, owing to their non-homogeneous character, and the numerous blowholes which they contain. 4. Are there any castings made of pure copper? A. No.

(45) A. H. says: In Machinery Hall at the Centennial, I saw in the exhibit of a compressed air railroad brake a wooden ball, dancing in a strong current of air which was escaping from the apparatus. Please explain why the ball did not leave the stream of air and fall to the ground. A. The explanation, with diagrams, was published in SCIENTIFIC AMERICAN SUPPLEMENT No. 37.

(46) J. H. L. asks: How can I get a humming or whistling noise out of a tin tube attached to a wheel of 2½ inches circumference? The tube is 1 inch long by ⅛ inch wide, and the wheel runs at 60 turns a minute. A. It will probably be necessary to allow the tube to project some distance beyond the rim of the wheel, with one side a little longer than the other.

(47) C. C. P. and others.—The aniline colors are not, in themselves, poisonous; the poisonous qualities are attributable to the small trace of arsenical compounds to be found in almost any of these commercially prepared dyes. It has been found necessary to employ arsenic acid in the preparation of these beautiful and, at present, indispensable colors; and the best that we can do, under the circumstances, is to avoid placing any colored fabric suspected to owe its tints to the aniline dyes, in contact with the cuticle, especially of children.

(48) C. J. H. asks: 1. Is there any way to determine the presence or absence of carbolic acid, chloride of lime, and copperas in a mixture of gas tar and brick clay? A. Yes, but we do not think it probable that notable amounts of the substances enumerated would be likely to exist in such a mixture. 2. If so, can I do it myself? A. It would require the skill of a chemist. We do not think that any instructions we could give you here would enable you to make a satisfactory analysis of the material.

(49) D. W. H. says: I am engaged in manufacturing an article into which liquid ammonia of 16° proof enters largely. I am informed that it can be made very cheaply from sulphate of ammonia and lime, and that the apparatus for making 25 to 60 gallons per day is not expensive. What do I need in the way of apparatus? A. All that is requisite is a large iron retort in which to heat the mixture of ammonia salt and lime, and a suitable absorption apparatus, preferably a series of large Woulfe's bottles, partially filled with pure cold water. The proportion of caustic lime and ammonia salt employed should be about equal weights. In order to free the ammonia gas from impurities before dissolving it in the water, it is advisable to pass it through an iron worm surrounded by cold water, and then through a strong solution of potash.

(50) C. C. B. says, in reply to a correspondent who asked as to the origin of the $ mark: By the ancients the pillars of Hercules (Gibraltar) were regarded as marking the end of the world; and the two pillars are displayed on ancient coins, bearing a fillet between them with the motto *ne plus ultra* (nothing further, or nothing beyond) On the discovery of America by Columbus, Spain, with pardonable vanity, stamped her dollars and other coin with the same pillars, and threw between them a fillet bearing the motto *plus ultra* (further yet). The mark $ thus designated the Spanish dollar, and in time the American.

(51) J. W. W. says, in reply to J. A. P. who asked how to make apple butter: Take any quantity of fresh unfermented cider and boil it down to half its quantity. Then add fresh ripe apples which are quartered and deprived of their cores. Continue the boiling, stirring all the time with a wooden paddle to prevent burning and adhesion to the sides of the kettle. The boiling is to be continued until the butter is of the proper consistence, when it is put away in jars or kegs for use. If the butter is made properly, it will keep all winter in a perfect state of preservation

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

R. M.—Both specimens contain gold.—W. S. V.—No. 48 contains a considerable quantity of iron pyrites. No. 49 is orthoclase, a silicate of alumina, iron, lime, and potassa.—No. 50 is not of natural occurrence. It is a furnace product, probably spiegeleisen, a carburet of iron containing manganese.—L. W. S.—The curious piece of wood you send us appears to have been taken from the shell immediately surrounding the pith of the log, and has subsequently been subjected to a process of rolling or pressure, which has imparted to it its remarkable suppleness and strength. We should like to have further particulars concerning the material, as your letter is not quite clear.—H. G. S.—It is spiegeleisen, a carburet of iron containing manganese. It is not an ore.—D. A. C.—It is hornblende.—J. M. L.—It is trap rock containing iron pyrites.—E C.—It is hornblende with quartz containing iron pyrites or sulphide of iron.—J. D. S.—It is a limestone (marble), but contains too much alumina to be useful for lithographic purposes.—J. W. G.—It is a species of rock very closely resembling that employed for lithographic purposes. It might, we think, answer for that purpose.—W. W. S.—It is a sand formed by disintegrated granite of quartzose rock, containing minute spangles of iron pyrites, but no silver.—G. L. W.—It is a quartzose rock slightly discolored by iron. It may contain a small quantity of gold, but this could not be determined without a qualitative analysis.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On a New Form of Chuck. By C. R. W.
On Locomotive Drive Wheels. By G. C.
On Working Men's Demonstrations. By J. G.
On Keeping People Employed. By D. M.

Also inquiries and answers from the following:

J. D. F.—E. M. S.—H. F. W.—E. T. P.—B. L. T.—W. N.—J. C. D.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who sells nautical instruments? Where can gyroscopes be bought? Whose is the best lightning rod? Who sells photographic apparatus? Why do not makers of guns and rifles advertise in the SCIENTIFIC AMERICAN? Who makes drop presses? Who sells portable boats, that can be folded up?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL]

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A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

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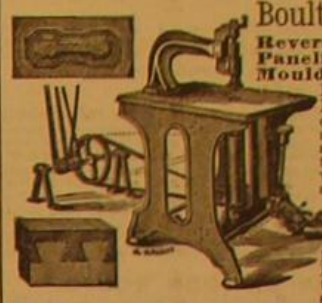

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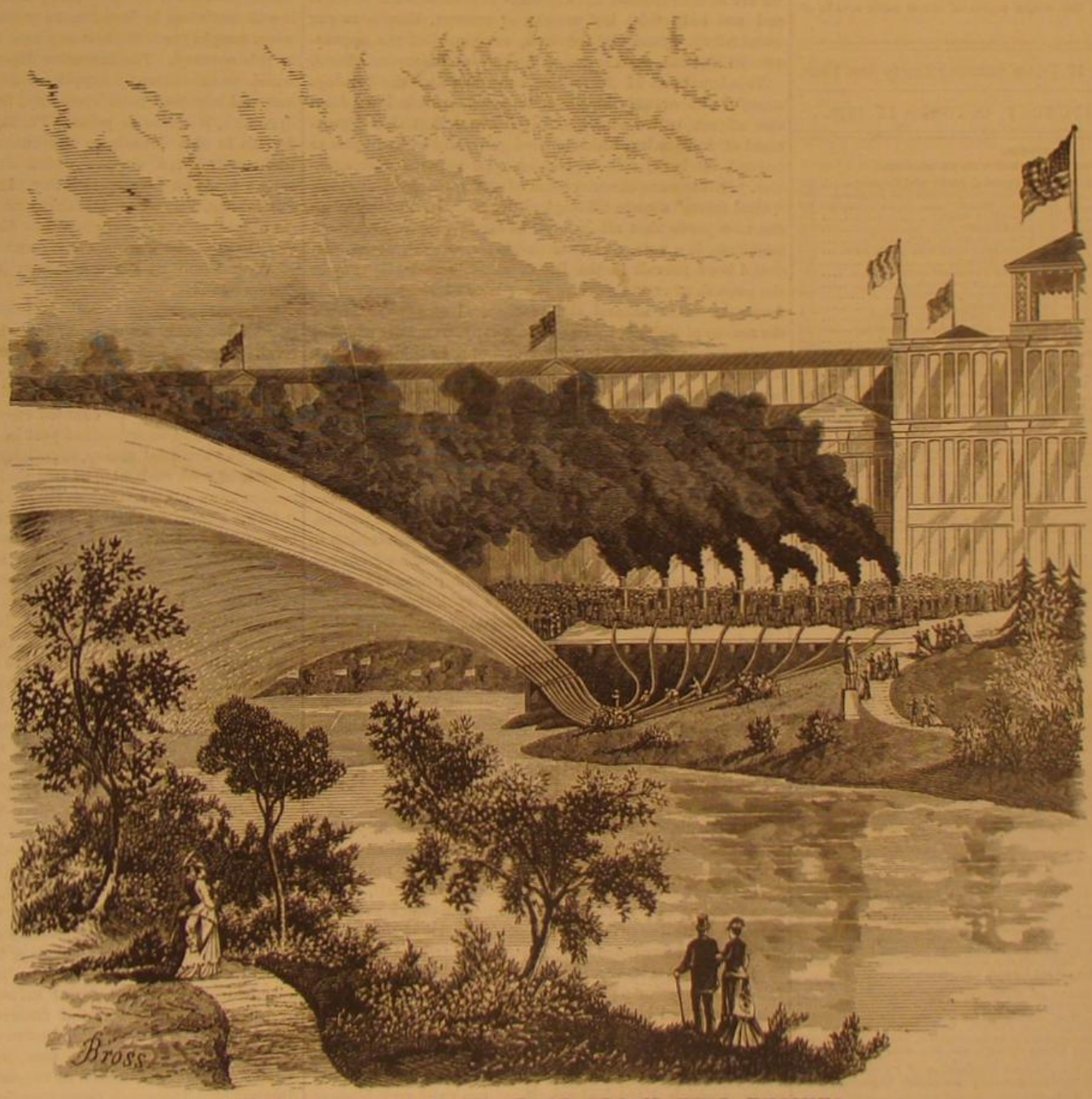
TRIAL OF STEAM FIRE ENGINES AT THE CENTENNIAL EXHIBITION.

There is probably no engine or machine in which the work done bears so great a ratio to the weight, strength, and size of the apparatus as the fire engine. The requirements of fire engines are so exacting, and the necessity for the greatest obtainable efficiency is so vitally important, that the cost is a secondary consideration. The breakage of a single bolt, pin, or casting may entail the loss of thousands of dollars' worth of property, in addition to the damage resulting to the engine; and hence it is that the material and workmanship employed in the construction must be, and are, of the very highest order. A steam fire engine is in actual use during but a comparatively short time of its period of existence, but it must always be ready to perform, at a moment's notice, its arduous and important duties; and the thorough order in which it must, therefore, be kept, makes it a fitting subject for beauty of design and ornamentation, so far as is consistent with the necessities of its construction. Thus it is that, for elegance and finish, the steam fire engine is unsurpassed in machine production.

The steam fire engines exhibited at the Centennial Exhibition are beautiful specimens of mechanical architecture, and form an attractive feature in Machinery Hall. Our illustration represents the trials of these engines, which were conducted by the judges on September 4, 5, 6, and 7. This exciting contest formed the center of attraction during those days, being attended by a large concourse of engineers and mechanics, as well as by the visiting public. The eagerness, watchfulness, and assiduity of the engineers, the restlessness of the contesting exhibitors, the gravity and coolness of the judges, the almost life-like struggle of the engines, together with the long rolling volumes of gyrating black smoke above, and the rushing stream of water beneath, formed a scene which made considerable impression upon contemplative minds.



THE CENTENNIAL.—TRIAL OF STEAM FIRE ENGINES.

The conditions of the test were made known to each of the contestants, and every precaution was taken to have every requirement clearly understood and all in readiness at the appointed time and place: ample notice being given for any preparations that might be deemed necessary by any of the contestants, each of whom employed his own engineer and assistants.

The conditions of the trials on the first day were that the engines were to be tested for capacity and endurance in delivering water through three different sized nozzles, furnished by the judges, and varying in area for each engine according to its weight with the boiler filled. The second day's trials were for distance and character of the stream thrown; and the third day's were for the character and hight of the stream. On each day, the trials were continued for three hours each. On the fourth day, the tests consisted of three runs over a course of a mile, each run followed by a play of about half an hour, in which nothing was used that was not carried over the course, the engineers and assistants making the trips with the engines. The engines were supplied with bituminous coal, the fuel used, both for lighting fires and and running, being weighed and charged to the account of each engine respectively. Each engine had connected to it 35 feet of suction and 100 feet of delivery hose, supplied by the exhibitors themselves, who had the liberty of selecting the size and kind of hose, and of using as many lines as they chose, provided that they joined into one before reaching the nozzle. The water was lifted 15 feet; and on the second and third days, the exhibitors selected their own nozzles, three of which were used, the sizes varying from the smallest to the largest used by them respectively on the first day's trials.

The engines were weighed previously to the trial, first without water and equipments, secondly with the boiler filled with water to its proper working level, and thirdly with equipments complete, ready for service. Each competitor fixed his water level and started from such level on each trial. The judges were Messrs. Charles T. Porter, Emil Brugsch, and Joseph Belknap, assisted by Mr. Wellington, of New York. From the delivery hose pipe of each engine there was conducted a hose leading to the judges' stand and connected to a pressure gage. The nozzles were connected to a fixed platform and held stationary at an angle of about 45° for the distance test and 90° for the hight test. The water in the boilers was required to be cold, and its temperature recorded; and all the fires were started at a given signal. The pressure of the steam was recorded every five minutes, and the water pressure every two minutes. Eight engines entered for the test, namely, one Silsby, one Ronald, one Gould, one *La France*, one Button, and three Clapp & Jones engines. The Button engine was disabled on the first day of the trial, in consequence of the fracture of a bracket attached to the cylinder head. The sizes of the nozzles used varied from about $\frac{7}{8}$ to $1\frac{3}{8}$ inches diameter of bore; the distance the water was thrown was about 220 feet. There are, we are informed, awards to be made to these makers independently of the data obtained from the trials, the results of which are not, as yet, fully computed by the judges. The merits or points of advantage in the respective engines are to be recognized by these immediate awards; and the results of the trial tests will be announced, and a suitable award made, at some future time. In the meantime, it is, we are informed, contemplated to secure the coöperative assistance of additional experts, in order to form a just and comprehensive decision as to the merits of the engines, as indicated by the data given by the logs of the whole series of tests.

American-made Bunting.

General Benjamin F. Butler gives the following account of the rise and progress of this industry:

"The manufacture of bunting was unknown in this country until after the close of the war, so that no American ship ever fought under a yard of American bunting. One or two attempts had been made to make it in America, which had failed. It was substantially a monopoly of a few firms in Bradford, England; and although it cost, in the war, the Englishmen to make it no more than now, they put up the price upon us to $36 gold per piece. In 1866, because I lived in a manufacturing city, I was requested by the Navy Department to examine into the subject and see if it could be made here. I consulted with some friends of mine in Lowell and interested them in the subject, and they agreed to make an attempt, provided I would furnish part of the capital, which I did. After many experiments, attended by very considerable expense, and by employing English machinery, an article of bunting was made, which, upon competitive trial with the English, was pronounced by a board of experts to be superior. The demand for the article is very limited, except in presidential years and the Centennial year. There are now three or four other establishments which manufacture bunting in the country, besides the one at Lowell. It is said by a newspaper that the tariff is more than the cost, leaving the inference that that is added to the price. The effect of the manufacture here has been that bunting is produced at $10 a piece, gold, as against $36, which our government paid for over 11,000 pieces yearly during the war."

New Weapons of War.

A series of trials of the Hotchkiss revolving cannon were recently begun at Sandy Hook under U. S. army auspices. Seventy shots were fired, at four targets, the nearest of which was placed at 2,000 yards distance. The shells burst between the first and second targets, hitting the four screens 206 times. A new magazine breech-loading rifle was also tested, and a firing speed of six shots in six seconds was attained. The cannon trials are soon to be resumed, when the capabilities of the gun will be put to the severest tests. The inventor, Mr. B. B. Hotchkiss, claims that the weapon has an effective range of 6,000 yards.

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Contents.

(Illustrated articles are marked with an asterisk.)

THE SCIENTIFIC AMERICAN SUPPLEMENT.

Vol. II., No. 42.

For the Week ending October 14, 1876.

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WHAT IS MATERIALISM?

Those advanced scientists of the present day who have abandoned the old and easy way of explaining every obscure physical phenomenon by asserting a supernatural cause (such as vital force in the organic kingdom, or a separate creation for each species of plant or animal) are denominated "materialists" by the adherents of the supernatural or spiritual. Those who use this word so profusely confound, however, two very different things, which have nothing in common, namely, the scientific materialism and the immoral materialism. The scientific materialist maintains that all the phenomena we see on our earth take place by natural means, that every effect has its cause, and that every cause will produce its effect. In his view, law regulates the sum total of all physical phenomena, which depend on the necessary relations of cause and effect. He rejects, therefore, most emphatically, the belief in miraculous interferences, and every conception, of whatever form, based on a belief in the so-called supernatural. In his view, there do not exist, anywhere in the whole range of human cognition, real metaphysics, but everywhere only natural physics. For him, the inseparable connection of matter, form, and force is self-evident. This scientific materialism has long since been accepted in the realm of the inorganic natural sciences, physics, chemistry, mineralogy, geology; and no one, however poorly educated, has now the least doubt in regard to the correctness of basing these sciences on such materialism. Only savages believe now in the spirit of a cataract or of a storm, some supernatural power which presides over such phenomena; and this can arise but from utter ignorance of the whole system of natural laws, by which we are able to explain the existence of cataracts and storms: and not only this, but we can at present, thanks to our materialistic system of research, even predict the appearance of a storm, so as to guard against its disastrous effects.

This ignorance of the natural laws on which the development of the organic kingdom is based—which laws form the science called biology—is the cause that this department of Science has hitherto been generally looked upon as beyond all laws, and dependent upon supernatural agencies. Hence came the invention of the metaphysical spook "vital force," a mere theological dogma. If, however, we can now prove that all Nature, as far as subject to human cognition, is a unit, and that the same eternal, stern, and grand laws prevail in the life of animals and plants as in the growth of crystals or in the power of steam, we shall reach the same natural and mechanical standpoint in all the realms of biology, zoölogy, and botany, no matter whether we are suspected of materialism or not. In this sense, the whole realm of the positive natural sciences, and the fundamental laws of causes and effects, are pure "materialism."

A very different thing from this scientific materialism, however, is the immoral materialism, which, as we have stated, has nothing in common with the other, except its name. This materialism, in its influence on practical life, leads to nothing but material enjoyment and the indulgence of sensual passions. It lives under the sad illusion that indulgence to mere natural pleasures can give satisfaction to man; and under this illusion, it drives its votaries from one indulgence to another, while rest and peace are never reached. It is a grand and profound truth that the proper value of life does not reside in material enjoyment, but in moral acts, and that true happiness cannot be found in exterior appearance, but in virtuous conduct: this is, however, unknown to the votaries of the immoral materialism. For this reason, such a materialism cannot be found among the investigators of Nature; and philosophers, whose highest pleasure is the intellectual enjoyment of Nature, have for their highest aim the knowledge of Nature's laws. This immoral materialism was found especially among the religious pretenders of the middle ages, who, under the mask of a pious exterior, aimed at nothing but an hierarchical tyranny and a material exploitation of the possessions earned by the labors of their fellow men. Blind to the supreme nobility of what they called, and what their successors still call, "common matter," and to the magnificent phenomena produced thereby, as well as to the inexhaustible charms of Nature, and without any knowledge of her laws, they treated the whole field of natural science and all the civilization derived therefrom as an heretical and sinful materialism: while they themselves practised immoral materialism in its most abhorrent forms. To avoid confounding such immoral materialism with the scientific materialism, Haeckel proposes to call the latter "monism," or (with Kant) "the principle of mechanism," without which, Kant declares, there can exist no science of Nature; and this principle lays at the base of the theory of evolution, and distinguishes it forcibly from the theologic belief in miracles, or in a series of separate and supernatural acts of creation.

INFUSORIAL EARTH AND ITS USES.

It is one of the paradoxes of Nature that the smallest creatures contribute most to the structure of the earth. The higher forms of life are barely traceable in the rocky strata; the lowest make up the bulk of vast formations, thousands of miles in area, thousands of feet in depth. The gigantic labors of the minute but multitudinous coral polyps are proverbial: but these are surpassed by the remains of still more microscopic creatures which swarm in all waters, arctic as well as tropical, fresh as well as salt, and whose cast-off shells fall like a ceaseless rain of solid matter on every part of the ocean's bed, on the beds of every inland sea and lake, every river, and marsh, and roadside pool. And minute though they be, the bulk of matter they contribute to the earth's strata every year is quite incalculable. The celebrated microscopist Ehrenberg, the first to realize their importance, estimated that in the single harbor of Wismar, in the Baltic Sea, as much as eighteen thousand cubic feet of these silicious organisms accumulated annually. The deep sea explorers of the Challenger expedition found them everywhere above the depth of two thousand fathoms; and below that their insoluble remnants made up thousands of square units of "red clay" deposits, apparently the stuff from which the azoic bases of the continents were formed. The limestones and chalks derived from calcareous infusoria are still more abundant and important: and by no means insignificant are the unconsolidated silicious strata of modern origin, to which the name *infusorial* earth has been applied. The stratum at Bilin in Bohemia, in which Ehrenberg found the enormous number of forty thousand millions of individuals to the square inch, is eighteen feet thick, and extends over a large area. At Lünenberg is another deposit, nearly twenty-eight feet thick; and less important strata are found in other parts of Germany and throughout Europe. In Lapland and Sweden it constitutes the well known "mountain meal," used to swell the bulk of certain foods. Many deposits of considerable magnitude are known in England, and the Irish beds are celebrated, especially those of the county of Down. Africa for a long time monopolized the supply for use in the arts, and furnished the familiar name Tripoli. The material is now abundantly supplied by other parts of the African continent, by Asia, Australia, New Zealand, South America, our own country—indeed every part of the world. In South America, the natives count it in some parts an essential portion of their diet, using it as food mixed with fat. Along the Amazon, beds of this useful earth are numerous; and since the organisms which produce it are universally distributed, the deposits of it will doubtless be found more or less abundant everywhere when sought for. Such at any rate appears to be the case in this country. The extensive deposit at Drakeville, N. J., which so conveniently supplies a demand originally met by material imported from Germany, for the manufacture of dynamite, is a case in point. Perhaps the most extensive deposit in this country is the one underlying the city of Richmond, Va., a deposit which Professor Rogers traced from a point on Chesapeake Bay, in Maryland, to beyond Petersburg, Va., where it is thirty feet thick Beds of similar character have been found in California, Oregon, and elsewhere on the Pacific Coast; and smaller deposits occur at West Point, at Wrentham and Andover, Mass., and in Connecticut and Rhode Island.

Infusorial earth, or tripoli, is best known as a polishing powder for gold, silver, etc., for which purpose it has no rival. Mention has already been made of its use in the manufacture of blasting powders, in which it serves the useful purpose of holding the explosive nitroglycerin. But these will ultimately be counted among the least of its uses. Already it plays an important part in the manufacture of cements and artificial stones, especially in Ransome's process. Combined with carbonate of magnesia, it forms the excellent cement known in Germany as albolite. With borate of lime, it forms a valuable glazing for furnaces, pottery, etc., and is found very useful as an enamel for iron and slate. Fused with borate of magnesia, it forms a beautiful and durable porcelain which can been cast and even blown like glass. A multitude of minor uses have been suggested, and many more will no doubt follow as our artisans become acquainted with its properties. Its lightness, indestructability by fire, and slowness of heat conduction are qualities of very great value. Bricks of it, with a little clay, are nearly as strong as common bricks, yet so light as to float on water. At the same time they are infusible, and such poor conductors of heat that they may be held at one end while the other is heated to redness. As an experiment, an Italian engineer constructed the powder magazine of a wooden vessel with such bricks, and when set on fire the vessel burned till she sank, without exploding the powder. The lightness of such fireproof bricks makes them specially valuable for such uses. They have also been used to advantage in the construction of reverberatory furnaces, pyrometers, etc. The heat-resisting quality of infusorial earth makes it not less useful as a protection to ice bins, ale cellars, etc., and as a lining for fireproof safes and the like, for which purposes it is rivaled only by asbestos. Agriculture furnishes another promising field for the use of infusorial earth. Professor Wilson, who has the honor of discovering the use made of this form of silica by plants, pronounces the application of it to fertilizing purposes the most important adaptation of matter for the reproduction of vegetation that has ever been discovered. There can be no question of the importance of such assimilable silica to soils like those of Bermuda, where the silicious element is nearly if not entirely wanting.

THE HELL GATE BLAST.

The result of the great blast at Hell Gate, or Newton's Channel, as the locality is now termed in honor of the successful engineer, is in every way satisfactory. The rock has been shattered much more than was expected, and the work of dredging is consequently greatly lessened. Soundings are still in progress, and divers are at work surveying the bottom and locating the larger fragments of rock. Vessels drawing 18 feet of water and over cannot pass within 300 feet of the shore; at 180 feet, there is a clear depth of 8 feet of water. Of course, the results are merely preliminary, and the channel will be gradually improved as the stone is removed. The pilots say that navigation is bettered already. In some localities eddies have been replaced by true tides, and the current has materially decreased in swiftness, while about 200 feet more room is afforded for passing the strait.

The observations of the shock wave generated by the ex

plosion were made by General Abbott and his assistants stationed at distant points, with whom telegraphic communication was held. At West Point, fifty miles away, no shock was perceptible even by the delicate instruments employed. At Springfield Junction, Long Island (not Massachusetts, as was at first reported) at a distance of twelve miles, the shock was noted in 13 seconds after the time of explosion. General Abbott is preparing a paper giving all the results of his observations, which will be read at the next session of the American Academy of Sciences.

Apart from the dredging, work at Hell Gate is by no means yet finished, and the operations are but fairly in progress on Flood Rock, the demolition of which is to leave a clear channel 1,200 feet in width. This rock forms a reef of about 7 acres in extent, and lies in the middle of the river, about 1,000 feet from Hallett's Point. Work was started on this obstruction in July, 1875, and continued steadily until May last, when the fear of its interference with the Hell Gate tunnels, through its growing proximity to them, together with the lack of necessary funds, determined its suspension. At the present time, two tunnels are partially finished. These are about 65 feet apart, aggregate in length 229 feet, and from them 1,462 yards of stone have been removed. Other tunnels have been begun. There is no coffer dam, as the point at which the main shaft is sunk is above high water mark. It is estimated that about two years of continuous labor will be required to complete the excavation, and that to blow it up 100,000 lbs. of explosive will be needed.

THE CENTENNIAL AWARDS.

The awards made to exhibitors at the Centennial Exposition were publicly announced on September 27. Some simple exercises, consisting of music and brief speech making, by Hon. D. J. Morrell, of the Centennial commission, Director General Goshorn, and others, took place in the Judges' Hall, after which General Hawley delivered the lists of successful competitors to the various national commissioners. General Hawley, in his remarks preceding the distribution, explained that the system which had been followed in granting these distinctions is different from any hitherto adopted at international expositions. The main features are the absence of any graded scale of merit and of distinctive prizes, the reduction in number of the judges, and the payment of the latter for their services. Medals of bronze are awarded, and each is accompanied by a brief report stating why the exhibit is deemed worthy of distinction. This report is of more intrinsic value to the exhibitor, as indicating the relative merits of his exhibits over others, than the possession of the medal. A copy of the report signed by a judge who is individually responsible for the opinions set forth (which views are further attested by the signatures of as many of the examining group as concur therein) is furnished to the exhibitor with authority to reproduce it in any way deemed, most to his advantage. It will be observed that the written professional opinion of a paid expert is here substituted for the anonymous verdict of a jury; and therefore in that opinion, and not in the mere bestowal of a medal, the value of the award lies. Of course under this plan several awards may be given in the same class of articles, based upon the same or differing qualities.

The American awards number several thousand, and the mere list occupies twenty-eight closely printed columns of the New York *Times*. It is manifestly impossible, therefore, for us to publish all of them. We note, however, a few of the firms best known to our readers, upon whom well merited honors have been bestowed: In the mining and metallurgy group, the Blake Crusher Company, for their ore and stone breaker; P. H. & F. M. Roots, for pressure blower; B. F. Sturtevant, for fan blower; the Loiseau Pressed Fuel Company, for artificial fuel; Jones & Laughlin, for cold rolled shafting; in the cotton and linen fabric group, Messrs. J. & W. Lyall, for the positive motion loom, which we recently described; and the same firm obtain another award for a sewing machine, which presents some points of remarkable ingenuity which are not generally known. It is a double thread lock stitch shuttle apparatus, capable, when driven by steam power, of making 2,500 stitches per minute, something, we believe, hitherto unparalleled in machines of its class. Mr. James Short is awarded a medal for his carpet loom; the Dixon Crucible Company, one for lead pencils. Among the printing presses, the Campbell and Cottrell & Babcock are both distinguished. Among the pumps, those of the Valley Machine Company, the Gould Manufacturing Company, L. J. Knowles, the Silsby Manufacturing Company, Bagley & Sewall, and the Niagara Works gain medals. Other successful competitors in the machinery groups are Nathan & Dreyfus, lubricators; Chalmers Spence Company, boiler and pipe covering; Branch, Crookes & Company, stone saw, countershaft, belt tightener, etc.; John A. Roebling's Sons & Company, wire rope; John T. Noye & Son, turbine wheel; Frick & Company, engines; Utica Steam Gage Company, gages; Babcock Manufacturing Company, fire extinguishers; Bolen, Crane & Company, hydraulic press; Ward B. Snyder, small steam engines; Buckeye Engine Company, engines; Lidgerwood Manufacturing Company, rotary engines; Stillman B. Allen, governor; I. B. Davis, Berryman feed water heater and purifier; Morris, Tasker & Company, wrought iron tubes, Burleigh Rock Drill Company, air compressors; Stillwell & Bierce Company, turbine wheel, feed water heater, etc.; Jerome Wheelock, piston packing; Hugh Young, stone saw; Emerson Steam Stone Saw Company, same; Union Stone Company, emery wheels; C. & S. Burt, shingle machine; J. A. Fay & Company, woodworking machinery; E. & B. Holmes, barrel machinery; H. B. Smith, woodworking machinery; Stiles & Parker, drop presses, etc.; Fitchburg Machine Company, machine tools; Trump Brothers, scroll saw; Campbell & Clute, knitting machines; Hull & Belden Company, drop forges, etc.; R. S. Newbold & Son, shearing machine; Richards, London & Kelley, woodworking machinery; Bentel, Margedant & Company, same; Pratt & Whitney Company, metal working tools; Brown & Sharpe Company, same.

The completion of the awards at this early day is a substantial triumph for the new jury system. The whole board of judges numbered but 250, and they were called upon to examine the contributions of over 30,000 exhibitors. When it is remembered that, at the American Institute and local fairs in general, the judges' reports are rarely finished till after the close of the exhibition, to the dissatisfaction of exhibitors, the advantage of employing paid experts is manifest. The judges at the Centennial were allowed compensation, obviously small in comparison with the duties imposed; but it was sufficient to fulfil its purpose and render the judicial labors a business transaction instead of one resting on mere favor and obligation. We commend the result to the notice of present and future fair managers. Exhibitors go to considerable expense to attend local fairs, in hopes of obtaining valuable reports on their productions, and it is but right that they should have them before the fair closes. At the Centennial it has been proved that this can be satisfactorily accomplished.

A CIGAR SCIENTIFICALLY DISSECTED.

A polite visitor, who, during his interview with us, had rendered our sanctum redolent with the fumes of a fragrant Havana, has just left a cigar on our table with the laughing request that we smoke it. Despite the fact that it is an exceptionally fine cigar, we are unable to gratify our friend's desire, seeing that we don't smoke; but the thought occurs that we can show our appreciation of the gift by applying the light, not of a match but of science, to it, and thus giving our friend and his brother smokers something to ponder over next time "the blue up-curling smoke" leads them to reverie.

To the world in general a cigar is merely a tightly rolled packet having brittle fragments of dry leaves within, and a smooth silky leaf for its outer wrapper. When it is burnt, and the pleasantly flavored smoke inhaled, the habitual smoker claims for it a soothing luxury that quiets the irritable, nervous organism, relieves weariness, and entices repose. Science, scouting so superficial a description, examines first the smoke, second the leaf, third the ash. In the smoke is discovered water in vaporous state, soot (free carbon), carbonic acid and carbonic oxide, and a vaporous substance condensable into oily nicotine. These are the general divisions, which Vohl and Eulenberg have still further split up; and in so doing have found acetic, formic, butyric, valeric, and propionic acids, prussic acid, creosote, and carbolic acid, ammonia, sulphuretted hydrogen, pyridine, viridine, picoline, lutidine, collodine, parvoline, coridine, and rubidene. These last are a series of oily bases belonging to the homologues of aniline, first discovered in coal tar. Applying chemical tests to the leaves, other chemists have found nicotia, tobacco camphor or nicotianine (about which not much is known), a bitter extractive matter, gum, chlorophyll, malate of lime, sundry albuminoids, malic acid, woody fiber, and various salts. The feathery white ash, which in its cohesion and whiteness is indicative of the good cigar, yields potash, soda, magnesia, lime, phosphoric acid, sulphuric acid, silica, and chlorine. Our friend has kindly left us a fine cigar; had it been a poor and cheap one, the ingredients we should extract would be fearful and wonderful to contemplate. Here is the list from an English parliamentary report on adulterations in tobacco. Sugar, alum, lime, flour or meal, rhubarb leaves, saltpeter, fuller's earth, starch, malt commings, chromate of lead, peat moss, molasses, burdock leaves, common salt, endive leaves, lampblack, gum, red dye, a black dye composed of vegetable red, iron, and liquorice, scraps of newspaper, cinnamon stick, cabbage leaves, and straw brown paper.

Returning now to the smoke, or rather its ingredients, Dr. B. W. Richardson, in his "Diseases of Modern Life," considers the effect of the same on the body at considerable length, basing his conclusions on actual investigation. He tells us that water, of course, is harmless; free carbon acts mechanically as an irritant, and tends to discolor the secretions and the teeth. Ammonia bites the tongue, exercises a solvent influence on the blood, excites the salivary glands, and thus causes a desire to drink while smoking. The tendency of carbonic acid is to produce sleepiness, headache, and lassitude. When a cigar is smoked badly, that is, when the combustion of the tobacco is slow and incomplete, carbonic oxide is produced in small quantities, and is an active poisoning agent, resulting in irregular motion of the heart, vomiting, convulsions of the muscles, and drowsiness. The nicotine tends to cause tremor, palpitation of the heart, and paralysis. The volatile empyreumatic substance produces a sense of oppression and taints the breath and surroundings of the smoker with the well known "stale tobacco smoke" smell. The bitter extract causes that sharp nauseous taste peculiar to a re-lighted cigar or an old pipe.

By trying the effect of tobacco smoke on lower animals, we can obtain an idea of its influence on ourselves. Small insects are stupefied rapidly, but recover in fresh air. Cold-blooded animals succumb slowly to the smoke, birds rapidly. Some animals, such as the goat, can eat tobacco with impunity; but none escape the effects of the fumes. Persons suffer most from tobacco while learning to smoke. Dr. Richardson says that the spasmodic seizures are sometimes terrible, especially in boys. There is a sensation of imminent death, the heart nearly ceases to beat, and sharp pains shoot through the chest. Examination of inferior animals under such conditions shows that "the brain is pale and empty of blood; the stomach reddened in round spots, so raised and pile-like that they resemble patches of Utrecht velvet." The blood is preternaturally fluid, the lungs are as pale as those of a dead calf, and the heart is feebly trembling: such is the primary action of one's first cigar.

After a time, however, the body becomes accustomed to the influences of the poison; and with the exception of constant functional disturbances (owing to the excretory organs; notably the kidneys, being compelled to do work not essential to their duties), no distressing results are felt. There are numerous instances where the evil effects are scarcely appreciable, the physical and nervous constitution of the smoker being capable of resisting the influence. In many cases copious salivation attends smoking, and in this circumstance the opponents of tobacco have found a strong argument. Still, either to expectorate or not to do so is a choice of two evils. In the latter case, the result is to swallow the saliva charged with poisonous matter; in the former, the saliva needed to prepare food for digestion is lost, and besides, as it contains salts of lime in solution, the effect is to produce large formations of tartar on the teeth. "Smoker's sore throat" is a special irritable state of the mucous membrane induced by cigar smoking, which soon disappears when the habit is broken off. Tobacco smoke does not produce consumption or bronchitis, but it tends to aggravate both maladies. Its effect on the organs of sense is to cause, in the extreme degree, dilation of the pupils of the eye, confusion of vision, bright lines, luminous or cobweb specks, and long retention of images on the retina, with other and analogous symptoms affecting the ear, namely, inability to define sounds clearly and the occurrence of a sharp ringing sound like that of a whistle or a bell. Its effect on the brain is to impair the activity of that organ and to oppress it if it be duly nourished, but to soothe it if it be exhausted. It leads to paralysis in the volitional and in the sympathetic or organic nerves, and to over-secretion from the glandular structures. Science was not wise enough to prepare so formidable an indictment of the nicotian weed as the above in King James' time, else that monarch might have had better ground than his personal dislike for stigmatizing the habit of smoking as a "custom loathsome to the eye, hateful to the nose, harmfull to the braine, dangerous to the lungs, and in the black stinking fume thereof, neerest resembling the horrible Stigian smoake of the pit that is bottomlesse."

And yet, despite all that Science can say, the habit is increasing. Two centuries ago the Turks regarded smoking as a religious offense, and paraded a smoker through the streets of Constantinople with his pipe stuck through his nose as a warning to others. Who can disconnect the Turk now from the ideas of chibouque or nargileh, or fragrant Latakia? Look at the best cigar wrappers the world can produce, raised on tobacco fields in the heart of New England, where the Puritan fathers once visited the direst of blue law vengeance on the wretch who profaned His Maker's handiwork by "making a chimney of his nostrills." The value of our tobacco crop last year reached nearly $30,000,000. We consume annually some 75,000 hogsheads of the leaf; we imported about 83,000 bales of cigars, etc., from Cuba in 1875.

What is the end of it all? Effects on individuals likewise affect communities, these in turn influence the nation. No person that smokes can be in perfect health, and an imperfect organism cannot reproduce a perfect one. Therefore it is logical to conclude that, were smoking the practice of every individual of a nation, then that people would degenerate into a physically inferior race. It would follow, moreover, that, in those countries where smoking is most practised, a lower physical, and a consequently lower intellectual, development must be found. Such, we think, will be conceded to be true of Spain, of Cuba, of Portugal, of Turkey, of Greece, and of the South American countries, where those who are addicted to the habit vastly outnumber those who do not smoke.

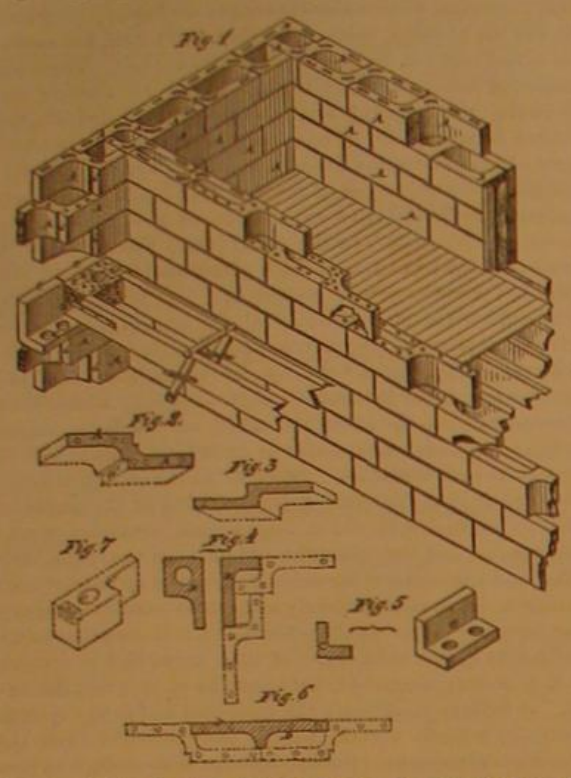
Passage of Electricity through Gases.

The author inserted in the circuit of an induction current a variable spark interval, a strong resistance in form of a tube with blue vitriol solution, which could be shortened or lengthened, and a galvanometer; and observed each time how much the liquid resistance had to be changed, in order, after determinate change of the spark interval, to obtain the same deflection of the galvanometer. The spark path was inclosed in a glass sphere in which the gas and the pressure could be varied. The conclusions arrived at are stated briefly thus:

1. Gases conduct electricity, in the glowing state, like metallic conductors. The induction spark is a suitable means for the comparative experiments. 2. The conductivities of gases at ordinary pressure are not inconsiderably different from each other. Perhaps this difference may be attributed to differences of temperature of the spark interval in the separate gases. 3. With decreasing pressure, the conductivity of gases increases very considerably. At small pressure, the gases differ very little from each other. 4. With less strength of the current, there is a decrease of the conductivity, probably due to the less temperature of the gas. 5. The conductivities of gases for electricity and heat stand in no close relation to each other. 6. The values found for the specific resistances investigated are to be distinguished from the resistances at the beginning of the discharge, which have before been investigated by other physicists.—*M. Oberbeck.*

IMPROVED BUILDING BLOCKS.

Mr. Nicholas J. Clayton, of Galveston, Texas, has recently (August 15) patented a cellular building block, of which we give engravings herewith. Fig. 1 is a perspective view of a portion of a building in process of erection. Fig. 2 shows one of the main building blocks, and Fig. 3 one of the partition wall blocks. In Fig. 4 are seen two forms of angle blocks or quoins. Fig. 5 gives two views of the bearing blocks for the joists. Fig. 6 shows a flue block, and Fig. 7 a jamb block. The blocks may be made of artificial



stone, cement, or clay, baked afterwards; and they are so constructed as to tie the outer and inner parts of the hollow wall securely together, forming one wall with numerous cells or passages through it.

A are the building blocks for the main walls, which are made with offsets in their middle parts, binding the two walls together. The offsets of the blocks, A, have rabbets, *a'*, formed in them to form seats for the ends of the adjacent blocks. B B are corner blocks, which may be formed of two wings meeting each other at right angles, the shorter wing being of a length equal to the thickness of the wall; or the outer end of the block, B, may be made solid for a distance equal to the thickness of the wall, and with a hole through said solid part. C are right-angled blocks, the outer end of which is vertical, and forms a part of the outer walls. The inner wing of the blocks, C, is horizontal, and forms a support or rest for the ends of the joists. Through the horizontal parts of the blocks, C, between the places where the ends of the joists will rest, are formed holes to connect with the cavities above and below said blocks. The space above the horizontal wing of the block, C, and between the ends of the joists, may be filled with concrete or with blocks of the proper size, to support the blocks, A, placed above them. The blocks, D, are for forming chimney and ventilating flues; and they are made with a projection or flange upon the middle part of their inner sides of such a hight as to meet the inner ends of two adjacent blocks. In places where woodwork is to be attached to the wall, recesses are formed in the blocks to receive pieces of wood to which said woodwork may be nailed. In the upper and lower edges or sides of the blocks, A, are formed holes or recesses of any desired shape for the cement or mortar, with which said blocks are laid, to enter, and thus key or dowel the said blocks together.

He Wanted to Sell a Patent Machine.

Soon after dinner yesterday a pleasant-faced man, having something wrapped up in a paper under his arm, called at a Detroit hotel, and requested a few minutes' conversation with the landlord. When they were seated, the stranger began: "I am an old landlord myself. I kept hotel in St. Louis for twenty eight years."

"Yes," was the non-committal reply of the landlord.

"And of course I know all about the inconveniences of hotel keeping," responded the man. "There were bugs around the beds in my hotel, and there are bugs around the beds in any hotel, I suppose. Of course I used to lie to the guests, but the bugs were there, and I knew it."

"What do you mean?" demanded the landlord, growing red clear round to his neck.

"Just keep right still," replied the man, "for now I'm coming down to biz. This is the summer season, isn't it, and the only season when bugs bite? In the winter they are dormant, and unless there's a fire in the room they don't care to get in their work on the weary traveler. Well, the summer season is the season for the mosquito also. All hotels and houses have mosquitos, and nothing is thought of it. They seem to be a sort of necessity. Travelers will raise a howl over bugs, but they never grumble at anyone about mosquitos."

"Sir! do you think I keep a junk shop?" roared the landlord.

"No, sir; I don't. This is a regular hotel, and a very good one. As I was going to remark, I have invented and patented a machine, operated by a boy and a crank, which you and all other landlords want and will have. It is a machine to imitate the hum of the mosquitos. Its notes can be heard all over each floor, and with a good boy at the crank there can be no failure. The traveler, just dozing off to sleep, hears the hum. At the same time a bug works out from under cover. Then more hums and more bugs. Actually, sir, without any lying or exaggerating, men will strike and claw the air all night long to kill imaginary mosquitos, while the bugs go unmolested and grow fat. The hum is a perfect imitation, and has even deceived Yale College professors. Without it your guests will blow around about bugs. With it no traveler will mention bugs at all, but will rip and tear at the mosquitos."

"Do you mean to insult me?" shouted the landlord.

"No, sir."

"But you talk as if I had bugs in my house!"

"I tell you what I'll do, landlord. I'll examine five beds, and if I do not find bugs in at least three of them I'll give you a machine for nothing."

It would have been a nip and tuck fight if the great big porter hadn't jumped in and hit the stranger with an iron boot jack. The inventor still lived, however, and within an hour was seen bearing down for another hotel under full sail.—*Detroit Free Press.*

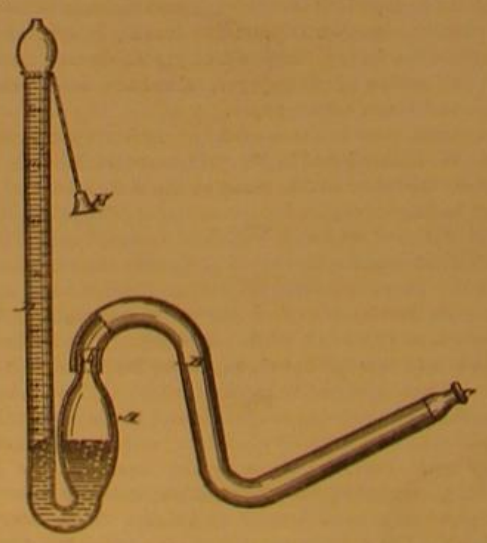
Knight's New Mechanical Dictionary.

Mr. Edward H. Knight, the author of the "New Mechanical Dictionary," now in process of publication by Messrs. Hurd & Houghton of the Riverside Press, Boston, informs us that the last sheets of the manuscript of his work have just been placed in the printer's hands. The fact is an event in the annals of literature in this country, as it marks the substantial completion of a great and elaborate undertaking, the labor on which has extended over a period of eight years. It is difficult to realize how colossal is the task involved in the preparation of a work of this description. Thousands of patents, American and foreign, have been digested, industrial processes of every nature have been examined, and the latest improvements therein noted. Engineering works, scientific discoveries, and tools of every craft have been studied; and finally all this immense collection, gathered from the whole field of applied science, has been subjected to careful revision and condensation, and, by means of ingeniously contrived systems of indexing, rendered invaluable for purposes of reference and research. Add to this the labors of artist and engraver, and there is little food for marvel that the work has cost $100,000; that it treats of 20,000 subjects; contains 7,200 engravings; and that its three volumes include 2,800 pages. It is more an encyclopædia than a dictionary; it is in fact a mechanical and scientific library, carried up to the latest dates.

The many extracts froms its pages which we have published will serve to give our readers an idea of its range of subjects. No single topic, however, has been wholly reproduced in these columns, as the engravings have been selected for their individual interest from the mass of the work, and afterwards grouped as seemed to us best befitting their character, without any reference to the author's classification. A just estimate of the comprehensive nature of the work, and its importance to inventors, engineers, and artisans of every class and in all libraries, can only be gained by careful examination of the volumes themselves. The work is published in parts, forty of which have appeared; and the remaining ones will shortly follow.

A POCKET LUNG TESTER.

Mr. William H. Burt, of Chicago, Ill., has patented through the Scientific American Patent Agency, August 8, 1876, a new spirometer, by which the breathing capacity of a person's lungs can readily be measured in cubic inches, by mercury, oil, glycerin, spirits, water, or any other liquid substance.



A is a glass bulb for containing the mercury or other liquid substance. B is the rubber tube, with a mouthpiece, C; and D is the scaled tube for measuring the hight of the column raised by the lungs. The rubber tube connects with a nozzle on the top of the bulb, and the glass tube connects with the bottom of the bulb by a return bend. The top of the vertical tube is open to the atmosphere, to prevent compressing the air above the liquid; and a little cap, E, may be used for closing it, to exclude dust, etc., and to prevent the liquid from running out by pneumatic pressure. This cap must be taken off when in use. It is only necessary to blow into the mouthpiece, when the hight of the mercury represents the lung pressure exerted.

A LIFE-PRESERVING CAP AND CAPE.

Messrs. E. J. McCarthy, of Red Hook, N. Y., and Gaston Wilbur, of Saugerties, N. Y., have recently invented a new sleeping cap, the object being to furnish a cap which may answer the threefold purpose of protecting the wearer from cold and storm, of an air pillow, to be used on the cars or in camp, and as a life preserver. The cap is made from rubber or other material which is impervious to water or air, and is provided with an external envelope, *a*, which is also made from waterproof material, and is united to the band of the cap by an airtight seam. A tube, *b*, having a suitable mouthpiece and valve, is attached to the cap, for inflating it while it is on the head. A cape, B, is attached to the cap, and is made from waterproof material, and is double at *c*, so that it may be inflated by blowing through the tube, *d*, which is provided with a mouthpiece and valve.

It will be seen that, when the cap and cape are not inflated, it forms an ordinary storm cap, and that when it is inflated the confined air in the space serves to protect the head from cold and to afford the necessary buoyancy for a life-preserver. This device was patented through the Scientific American Patent Agency, August 8, 1876.

An African International Exposition.

Expositions seem to be becoming epidemic. There is our own Centennial, named first because actually the largest yet held, but to be eclipsed, it is said, by the grand French sfiow of 1878. An exposition of marine and life-saving devices has lately been in Brussels, Belgium; another of general exhibits, of which we have heard little save the fact of its existence, has been held in Finland. There are rumors of a grand international display in Australia, soon to occur; and now last of all, South Africa announces that a World's Fair is to open in Capetown, Cape of Good Hope, on February 15. The director general of the African Exposition is already *en route* for Europe and this country: and before very long, our manufacturers will be informed that industries at the Cape are at the lowest ebb, that an exhibition of what other people in the world are doing is needed to wake up the colonists, and that probably any portions of our splendid exhibit in Philadelphia will be gladly made part of the African show. We advise exhibitors to keep all their decorations, show cases, special machines, and extra fine goods, prepared for the Centennial, in as good order as possible, and not to think of throwing the two first named articles aside when the Exposition is over, as there are plenty of opportunities to come, when all such will be found abundantly useful.

The Effects of Physical Culture.

An official inquiry into the results of gymnastic exercises has recently been instituted at a military gymnastic school in France. The results of the inquiry, which extended over six months, established: 1. That the muscular force is increased, on an average, 15 to 17 per cent, and occasionally from 25 to 30 per cent, while the force has, as we might expect, a tendency to become equal on both sides of the body. 2. That the capacity of the chest is increased by one sixth at the lowest. 3. That the weight of the individual is increased from 6 to 7 per cent, and occasionally from 10 to 15 per cent, while the bulk of the body is diminished, thus showing that profit is confined to the muscular system. The increase of muscular force was generally confined to the first three months of the course. During the last moiety a serious diminution usually occurred; and here the dynamometer gave positive indication of the necessity of moderating or suspending the exercises.

Dangers of the Sea.

The steamer Arbitrator left New Orleans, August 9 last, for Liverpool. On August 23, when about 100 miles east of Halifax, N. S., she struck a ledge of floating ice, and ran right upon it as far as the foremast. She then made water rapidly, and went down stern foremost, the ice holding her up forward. After being in the boats several hours, the crew were picked up by the brigantine Baltic, and landed at Dublin.

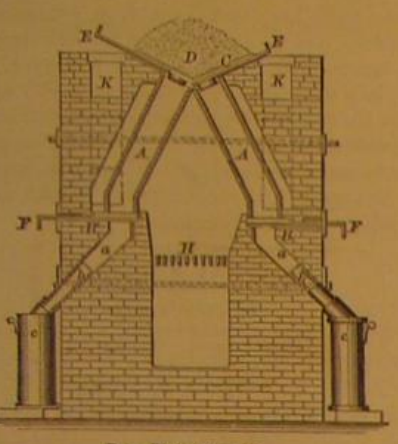
APPARATUS USED IN INDUSTRIAL PROCESSES.

Our extracts this week from Knight's "New Mechanical Dictionary" include apparatus of various kinds employed in several industrial processes. Fig. 1 is a

BONE BLACK FURNACE,

used for revivifying bone black for the purification and decolorization of saccharine solutions. The bone black, D,

Fig. 1.



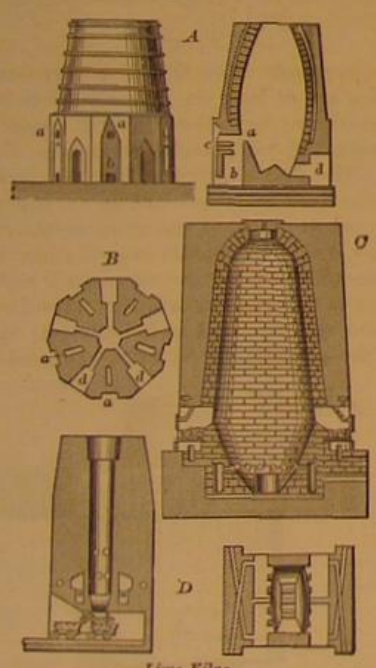
Bone-Black Furnace.

charged with impurities, is deposited in the hopper, C, where the withdrawal of slides, E, permits it to fall into the tubes, A, which are exposed to the heat from the grate, H, until the impurities are discharged. Then, by withdrawing the slides, F, on the bottom plates, B, it passes into the tubes, *a b*, and is received in vessels, *c*. At K are flues for conducting off the products of combustion and partially drying the black before it is admitted to the tubes, A. The process of

LIME BURNING

consists in calcining the carbonate in the form of limestone in kilns, during which the carbonic acid is driven off, leaving oxide of calcium or quicklime. Fig. 2 represents various forms of kilns. A B represents the kiln used at Ruders dorf, Prussia, and adapted to burn one part wood to four of turf. It has five fireplaces, *a*; *b* is the ash pit; *c c* are openings for regulating the draft, and at *d* are apertures for withdrawing the lime. The kiln is lined with a double thickness of fire bricks, the space between which and the outer masonry is filled in with well rammed cinders to prevent loss of heat. In the kiln, C, blasts of air are forced through the burnt and cooling lime, and mingle with the

Fig. 2.



Lime-Kilns.

hot currents from the furnaces. The latter are placed around the kiln, and air blasts are driven through the fuel. The upper end of the kiln is arched over, and the feed hole has a removable cover. The kiln, D, has bottom discharge, and the furnaces arranged on each side connect with it. A cross arrangement of flues counteracts irregularities of draft on the windward and leeward sides. Fig. 3 is a form of

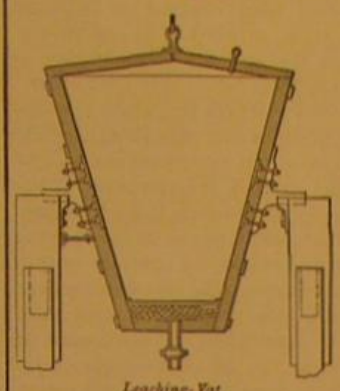
LEACHING VAT,

used in the process of chlorinating gold It is made of two inch plank, and is pitched inside. Lead discharge cocks are placed at the bottom; and under the false bottom, which is fastened so that it will remain in place when the vat is overturned, pieces of quartz are loosely laid. A pipe inserted into the airtight lids leads the chlorine gas from one vat to another of a series. The vat, before the admission of gas, is charged with the auriferous material. After the gold is dissolved, water is admitted, carrying off the chloride of gold to a vat. When the ore is thoroughly leached, it is discharged into a car and removed outside the works. Another process for the extraction of gold or silver from comminuted ore is conducted by exposing the material to molten lead, with which it forms an alloy. The apparatus is

THE LEAD BATH.

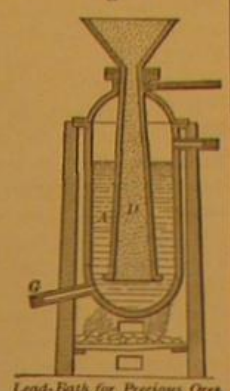
In the form represented in Fig. 4, the ore occupying the

Fig. 3.



Leaching-Vat.

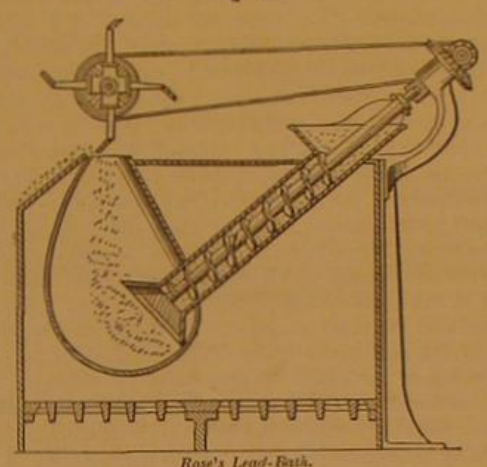
Fig. 4.



Lead-Bath for Precious Ores.

central shaft, D, is discharged beneath the column of lead, A, which is kept molten by the furnace beneath. The heavier portions of the alloy are drawn off by the pipe, G. The ore rises through the lead, bringing the particles of precious metal in contact therewith. The flow of ore is assisted by withdrawing air from above by an air pump. In Rose's lead bath, Fig. 5, the vessel is suspended in a furnace.

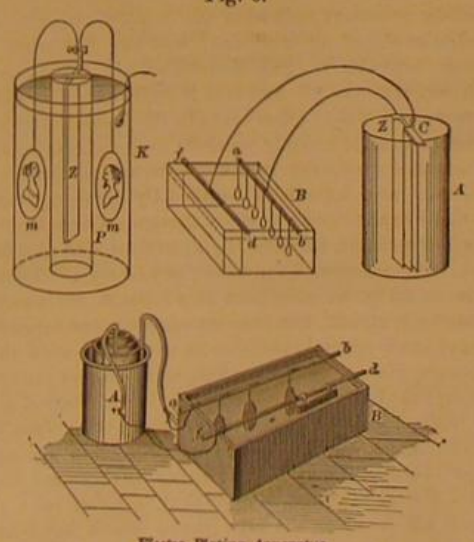
Fig 5.



Rose's Lead-Bath.

through which extends an inclined tube which discharges its contents near the bottom. The tube has a propelling screw, with a shoulder and elastic collar at its bearing, and a grinding plate at its lower end, which works against a grinding surface. Above the mouth of the vessel is a wheel which removes the waste ore as it rises to the surface of the

Fig. 6.



Electro-Plating Apparatus.

molten lead. Fig. 6 represents the apparatus commonly employed in

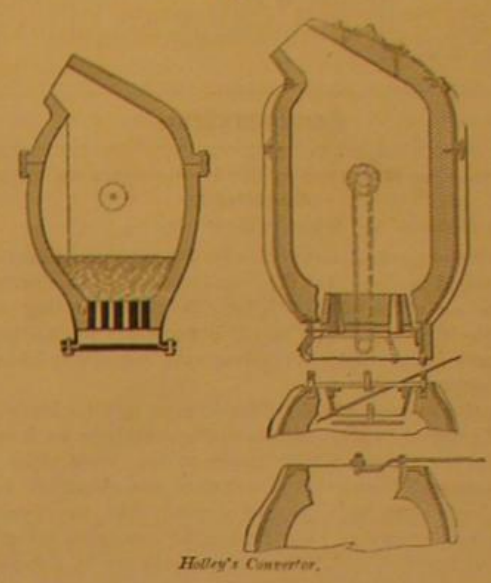
ELECTROPLATING.

A is the battery, and B the vessel into which the solution of the metal to be deposited is placed. The molds are suspended from a metallic rod, *a b*, opposite to which the plate, *f d*, is hung. Copper, if the solution be of a salt of that metal, serves as a soluble electrode, and is dissolved in the same ratio as the metal is deposited upon the mold. The battery being charged, *f d* is put in communication with the copper pole, C, by a copper wire, and *a b* is connected with the zinc pole, Z. The current produces decomposition, and the electro-positive metal is deposited on the object attached to the negative pole.

THE CONVERTERS

used in steel making are represented in Figs. 7 and 8. The

Fig. 8.



Holley's Converter.

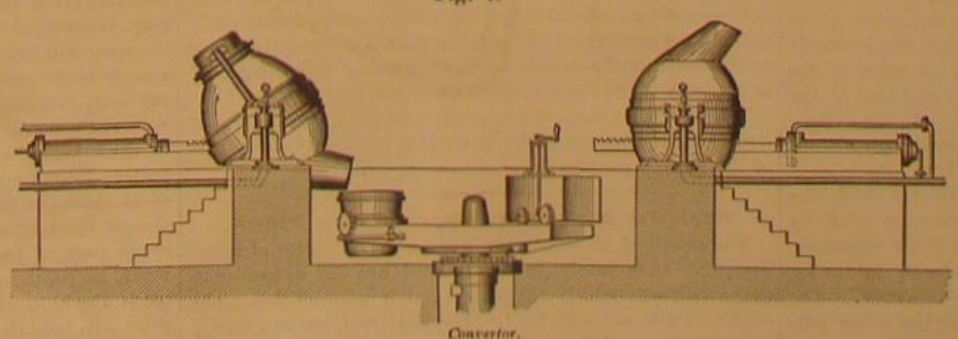
five-tun converter is an iron vessel, 14½ feet high and 9 feet in diameter externally, of a bulbous shape, and hung upon trunnions. The lower hemisphere is truncated, giving a flat bottom, five or six feet in diameter. The upper hemisphere terminates in a large neck inclined sidewise, so that a flame issuing under pressure from the mouth of the upright converter is obliquely directed into a chimney, guarded by a hood. The whole vessel has a rude resemblance to a pear. It is supported by heavy trunnions on each side of the center, and revolved upon these by hydraulic power.

This huge iron bottle, with its neck awry, is lined with a foot of refractory material, known as ganister, to preserve the iron shell. The trunnion is hollow, and a passage from it runs down the outside, looking like a strong rib in the iron surface, to the bottom, where it communicates with the tweers. The bottom of the Holley converter is movable, and when taken out looks like a great plug of fire brick, two feet high, resting upon a cast iron disk. The tweers, or nozzles for the blast, are imbedded vertically in the lining, and present ten groups, each containing a dozen three-eighth inch holes. The aggregate area of these openings is equal to that of a single tweer 4·1 inches in diameter; but the thorough agitation produced by dividing the blast secures much greater useful effect. The pressure of the blast is twenty-five pounds per square inch.

The converter in its upright position, being heated by a charge of coals and the blast, is turned mouth downward to vomit out the glowing coals, then upon its side to receive its charge, which runs from the cupola furnace above, along a trough, and plunges into the mouth of the converter. The position of the retort as this time prevents the charge from running into the tweers before the blast begins. Afterwards the pressure of the air itself keeps the passages clear. Then the blast is let on, and the converter swung back to a vertical position. A tongue of white flame comes roaring out of the mouth. The silicon of the pig oxidizes first, without very intense flame; but as the graphite and especially the combined carbon begin to burn also, the heat rises to some 5,000° Fah., and the light is so brilliant as to cast shadows across full sunshine

In fifteen or twenty minutes the marvelous illumination ceases more suddenly than it began. The volume and brilliancy of the flames diminish together with startling rapidity. This change of the Bessemer flame marks the elimination of most of the carbon, and indicates the critical moment. When it arrives, the blast is stopped, the converter is turned upon its side, and 600 pounds of melted spiegeleisen are turned into it, as the pig was previously charged. The reaction is instant and violent. The manganese of the spiegeleisen combines with any sulphur that may remain in the bath, forming compounds which pass into the slag. It also decomposes, in the slag, silicates of iron, taking the place of the iron and returning it to the bath. Finally, the carbon and manganese together reduce the oxide of iron formed during blowing, which would destroy the malleability of the iron. This is quickly accomplished, and now the gigantic converter, like a monster weary of drinking boiling iron and snorting fire, turns its mouth downward, and discharges its contents into a vast kettle or ladle, brought underneath for the purpose by one of those intelligent cranes that stand around, so silent and so helpful. The ladle is swung over the molds ranged round the side of the semicircular pit below, like a row of Ali Baba's oil jars, each capable of containing a bandit. The white, one would almost say transparent, metal is drawn off into these through a tap hole in the bottom of the ladle, retaining the slag which floats on the surface till the last. When the first mold is filled, the plug is closed, the ladle swung round to the second mold, and so on till all the steel is thus cast into ingots, the size of which varies with the kind of work for which the steel is required. A thin

Fig. 7.



Converter.

*Published in numbers by Messrs. Hurd & Houghton, New York city.

steel plate is placed on the top of each casting immediately the mold is filled, and over this a bed of sand is placed, and speedily and firmly pressed down.

As soon as the ingots have solidified, and while they are still glowing, the molds are lifted off them by means of an hydraulic crane, and afterwards the ingots are picked up by tongs attached to the same machinery, and are carted away, all red hot, to the hammer shops, where they are thumped and rolled or otherwise tortured into their required forms of rails, tires, and plates.

Correspondence.

The Inverse Rotation of the Radiometer an Effect of Electricity.

To the Editor of the Scientific American:

In a former communication to the SCIENTIFIC AMERICAN, I endeavored to show that the direct rotation of the radiometer was an effect of electricity. Before attempting to explain the inverse rotation, it will be necessary to state briefly some new facts which my electroscopic researches have led me to establish.

In order to ascertain the electric state of their inner surfaces, I exposed, to solar radiation, glass receivers such as are used for the air pump. By means of the proof plane and electroscope, I found that this surface was electrified negatively, and even to a greater degree than the exterior. This excess of energy I attribute to the numerous reflections from the interior. If, however, we hold one of these electrified receivers near the Böhnenberger electroscope, taking care that it does not come in contact with it, the electroscope at once indicates the presence of positive electricity. As both the outer and inner surfaces are negatively electrified, this phenomenon must be attributed to the electricity developed in the interior of the glass itself by its molecular polarization and feeble conductivity. The following experiment confirms this explanation If we remove from the exterior, by means of the proof plane, a portion of the negative electricity, and then approach, as before, the globe to the electroscope, a remarkable increase of positive electricity is at once shown. The same results are observed in the radiometer.

I next examined the electric state of the exterior of the radiometer globe when placed in partial obscurity and moistened with ether. There are no signs whatever of electricity, as long as the inverse rotation continues; but as soon as the direct rotation commences—on account of the obscure radiations given forth by the surrounding bodies—positive electricity manifests itself and rapidly increases. While in this state, I exposed the radiometer to solar radiation, and I found that this positive electricity remains quite a long time, and that, notwithstanding the positive charge on the exterior, the direct rotation continues with its usual rapidity.

The fact last mentioned enabled me to determine by experiment the electric state of the inner surface of the radiometer globe. Only two suppositions can be made in regard to it: either the electric state of the inner surface is dependent, by means of molecular polarization, upon the electric state of the exterior, or it is independent. In the first supposition the interior face is electrified positively when the exterior is electrified negatively, and *vice versâ*. The second supposition may be divided into three hypotheses, for we can admit that the interior is constantly, under the same circumstances, either neutral, or negative, or positive. Hence we have in all four hypotheses, *à priori*, namely: 1. Inner surface is dependent upon electric state of exterior. 2. In ner surface is independent and neutral. 3. Inner surface is independent and negative. 4. Inner surface is independent and positive.

Now of these four hypotheses, the fourth alone is verified by experiment. This I have established as follows: In one series of experiments I charged the exterior of the radiometer with positive electricity by exposing it to solar radiation. In a second series I charged the same surface with positive electricity by exposing it to solar radiation after moistening it with ether. Each experiment comprised two operations. I touched a certain number of times the exterior of the glass globe with the proof plane, and I carefully observed the electroscopic signs of the Böhnenberger electroscope when brought in contact with the proof plane; then I approached to the electrometer the glass globe which had been partially discharged by the preceding experiment, and I again observed the signs given by the electroscope. In the case that one of the first two hypotheses expresses the real state of the inner surface of the radiometer under the influence of radiation, on approaching the glass globe we should have, in both series of experiments, electroscopic signs of equal intensity for equal electric changes of the exterior surface, manifested by the equality of those of the proof plane. Now this does not take place. In my experiments on the approach of the globe, the electroscopic signs in the second series surpass in intensity those observed in the first series. These results agree perfectly with the fourth hypothesis, but are in open disagreement with the third. Any one can easily see this, with a little attention, by considering the layers of electricity produced in the interior of the glass walls by molecular polarization. The fourth hypothesis is, then, the true one, and the inner surface is electrified positively.

The explanation of both the direct and inverse rotation follows naturally from these facts and those communicated in my former note. For, since the inner surface, when exposed to luminous or calorific radiations, is electrified positively, the direct rotation is a necessary consequence of the attractions and repulsions which this positive electricity exerts upon the free electricity of the vanes. This rotation continues when the radiometer is surrounded by light, because a perfectly homogeneous layer of electricity upon the inner surface is almost impossible.

The inverse rotation occurs in two circumstances: 1. When the instrument, having been exposed to radiation which produces a direct rotation, is allowed to cool slowly. 2. When the radiometer at the ordinary temperature is cooled suddenly, for instance, by moistening it with ether.

In the first case, the electricity, which the globe acquires when exposed to radiation, disappearing very slowly, as experiments show, an inversion of the movement can be produced by an inversion in the signs of the electricity of the vanes. In fact, in accordance with the principle of reciprocity, the emission of the radiations gives rise in the vanes to a development of electricity equivalent and contrary to that which absorption has produced there. By this development of electricity, the vanes would return to their neutral state if the electricity produced by absorption had not passed in part from the vanes into the rarefied gas of the globe. Now this passage took place with a greater energy as the rotary movement of the vanes had renewed more frequently the mass of air in contact with them. Hence the electric effect of the emission will be to change the signs and to diminish the charge of free electricity of the vanes. In the second case, where the cooling is produced by moistening the exterior, the globe remains in its neutral state. For, as I have above remarked, during the whole time of the inverse rotation the cooled surface of the globe gives no sign of electricity. It appears that the cooling itself is not capable of producing electricity, but that the passage of a radiation through the surface is absolutely required. In these conditions, the vanes become charged with negative electricity upon the dark, and positive electricity upon the bright, side, by reason of the emission, at the same time that the radiations, given forth by the vanes and absorbed by the inner surface of the glass globe, electrify the latter positively. Thus the electric theory of the radiometer explains quite well the principal phenomena which have been observed up to the present time. I hope to make, hereafter, a study of all the particular movements which different observers have published in the *compte rendu* of their experiments. I will only say now that the most remarkable of them, namely, the rotation of the radiometer globe when an obstacle is put to the rotation of the vanes, as discovered by Schüster, is in entire conformity with the above theory, while it constitutes a very serious objection to the hypothesis of mechanical impulsion by radiation.

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Petroleum as a Lightning Conductor.

The destruction of oil by lightning this year has been remarkable, amounting to 242,412 barrels, from January 1 to July 31 of this year, or rather from April to August; there were no fires from this cause in January, February, or March, two in April, none in May, four in June, and five in July. It is scarcely necessary to inform our readers that the oil destroyed is in closed-top iron tanks, and the lightning, striking these, explodes the gas that collects in the space above the oil, scatters the oil, and sets it on fire, and in this way often communicates to other tanks in the immediate vicinity. The theory most commonly received in the oil regions of the cause of such frequent lightning strikes is that the gas, which, it is well known, is continually escaping from the oil in these tanks, rises to some distance above the tanks, acts as a conductor, attracts the lightning, and the damage is done. One peculiar feature in the history of these accidents is, so far as we have been able to learn, no iron-topped tank has been struck, but in every case wooden-topped ones. We have made special inquiries on this point with the uniform result given. So far, attempts to protect tanks with lightning rods have been failures; at Dilks' Station, a number of rods, supposed to be ample protection, were placed about the tanks, but they were no protection against this summer's bolts. It may be interesting, to those not acquainted with the oil business, to state that, in losses occurring in this way, all the oil in the pipe line to which the tanks belong is assessed *pro rata* for the loss; that is, the law of general average, so well known in marine law, is applied in this case.—*Stowell's Petroleum Reporter.*

REMARKS:—If it were possible to carry the rods entirely above the rising gas, then the rods would be a complete protection. But the probabilities are that the rods mentioned were either immersed in an atmosphere of explosive gas, which the lightning necessarily ignited before it reached the rods, or the rods, like the majority that are put up, were not properly connected with the earth, consequently could not protect anything. A lightning rod not sufficiently joined to the earth is of no more use in conducting lightning than is a pipe with one end stopped up to conduct water.

We wish that some of our readers would give us the particulars of the rods at Dilks, describing especially the nature of the ground connections.

Explosive Agriculture—Dynamite vs. Plows.

The agents of M. Nobel, the well known inventor of nitroglycerin, have lately found a novel use for dynamite in grape culture, which suggests further possibilities. The explosive was not used for its chemical effect, but in a purely mechanical way, literally to "shake up" the earth and allow the free percolation of water and the access of air to the roots of the vines. To this end holes were made in the soil about ten feet in depth, and at points where no roots of the vines were likely to be injured. Then cartridges of dynamite were introduced and exploded, and the result was that, for the entire depth noted, the earth was made loose and friable. The ground, in short, was not only rendered in better condition than could have been effected by plow and harrow; but every phylloxera, so the writer says, on roots of the vines was killed. The quantity of dynamite used is not stated, but it is likely to have been but small, just enough to shake the soil without blowing up the vines.

It seems to us that the use of dynamite in agricultural operations need not stop here. Instead of breaking up old pasture lands with the plow with great labor, the farmer might bore holes here and there, drop dynamite cartridges, blow them up, and in a second find his soil loosened and all noxious worms and insects therein destroyed. Dynamite, however, is a dangerous material, and hardly one of which to counsel the indiscriminate use; but nevertheless it might prove a profitable venture for engineers and powder and nitro-glycerin manufacturers, and others who may safely and lawfully be trusted with the explosive, to offer their services in breaking up land for farmers.

PRACTICAL MECHANISM.

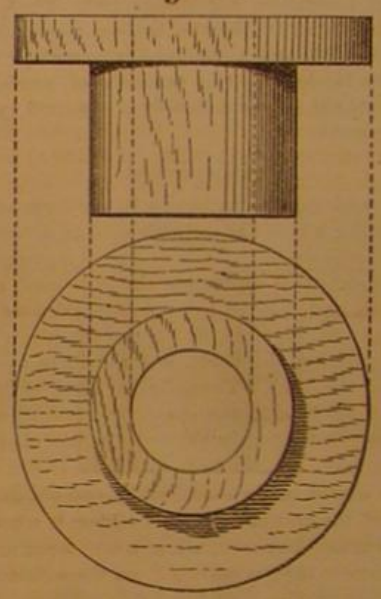
BY JOSHUA ROSE.

SECOND SERIES—Number XII.

PATTERN MAKING.

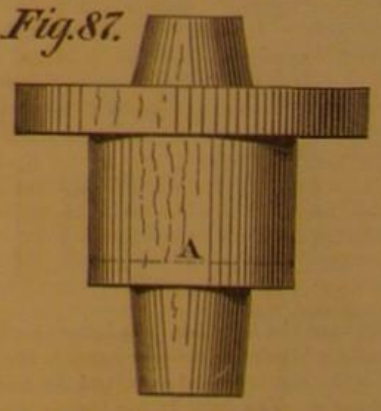
We may now commence a series of examples, accompanying each example with the explanations and considerations necessary to, and governing the method of, the construction chosen. Fig. 86 represents a drawing of a gland for which

Fig. 86.



a pattern is required. Now this is a very simple pattern, and yet there are at least six different methods of making it, any of which may be followed, as will appear more clearly to the reader by his glancing over Figs. 87, 89, 90, 92, 93, and 94. The first question is how to determine which method is the most suitable. Let us suppose the pattern maker to be uninformed of the purpose the casting is to serve, or how it is to be treated: in such a case he is guided partly by his knowledge of the use of such patterns, and a consideration of being on the safe side. The form shown in Fig. 87 would suggest itself as being a very ready method of making the pattern; by coring out the hole, it can be

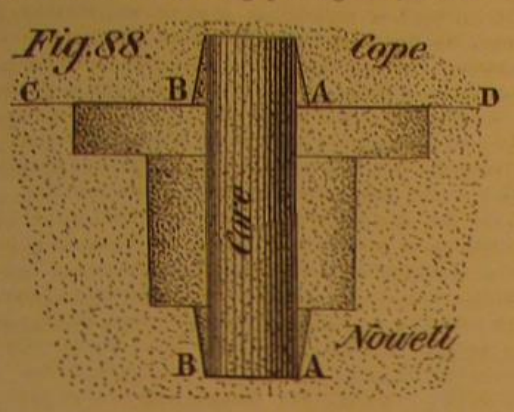
Fig. 87.



made parallel, which the drawing seems to require. The advantage of leaving the hole parallel is that less metal will require to be left for boring, in case it should be necessary; because, if the hole is made taper, the largest end of the bore will require to have the proper amount of allowance to leave metal sufficient to allow the hole to be bored out true, and the smaller end would, therefore, have more than the necessary amount: while just the least taper given to the exterior would enable the molder to withdraw the pattern from the mold. Made in this way, it would be molded as shown in Fig. 88, with the flange uppermost, because almost the whole of the pattern would be imbedded in the lower part of the flask, the top core print being all that would be contained in the cope; and even this may be omitted if the hole requires to be bored, since the lower core print will hold the core sufficiently secure in small work, unless the core is required to be very true. The parting of the mold (at C D, in Fig. 88) being level with the top face of the flange, much taper should be given to the top print (as shown in Fig. 87), so that the cope may be lifted off easily. Were this, however, the only reason, we might make the top print like the bottom one, providing we left it on loose.

or made it part from the pattern and adjust to its place on the pattern by a taper pin; but another advantage is gained by well tapering the top print, in that it necessitates the tapering of the core print at that end; so that, when the two parts of the mold are being put together, that is to say,

Fig. 88.



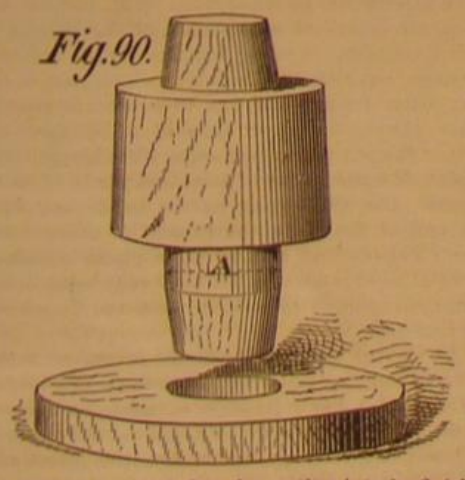
when the cope is being put in place, if the core has not been placed quite upright, its tapered end may still arrive and adjust itself in the conical impression, and thus correct any slight error of position of the core. The size of the core print should be, at the part next the pattern, the size of the core required; for if the extremities are made of the size of the core, and the taper or draft is in excess, there will be left a useless space around the core print, as shown at A B in Fig. 88, into which space the metal will flow, producing on the casting, around the hole and projecting from the end face, a useless web, which is called a fin, which will of course require to be dressed off the casting.

We will now suppose that our piece, when cast, is to be turned under the flange and along the outside of the hub or body, and that the hole also is to be bored. In this case the pattern made as above would still be good, but could be much more easily made and molded if it has to leave its own core, its shape being as shown in Fig. 89: because the trouble

Fig. 89.

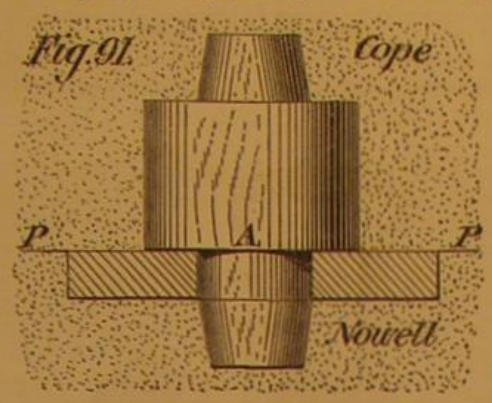
of making a core is obviated, and the core is sure to be in the center of the casting, which it seldom is when a core is used. We must, however, allow more taper or draft to a hole in a pattern than is necessary on the outside; about one sixteenth inch on the diameter for every inch of hight on work of moderate size is sufficient. The allowance for boring should be one sixteenth inch at the large end of the hole, providing the diameter of the hole is not more than five or six inches, slightly exceeding this amount as the diameter increases; whereas, if the pattern had been made with core prints, an allowance of one eighth inch for small, and three sixteenths inch for larger, work would be required. These are the advantages due to making the pattern leave its own core. We have still to bear in mind, however, that, if the casting require a parallel hole, a core must be used; and furthermore, if the hole is a long one, we have the following considerations: The separate dry sand core is stronger, and therefore better adapted to cases where the length of the hole greatly exceeds the diameter. Then again, if the hole require to be bored parallel, it can be more readily done if the hole is cast parallel, because there will be less metal to cut out. The casting also will be lighter, entailing less cost, providing it has to be paid for by the pound, as is usually the case. The molder is given more work by making the core; but the saving in metal and in turning more than compensates for this, provided the length of the hole is greater than the diameter of the bore.

Fig. 90.



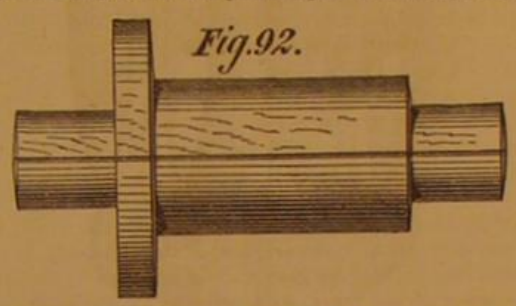
Let it now be required that the casting is to be finished all over, such as for a gland for a piston rod. It would, in that case, be preferred that, if the casting should contain any blow or air holes, they should not be on the outside face of the flange, and this will necessitate that the piece be molded the reverse way to that shown in Fig. 88: that is to say, it must be molded as shown in Fig. 91, with the flange downwards; for it may be here noted that the soundest part of a casting is always that at the bottom of the mold; and furthermore, the metal there is more dense, heavier, and stronger than it is at the top, for the reason that the air or gas, which does not escape from the mold, leaves holes in the top of the casting or as near to the top as they can, by reason of the shape of the casting, rise. The bottom metal also has the weight of the metal above it, compressing it, and making an appreciable difference in its density. It must, therefore, be remembered that faces requiring to be particularly sound should be cast downwards, or at least as near the bottom of the mold as they conveniently can. Following this principle, our gland will require to be molded as shown in Fig. 91, P P representing the line of the parting

Fig. 91.



of the mold; so that, when the cope is lifted off, the loose hub, A, will rise with it, leaving the flange imbedded in the lower half of the mold. It is evident that in this case the pattern must be made as shown in Fig. 90, the body and core prints being in one piece and the flange in another, fitting to an easy fit on to a parallel part on one end, and ad-

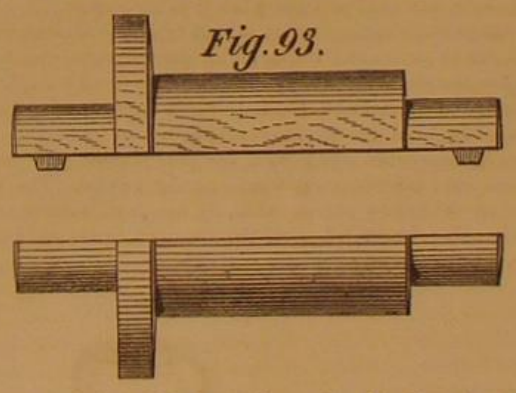
Fig. 92.



joining the core print, as shown at A. For glands of moderate size, this method is usually adopted, and it answers very well for short pieces; but in cases where the length of the body approaches, say three diameters, the horizontal position is the best, and the pattern should be made as shown in Fig. 92, 93, or 94. Even in short pieces, when the internal diameter approaches that of the external, this plan is the best, because it is difficult for the molder to tell when his core is accurately set in position.

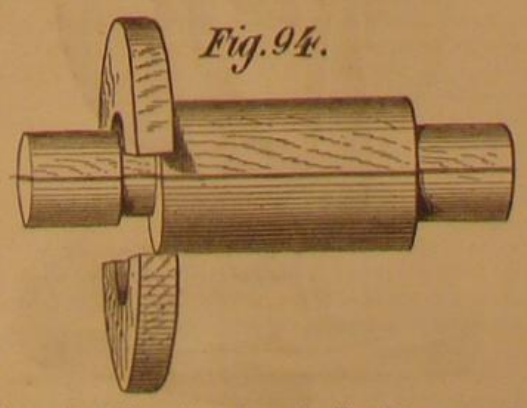
For a pattern to be molded horizontally, Fig. 93 shows

Fig. 93.



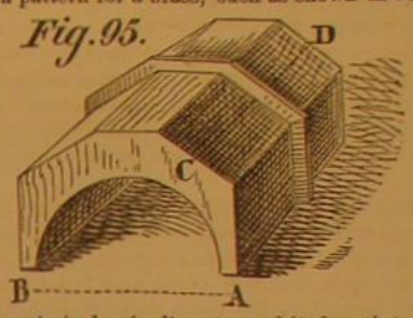
the best style in which it can be made. Its diameters are turned parallel; the required draft is given by making the rim of the flange a little thinner than at the hub, and by making the end faces of the hub and the core prints slightly rounding. If the hub is very small, as, say, a half inch or less, and the flange does not much exceed it, the pattern may be made solid, as shown in Fig. 92; but if the hub be small and the flange large, it should be made as shown in Fig. 94.

Fig. 94.



To construct the pattern shown in Fig. 87, we proceed as follows: From a piece of plank, we saw off a piece of wood a little larger and thicker than the required flange, measuring with a contraction rule, that is to say, a rule specially made for the pattern maker, and having its measurements larger than the actual standard ones in the proportion of one eighth inch per foot: so that a foot on a contraction rule is $12\frac{1}{8}$ standard inches, and an inch is $1\frac{1}{96}$ standard inches. The reason for this is that, when the metal is poured into the mold, it is expanded by heat; and as it cools, it contracts, and a casting is, therefore, when cold, always smaller than the size of the mold in which it was made. Brass castings are generally said to be smaller than the patterns in the proportion of one eighth per foot, and cast iron castings one tenth inch per foot; and so, to avoid frequent calculations and possible errors, the contraction rule has the necessary allowance in every division of the foot and of the inch. It is not, however, to be supposed that the possession of such a rule renders it possible for the pattern maker to discard all further considerations upon the contraction of the casting; because there are others continually stepping in. Such, for example, is the fact that the contraction will not be equal all over, but will be the greatest in those parts where the casting contains the greatest body of metal. If we are required to make a pattern for a brass, such as shown in Fig. 95, its

Fig. 95.



bore being six inches in diameter and its length ten inches, we shall find that the diameter of the casting will be less at A B than can be accounted for on the basis of a contraction of one eighth inch per foot; and furthermore, the projection in the middle of the brass, which is sometimes provided instead of flanges to prevent the brass from moving endwise in the box, will cause the sides of the hexagon to cast hollow in their lengths; so that a straight edge, placed along the bevel from C to D, would touch the brass at each end, and not in the middle.

In the smaller sizes of patterns, however, such as those of 6 and less inches in diameter, there is another and a more important matter requiring attention, which is that, after a molder has imbedded the pattern in the sand, and has rammed the sand closely around it, it is held firmly by the sand and must be loosened before it can be extracted from the mold. To loosen it, the molder drives into the exposed surface of the pattern a pointed piece of steel wire, which he then strikes on all sides, causing the pattern to compress the sand away from the sides of the pattern in all directions; and as a result, the mold is larger than the pattern. In many kinds of work, this fact may be and is disregarded; but where accuracy is concerned, it is of great importance, especially in the matter of our example (brasses for journals), for they can be chipped and filed to fit their places much more rapidly than they can be planed, and it is necessary to have the castings as nearly of the correct conformation as possible. In cases where it is necessary to have the castings of the correct size without any work done to them, the shake of the pattern in the sand is of the utmost importance. If he is required to cast a piece of iron 3 inches long and 1 inch square, supposing the pattern were made to correct measure by the contraction rule, the molder, by rapping the pattern (as the loosening it in the mold is termed), would, by increasing the size of the mold above that of the pattern, cause the casting to be larger than the pattern: that is to say, it would be longer and broader, and therefore, in those two directions, considerably above the proper size, since even the pattern was too large to the amount allowed for contraction. The depth, however, would be of correct size, because the loosening process or rapping does not drive the pattern any deeper in the mold. It follows that, to obtain a casting of as nearly the correct size as possible, the pattern must be made less in width and in length than the proper size, to the amount of the rapping; and to ensure that the molder shall always put the pattern in the sand with the same side uppermost, the word "top" should be painted on the face intended to lie uppermost in the mold. The amount to be allowed for the rapping depends upon the size of the pattern, and somewhat upon the molder, since some molders rap the patterns more than others: hence, where a great number of castings of accurate size are required, it is best to have two or three castings made, and alter the pattern as the average casting indicates. For castings of about 1 inch in size, the patterns may be made $\frac{1}{32}$ inch too narrow and the same amount too short; but for sizes above 6 inches, allowance for rapping may be disregarded.

In patterns for small cast gears, the rapping is of the utmost consequence. Suppose, for instance, we have 6 rollers of 2 inches diameter, requiring to be connected together by pinions, and to have contact one with the other all along the rollers: if we disregard the allowance for rapping, the pinions will be too thick, and we shall require to file them down, entailing a great deal of labor and time, besides the rapid destruction of files.

Garden Bulbs.

Now is the time when bulbs should be taken up and stowed away, as the leaves of the plants become ripe and brown, and the roots will die if the plants remain too long in the ground. The bulbs should be put away in the shade to dry for a few days; then the tops, roots, and rough skin should be removed, and the bulbs put in paper bags, properly labeled. Bulbs that have flowered in water should, as soon as the flowers begin to fade, be removed and planted in earth, where they will get a little nourishment for the future good of the bulb; but even then the bulbs is weakened, and bulb will not flower as well in water twice, though they will serve for planting in the garden.

IMPROVED CROSSHEAD FOR LOCOMOTIVES.

Mr. W. A. Alexander, the inventor of the new locomotive link which we recently illustrated, has also devised an improved crosshead for locomotives, which is represented in perspective, Fig. 1, and section, Fig. 2, in the accompanying engravings. The general object is to render the crosshead easily adjustable at the wristpin and jaws, so that a close fit and steady motion in the guides are obtained, and so that the device will possess greater durability. The crosshead is cast in the usual manner, and has side recesses back of the piston rod socket, for the insertion of the detachable wristpin, A. The latter is turned true in the lathe and is fitted into the recesses by side guide plates, which are secured by pins to the jaws of the crosshead. These jaws are not planed square, but are made at a slight angle tc the horizontal axis of the head, as shown in Fig. 2. In relatively opposite directions on the sides of the jaws, tapered wedges, B, are placed, forming a square base support for the top and bottom steel plates, C, which are secured firmly to the crossheads by countersunk steel bolts. The wedges have apertures for the passage of these bolts, which are loosened or tightened by a key introduced into interior recesses of the jaws.

It is claimed for the invention that one pair will outlast any engine, and effect a saving of fifty per cent in repairs of connecting parts, that when the guides are once set true with the cylinders they will never need relining, and that they can be secured to the frame without the intervention of liners. The mode of obtaining a perfect alignment of the crosshead and guides with the cylinder will be seen from

Fig. 1

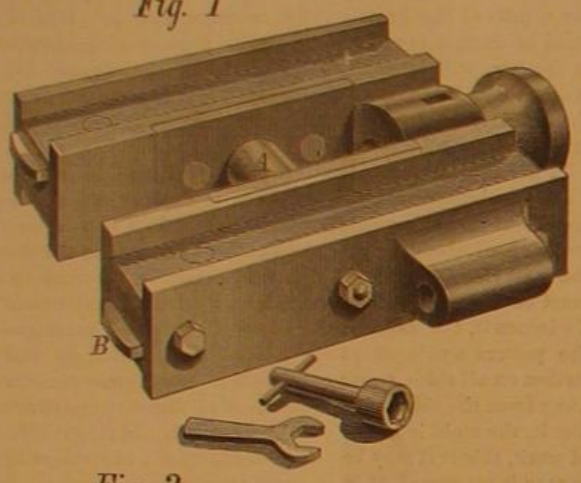
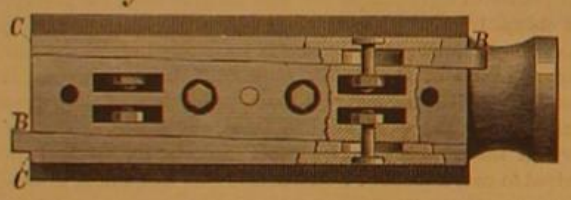


Fig 2



the following. The center line on the jaw of the crosshead, is cut in when on the planer, the guides being fitted and set true with the cylinder without liners, and secured with bolts or rivets and steady-pinned, and may be taken down and planed off the entire length whenever necessary, and replaced without the necessity of relining. The crosshead being in place, with the adjustable keys loose, is set true with the guides, with the rule, caliper, or compass by the center line on the jaws of crosshead. Thus it will be seen that no matter whether it be the guides or the jaws of the crosshead that are worn, it is only necessary to take up the wear with the adjustable keys, setting the head by the line, to insure both guide and crosshead being in perfect line with the cylinder. The piston rod and pump rod, it is further claimed, cannot get out of line, thus securing immunity from the breaking of pump lugs and the cutting away of the crosshead eye by the piston rod. The adjustable wrist pin gives at all times a round pin, effecting a great saving in the cost of brasses, oil, etc., and obviating a great amount of friction. Whenever it becomes necessary to take the piston rod out, by removing the wrist, direct access may be had to the end of the rod in order to back it out. These wrists can be made of cast steel at a very slight advance on the cost of cast iron.

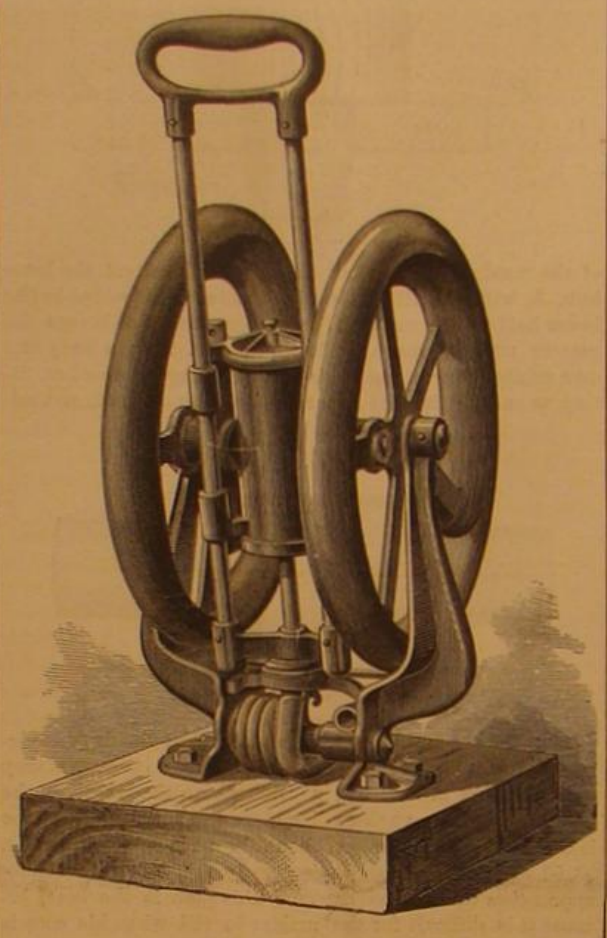
Patented through the Scientific American Patent Agency, October 6, 1874. For further particulars address the inventor, W. A. Alexander, P. O. box 130, Mobile, Ala.

Repairing Leaky Cellar Walls.

The season now at hand is the one most important for making cellars dry and cleanly. In fact, the repairing of leaky cellar walls should never be delayed, since the crevices are continually widened by the water soaking through. Cement, tar, and water glass are the best materials for the purpose, but the last two can only be used at a time when the cellar is dry, as in winter, perhaps even in September, or after drying and airing it in winter by artificial means. When nearly dry, the leaky portions of the wall can be readily recognized, and should be marked with charcoal. Holes and cracks should first be filled with hydraulic cement. The marked places, when dry, should be coated three to four times with a solution of 1 volume of commercial water glass in 2 of water, and finally, after becoming perfectly dry, with a solution of 1 volume of water glass in ½ volume of water. Instead of the solution of water glass, tar, kept quite liquid by heating, may be laid on a number of times If cement is to be employed, the marked portions of the wall should be cut out wedge-shaped, and carefully filled with a cement, rather thickly made up, with ¼ sand. If the cellar cannot be dried, the moist places should be cut out somewhat deeper (4 to 6 inches), and filled with cement, by placing a tube of material, about as thick as a finger, in the middle, and packing the cement in tightly around it, and, if necessary, holding it in place with a board until it hardens, while the water escapes through the tube without exerting any pressure upon it. After 20 to 30 days, the opening may be plugged up.

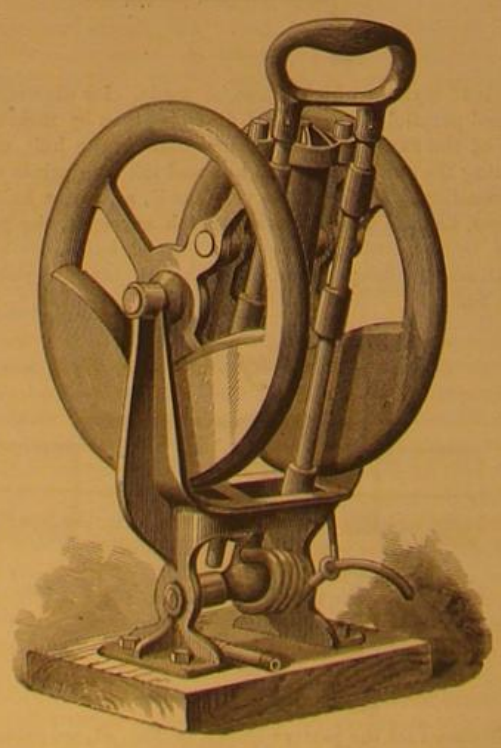
IMPROVED AIR PUMP.

The invention herewith illustrated is a new and simple air-compressing device, made of small size and excellently



adapted for use wherever liquids are to be raised by air pressure, and similar light work is to be done.

The general arrangement, as seen from the illustrations, is that of an oscillating engine, with the difference that in this pump the cylinder moves up and down, and the air is discharged or exhausted through the hollow piston rod, according as the pump used for purposes of plenum or vacuum. This arrangement does away with the complicated pipe connections, etc., necessary on double-acting pumps. The lower end of the hollow piston rod is, by means of a piece of flexible tubing, connected with the receiver or vessel operated upon by the pump.



The operation is as follows: By moving the hand lever, consisting of the frame containing the guides, piston rod, and piston, the two flywheels are rotated, and the momentum acquired by these is sufficient to bring the cylinder to a point where the resistance of the compressed air is equal to that in the receiver. At this point the guides (on hand lever) and the crank (formed on the flywheels) stand at such an angle as to work like a toggle joint and press the cylinder to the end of its stroke with great force. The same repeats itself in the other half of the rotation. All the bearings are amply large, of cast steel, and exactly in line, as the pumps are made by special tools. The clearance at top and bottom of the cylinder is reduced to a minimum, thereby, it is claimed, insuring a perfect expulsion of air; the valves are of expressly cured leather, which does not become hard, and backed by brass plates; said valves are as large as the diameter of the cylinder and piston will allow. The piston and stuffing box packing are likewise of the best material.

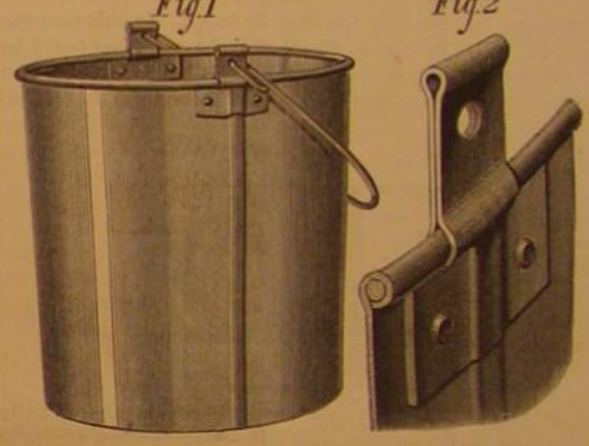
Several of these Centennial pumps are on exhibition at the Fair of the American Institute, New York city. We learn that one that has been in hard use for seven months in Philadelphia, in a large beer saloon, without being taken apart, is at present in the best possible condition. The manufacturer also builds vacuum gas-condensing pumps for higher pressure, or simple gas transferrers, on the same styles as those shown in the engravings, whose cylinders are from two by four inches up to six by seven inches.

Patent now pending. For further information apply to H. Weindel, 460 Dillwyn street, Philadelphia, Pa.

IMPROVED BUCKET EAR.

We illustrate herewith a new ear for buckets, kettles, coal hods, etc., which is constructed so as to be very strong and not liable to be torn out. Its application to a bucket is shown in Fig. 1. From Fig. 2 it will be seen that the ear is formed of a piece of any suitable metal, stamped or cut out, and bent in the middle so as to form a loop and clasping pieces, which extend, one on the inside, the other on the outside, of the bucket. The plate is so pressed that a groove will be formed to fit around the wire at the top of the vessel, and also so that it may be attached over a seam, as

Fig.1 *Fig.2*



shown. The rivets then pass through the side of the vessel and through both parts of the ear.

Patented June 27, 1876. For further particulars address the inventor, Mr. Joseph F. Donkin, St. Clair, Schuylkill county, Pa.

Metals Absorbed by Plants.

Professor P. B. Wilson has shown that plants take up free silica from the soil, in the form of diatom shells, which are deposited in the stalks of the plants. In a Dutch technical journal, Dr. De Loos states that vegetables are capable of taking up metallic particles from the soil. Consulted by a family suffering from lead poisoning, he found that they resided in the neighborhood of a place where the manufacture of white lead had been carried on some years previously, and they partook of vegetables grown on the spot. Dr. De Loos thereupon examined specimens of red beet, endive, and carrots, and found lead in all. In a beet weighing 1·43 lbs., he found the equivalent of 0·15 grain of metallic lead; in six carrots, weighing together 0·6 lbs., he found 2·7 grains of lead. The metal was also present in endive; and the ashes of the plants contained traces of copper, which, he thinks, existed as an impurity in the lead.

A New Electric Fire Alarm.

A new electric fire alarm, devised by M. Gaulne, of Paris, was recently described at a session of the Belgian Society of Civil Engineers. A metal box, fixed to the wall or ceiling of the room, has two metal columns which receive the conducting wires from below, and to which are attached two sensitive plates, the upper ends of which meet near the summit of the box at an acute angle when brought together. Each plate is made partly of steel and partly of an expansible metal, the steel being on the inside and extending to the end of the plate, the expansible metal being the shorter. The effect of heat on these plates is to cause the outer metal to expand; and the steel ends being brought in contact, connection is established between the wires, and a bell is sounded.

Besides serving as a fire alarm, the invention is intended to act as an ordinary call bell, and to this end a vertical rod, spring-supported, has at its upper extremity an index which, when the rod is drawn down by a cord similar to a bell pull on its lower end, rubs against the sensitive plates and thus establishes the current.

The degree of expansion of the outer metal of the plates being known, it is only necessary to approximate the ends more or less closely to cause contact to occur at any thermometric point and the bell to sound. A needle attached to one plate moves over a dial marked with degrees and fractions This plate is moved toward or allow to spring from the other by means of a regulating screw, and thus the needle may be adjusted at any degree.

THE SEA GULL.

A traveler, making his first voyage across the ocean, is astonished to find birds following in the ship's wake a thousand or more miles from land. That such small animals should be gifted with the endurance necessary for keeping on the wing for a week continuously, with the exception of an occasional rest on the surface of the ocean, is certainly an extraordinary proof of the muscular power and vitality of this species of the winged tribe.

These birds are nearly all members of the gull species (*larus*, of Linnæus), of which the largest *genera* are *larus glaucus* (Brünnich), which measures 30 inches in length, and has a wing breadth of 5 feet, and the *larus marinus* (Linnæus), which is nearly or quite equal in size to the *l. glaucus*. The gull family has several general characteristics, among which may be mentioned the curvature at the end of the bill, the length and pointed form of the wings, and the web between the toes, the hind toe being short and elevated. The *l. marinus*, commonly called the black-backed gull, may be distinguished by the dark slate color of its back and wings, its black primary feathers tipped with white, and its yellow legs and feet. This species is found in summer on the coasts of New England, and in winter travels as far south as Florida, its favorite breeding places being on the coast of Labrador. It flies high, and has a majestic carriage in the air: it encounters the fiercest gales, and swims well but slowly. It preys on fish, young birds, and carrion, indeed on anything but vegetable food; it is tyrannical towards weaker birds, but is naturally very cowardly. Its eggs are good eating, and the young birds are killed and salted by the fishermen of Labrador and Newfoundland; but the old ones are very tough and too fishy in taste for food.

Our illustration* shows a flock of black-backed gulls surrounding a wreck, and hurrying with screams of delight after small pieces of garbage or refuse food that float away from the wrecked vessel. Mr. Wolf, the artist, shows well the great wing power of these birds, and the easy grace with which they carry themselves in a gale. Their endurance in flight is aided by the lightness of their bodies, which, however, makes them the sport of a high wind; but this obstacle they overcome by a novel species of tacking, which enables them to make headway against the tempest.

Many of the high rocks and almost inaccessible cliffs of Scotland and North Wales are the homes of countless millions of sea birds; and the pursuit of them, for their eggs and plumage, is one of the most hazardous pursuits in which men ever engage of its downy covering, the eider duck has little thought of ministering to the luxurious requirements of civilized man, who appropriates it for his comfort. As much as 1,200 lbs. of this down is often sold annually by one company from Greenland; and when clean and pure, it fetches from $6 to $6.50 per pound. The export of eider down from Denmark, the produce of Iceland, Greenland, and the Faroe Islands, averages 6,000 to 8,000 lbs. weight a year. Paris enjoys a high reputation for the preparation, bleaching, dyeing, and arrangement of feathers, a great number of persons being employed in the feather trade, which was stated to have reached, before the late war, an annual value of nearly two and a half million dollars. The largest portion of these were exported to America and the colonies. A new and very pretty ornamental application of feathers, etc., is that of the entire head and plumage of some birds for fans and fire screens,

THE GLEANERS OF THE SEA.

Feathers.

The natural color of feathers is produced by the internal arrangement of the colorless plates of horny matter, and not by any pigment. This is also the cause of the iridiscence or varying shades of color on beetles' wings and some nacreous shells; the different thickness of the horny films interferes with the light, and produces the play of colors. Almost any artificial color can, however, be given to feathers by dyes. "When," says Professor Owen, "the barbules are long and loose, they characterize that form of the feather which is properly called a 'plume,' and such are the most valuable products of the plumage of birds in a commercial point of view." The annual quantity of bed feathers used in the United Kingdom has been estimated at nearly 700 tuns, a very large quantity when the lightness of the substance is taken into consideration. The foreign imports only amount to a few thousand hundredweight. Feather beds being a fruitful source of contagious disease, the feathers are frequently sent to the purifiers, where they are subjected to steam and dry heat, and again rendered perfectly sweet and pure. In making a nest for her young by robbing her breast instead of the mere feather trimming which was formerly applied to fans; and the brilliant heads of the humming bird family, set as necklets, ear pendants, brooches, etc., form a novel species of bird jewelry. Feather flowers are chiefly made at Madeira and in Brazil, but the latter are the best, and fetch a higher price. At Bahia the Solidade Convent is the great *locale* where they are made. They ought to be made entirely of undyed feathers, the best being those of a purple, copper, or crimson color, from the breasts and heads of humming birds. One of these wreaths has a beautiful effect, and reflects differently colored lights. The cocks of the rocks, white herons, roseate spoonbills, golden jacamars, metallic trogons, and exquisite little seven-colored tanagers (*calaspiga tatas*), with many gay parrots and other beautiful birds of the country, offer an assortment of colors capable of producing the most exquisite effects. The feather work is often applied with a pretty effect to the borders and fringes of hammocks. Examples of these, with the arms of Portugal or Brazil, have been frequently shown at the several International Exhibitions.

A celebrated brush manufacturer in Paris makes brushes from quills, which he splits by a mechanical process into thin strips, much resembling bleached bristles. Besides the neat appearance of this article, it possesses the advantage, over the common hair or whalebone brush, that its single fibers are more dense and solid, while the bristle represents a hollow tube.

* Our engraving is selected from Mr. Wolf's "Life and Habits of Wild Animals," published by Macmillan & Co., of London and New York.

Progress of Railroad Building.

One of the most encouraging features of the fall trade is the increase in the railroad building that is going on. The Chicago *Journal of Commerce* has a summary, from which we quote: "At the East a narrow gage road, nine miles long, has been commenced between Boston and Stoneham, that will cost $300,000. A road following the valley of the Lamoille river, in Vermont, is being ironed, and will be opened to Lake Champlain this fall. The Rochester, N. Y., road will reach Salamanca this year, and be pushed forward to the coal fields of Jefferson county in the spring. The Columbia and Port Deposit, Del., road has twenty-five miles of track laid, and is pushing ahead actively. The Portsmouth and Huntington, Ohio, to give the Scioto Valley an Eastern and Western connection, and obviate the delays of Ohio river navigation, only waits until it is decided whether the gage shall be common or narrow; and the Harrisonburg and Fredericksburg, Va., having been changed to a three-foot gage on the completed portion, will be pushed forward and completed from Orange Court House to Rawley Springs at once. A coal tributary of the Scioto Valley road has been surveyed, commencing a dozen miles above Circleville. The Cincinnati and Portsmouth having adopted a narrow gage will advertise for its roadway at once. The Cincinnati Southern has contracted for rails to complete the way to Lexington, Ky. The Federal Creek, O., coal road, eighteen miles, has its bed completed a part of the distance and is expecting iron. The Rock Island and Mercer county, Ill., striking the eastern portion of the country, is laying track and using it. The Omaha and Northwestern, completed to Herman, is being constructed at the rate of half a mile a day toward Tekamak. The Kansas and Northwestern narrow gage road is open forty-four miles to Lexington, Mo. In the South funds are being raised to extend the Mobile and Alabama road seventy-eight miles, from Uniontown to Birmingham, with a promise of speedy success. The gage of the Houston and Texas has been changed to 4 feet 8½ inches for 120 miles between Houston and Hearne, making it uniform through to Philadelphia and New York. Track laying has recommenced at Kingsbury, on the Galveston, Harrisburg, and San Antonio road, advancing toward San Antonio. Utah is solicitous of commencing a road from the Union or Central Pacific, by the valleys of the Snake and Columbia rivers toward Portland and Puget Sound, and one is to be surveyed along the Colorado Valley, with the hope of reaching San Diego. The Tomales, Cal., road to Freestone, Sonoma county, will reach Russian river this fall. Colorado is also at work on a narrow gage from Floyd Hill, terminus of a branch of the Central, to Idaho and Georgetown, that will branch to Central City and be extended into the Middle Park.

A New Use for Sea Weed.

Hai-thao, or gelose, is a tasteless, odorless, colorless mass, obtained from a fibrous sea weed common on the coast of China and Mauritius. It is insoluble in cold water, but dissolves in hot water after boiling for ten minutes, and then forms a thin, dirty white solution, which, on cooling, deposits a yellowish gray jelly. The material has lately been used for finishing cotton fabrics, and is reported to fill the thread more perfectly than dextrin or starch. By adding glycerin to the hai-thao solution, a still softer and at the same time stronger material is obtained. According to experiments made by Heilmann, an abstract of which is given in Dingler's *Polytechnisches Journal*, it appears that the material can only be employed for fine textures, soft and firm to the touch, and cannot be used as a substitute for dextrin or potato starch where a strong material is required.

CENTENNIAL NOTES.

THE BELGIAN WOOLEN MACHINERY.

Bede & Co., Verviers, exhibit a fulling machine for cloths and woolen stuffs, such as flannel. Five or six pieces of fine cloth or three pieces of military cloth can be treated at a time, and the entire mechanism is arranged so as to be of easy access to the workman. The same firm exhibits a machine for cleaning wool, which is represented to be an improvement on the American invention, and the manufacturers have supplied several factories in this country with machines of this kind. It is said to clean 250 lbs. per hour, and with an automatic feeding apparatus one man can attend it. All kinds of wool may be cleaned by it. Those for carding are worked dry, and those for combing in a damp state. A carding machine with a patent condenser is also exhibited by Bede & Co. It is fitted with cast iron cylinders, carefully turned. The patent condenser produces any desired number of slivers, which are rolled into fine rovings, and the latter may be spun direct to 1,000 yards per ounce. It is claimed that the usual waste of carding is avoided by this condenser, and that more is done with it because there is no necessity of roving or drawing halfway. The condenser can be used for all kinds of wool, from the shortest to the best merino.

Wool-spinning machinery invented by Celestin Martin, of Verviers, a distinguished Belgian inventor, recently deceased, is exhibited. He was a poor working machinist, who, through his mechanical skill and inventive genius, worked his way to the head of a great industrial establishment, and won from the King of Belgium the offer, twice refused, of the decoration of Chevalier of the Order of Leopold. His *métier fixé* or stationary spinning machine is exhibited with other machinery for wool manufacture, including a model for a new carding machine. There are a few wool-carding appliances shown by other exhibitors, and Horstmann Brothers, Liège, exhibit carding cloths.

THE FLORAL AND BOTANICAL DISPLAY.

The display of plants in the vicinity of Horticultural Hall is said to be the finest collection of the kind ever exhibited in this country. The flower beds are all made in different shapes and designs. Some are carpet bedding, so arranged as to display the figures of a carpet; others are ribbon bedding, in strips, made to secure the effect of ribbon, while the walks are laid out in geometrical and winding figures that make the place look very beautiful. In the western section of the grounds there are nearly 70,000 plants laid out, so the reader can easily imagine the result attained.

To the American exhibit are devoted 239,173 square feet, and 45,000 square feet to the foreign. The American exhibit is composed of 59,500 plants, and the foreign of 10,233. A magnificent display of the agave, or American century plant, and lemon and orange trees bearing fruit, immense sugar canes, crape myrtles—a little shrub bearing an exquisite pink flower—are on these grounds. The flowering plants embrace, among a legion of varieties, hollies, rhododendrons, roses (600 plants), gladiolus, magnolias, lilies, tulips, azalias, begonias, caladium, dahlias, geraniums, carnations, pansies, and hyacinths. Then there are the yuccas, coleus, fir trees, evergreens, and various deciduous and succulent plants.

All kinds of landscape gardening are represented. In one section of the grounds is a complete arboretum, embracing 750 different species. The flower beds, to which allusion has already been made, are made of achyanthus, centoria, alternanthera, golden feather fen, Madagascar periwinkle, gladiolus, cannas, petunias, caladium, and the castor oil bean plant.

Among the more striking trees and plants, there is a tall mahogany tree, looking like a giraffe among its fellows. The *cinchona succirubra* is one of the most valuable plants in the collection. From its bark the drug quinine is manufactured. The East India apple tree is a rather attractive-appearing shrub. The alligator pear tree yields a rich, large fruit, which the natives use instead of butter. The *Strelitzia requia* is a large plant bearing a large flower shaped like a bird's tongue and beak. The flowering banana is here in full bloom.

Coffee trees are abundant, and also the fan palm, with leaves ranging all the way in size from the ordinary palm fan to the size of a center table. With the latter leaf the people of the tropics thatch their houses. Loquat is the name of a peculiar, dark-looking Japanese plant with rich fruit. There is the common fig tree, and the *ficus Australis*, with aerial roots growing down from the branches like flowing hair. The moisture in the air affords them sustenance. The Chinese wampee fruit tree and the papyrus plant attract a good deal of attention. Many specimens of the *bambusa* (the bamboo tree) are on exhibition, some of them very high. The *eucalyptus globulus* is the fever tree of the tropics, and is highly prized because it absorbs all the malaria in the air. The *icica Indica*, or incense plant, is so called because it yields a sort of perfumed gum which is used for incense. There are also some very fine specimens of the *ficus micophylla* or india rubber tree, a plant which is pretty well known in this climate.

THE TURKISH SECTION.

If one might judge from the lavish profusion of so-called Turkish goods exhibited for sale in booths located almost at every turn, both within and without the grounds, Turkey is by far the best represented nation in the entire Exposition. Unfortunately for whatever credit the fact might bring, the majority of the small objects displayed evidently originated in that great mart of imitation jewelry and storehouse of all strange articles, from Chinese idols to Maori nose rings, Birmingham, England. Those not derived from this source are unmistakably French, while carpets savor more of German looms than those of Smyrna. A perfume of geranium oil, supposed by the uninitiated to be attar of roses and purchased as such at ten times its value, pervades the booths, and the oriental glamour is hightened by the Gibraltar Israelites and Bohemian Greeks, who assume the *rôle* of genuine Moslem salesmen. The stands, however, are extensively patronized, principally by visitors from the country seeking mementoes of the Exposition. Compared with this spurious display, the genuine Turkish exhibit, though excellent as representing the country, is small. Great carpets woven on the hand loom, in which no improvement has been made since the days of Mahomet, hang from the roof. The patterns are as old as the manufacture, but they are delightfully ugly and resplendent with their outlandish shades of red and queer blue-greens, dear to the antiquarian and *bric-a-brac* collector. The choicest of these Turkish rugs are apparently the coarsest. This last quality attests the genuine production, for the finer rugs are now imitated in great perfection on power looms in many parts of Europe. A real Turkish carpet is irregularity itself. The sides are never truly parallel, the texture rarely even; and as for the pattern, that follows the vagaries of the weaver, who takes every imaginable liberty with the normally rude design. Seated in front of his loom, he laboriously fastens a bunch of colored yarn to each warp thread. When a row is thus finished he passes the linen weft, then puts on a new row of tufts, and so continues until he completes a narrow strip of carpeting, which is neatly attached to other strips to make a large rug, the coarse long nap serving to conceal the seams.

There are several specimens of cloth exhibited which are likewise peculiar to the country. Camel's hair cloth resembles coarse silk, and the Angora wool fabrics have a like similarity. The tissues are all poorly woven. The same is true of the light silks, also handwork. In fact, wherever the work of Turkish men is displayed, there the inherent laziness of the true Mahometan is apparent. He has admirable materials, and controls a class of goods in which he has few rivals abroad; but the repressive policy of his government on one hand, and his own disinclination to labor any more than is necessary to provide for his wants from day to day on the other, effectually block his industrial progress, and he contributes nothing toward the advancement of the age. With Turkish women, if the results of their labor be taken as a standard, the case is different. They work, high and low alike, as a relief to the dreary existence to which their social position consigns them. The magnificent embroideries on silk, the gold thread stitching on velvet, and similar productions proving patience and skill, are mostly made in the harems, and by women ignorant that such a thing as education exists.

Turkey is the land of the far-famed attar of roses, and the visitor may buy, or rather may imagine that he buys, a minute bottle, holding three drops of the extract, for two dollars. The genuine attar does not appear to be exhibited, although it might be, for it can be found by the pint in the Constantinople and Smyrna bazars. The material at the Exposition comes from Kizanlik in Roumelia. It probably is olive, sandal wood, geranium, or other oil, perfumed with a minute quantity of the genuine article, as such is the compound most commonly sold the world over as the true attar. The latter, if genuine, is worth between $50 and $100 per per ounce, and to make that quantity 400,000 full blown roses are needed. The mode of preparation consists in boiling the roses in water and gaining the oil through distillation. The oil is volatile, nearly colorless, and deposits a crystalizable substance soluble in alcohol. A drop of it on the handkerchief perfumes the fabric indefinitely, despite numerous washings.

The best industrial productions displayed are the thin leather known as Turkey morocco, specimens of prepared opium, dried figs from Smyrna, gall nuts used for ink making, and various dye stuffs. There are a large number of ancient arms, some superbly inlaid in mother of pearl and silver, showing that the old Turks possessed a manipulative skill and a degree of patience which have not descended to their posterity. Turkish tobacco is likewise exhibited, and visitors are permitted to purchase a poor quality for a high price. The best Turkish tobacco is worth here from $4 to $8 per pound. The Turks themselves favor a Persian tobacco much more than the finely shredded material sold as Latakia or Scarfalatti. The former is used mainly in the nargilehs or water pipes, looks like dried oak leaves, tastes like them, and has to be moistened before packing in the pipe bowl; and then the constant attention of a servant is required to keep live coals on the damp mass, otherwise the fire promptly goes out. It therefore takes two persons' labor to keep the pipe lit, and their accumulated energy is represented by a scarcely perceptible whiff of faintly blue smoke, which is swallowed or inhaled before escaping from the mouth.

One of the best exhibits in the Turkish department is the sponge collection, and this represents a really important industry, which flourishes despite the unlimited taxation imposed upon it. Sponges of all varieties are exhibited, some marvelously fine. As might be expected, books are few, and such as are present are poor specimens of both printing and binding.

Zinc Roofing.

A controversy is just now going on in Germany as to the durability of zinc used for roofing purposes. The *Zeitschrift für Gewerbe* reproduces the calculations as to the durability of zinc made by Dr. Pettenkofer in Dingler's *Journal* some years since, but points out an error in them. Rectifying these afresh, on the basis that the oxidation of 1 square foot reaches 130 grains in 27 years, the *Zeitschrift* finds that a sheet of zinc $\frac{1}{50}$ inch thick would occupy 1,243 years in complete oxidation. A weight of 130 grains of zinc spread over the surface of a square foot would make a layer only $\frac{1}{5000}$ of a line thick. If the sheet be 0·25 line thick, there will be 46·04 such layers, and this, multiplied by 27, gives 1,243, the total number of years.

RAMBLING NOTES.

NUMBER II.

A GEAR-MARKING DIAL.

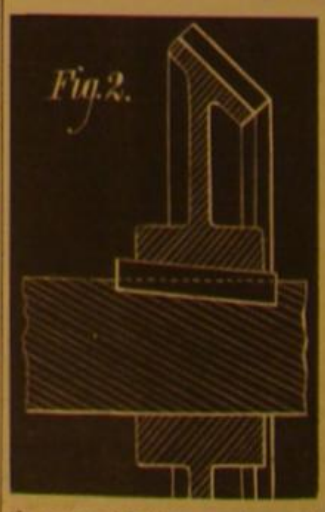
"I was up in George's pattern shop a few days ago. He was showing me a dial plate, which he had just gotten up for his gear pattern work. It is the neatest affair I have seen lately, and seems to be a real money-saving device. It is simply a cast iron dial fitting the spindles of the pattern lathes. It is machine-divided for all numbers below 200. A stationary marker completes the rig. After a gear pattern is so far finished as to be ready for spacing, it is put in a lathe with this dial. In ten minutes a wheel of 200 teeth can be accurately spaced, much more so than if done with dividers as usual. I believe it would take a good pattern maker fully three hours to step off such a gear, especially if he failed in luck, which seems to have a great deal to do with such processes. The device mentioned is convenient and very light. George says it only cost him twenty dollars."

"By the above I am reminded of the fact that many mechanics labor under the impression that the graduations on a dial or index plate of a gear cutter are of divine origin or some such thing. The impression is wrong. Some steady-nerved and keen-sighted workman stepped off the progenitor of such devices, with spacing dividers. The question will be asked: 'Is this little dial no more accurate than one which I could space off?' I answer: Much more so. In the first place, it is very rarely that a man is found possessing the personal peculiarities which fit him for such work. But few men have them, and they have become famous. Half a dozen names would probably cover the list. Next, the small personal error of these experts has been reduced by mechanical means. All original dividing of this kind is done on large circles, say twenty feet diameter or more. The graduations on this large dial are then transferred by mechanism to a small dial, say two feet in diameter. Now the proportion of error in the two dials will be precisely the same; but it will be readily understood that an operator's liability to error will be reduced as the sizes of his divisions are increased. There are graduated circles in this country which, by laying one upon the other, will be found to coincide at each division. Shifting their relative position still shows a coincidence. This process, watched through a microscope, constitutes the test of the accuracy of a graduated circle.

"There are or have been several original circles graduated in this country. One was a heavy twenty foot wheel, spaced off long ago, at Fitchburg, Mass., I think by Mr. George Putnam, the predecessor of the Putnam Machine Company. Another was spaced at the Lowell Machine Shop, in Lowell, Mass.; but by whom I have never learned, and I have never been able to hear anything of the others."

FITTING KEYS.

"George was in my place yesterday. He showed me a method of fitting keys which, he says, is as old as the everlasting hills. I know I never heard of it before. Fig. 1 shows the method The key seats in both shaft and hub draft the same way, and the key is consequently straight. If the fit is simply neat, the thing is firmly locked. It applies especially to bevel gearing in millwork, which must back up against something; and in many cases, finding no shoulder on the shaft or convenient box near, the firmness of the hub on the shaft depends on the key entirely. Fig. 2 shows this key in such a place. It will be noticed that in one direction the gear may even be slipped by hand and the key picked out; but in the other direction everything is self-tightening. It will be a novelty to many, and, I think, of considerable value.



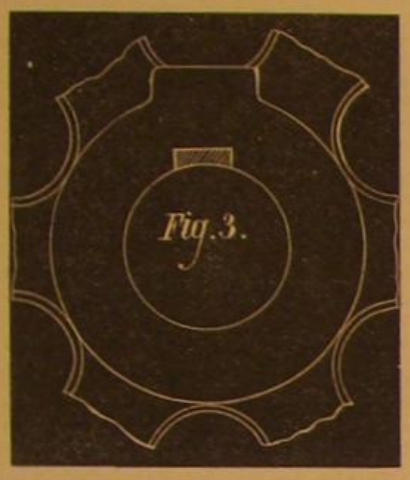
"Keys in shafting seem to be an indispensable nuisance, but they are often the only hope. I have become so disgusted with them that I never put one in where it can be dispensed with. They are all bad enough, but the taper key is the worst of the lot. The intention in these keys is to have the sides fit snug, so that they do all the work, the top and bottom or taper fit being just tight enough to prevent end motion. But I know, as others do, from vexatious experience, that it is almost impossible to get visemen

to fit these keys solid sidewise. They will invariably slack off the sides, and then waste their skill on the least important fit. Most visemen seem to think that, when they do this, they have a 'soft thing' in making the fit.

"These taper keys are miserable things anyhow, and cost $1 a lb., if properly fitted. They weaken the shaft, and cannot be made interchangeable. The all-absorbing top and bottom fit tends to split hubs, and makes a key cut and lock. Add to this latter the usual upsetting on the small end, and we have a fine mechanical contrivance.

"Where keys must be used, the properform is parallel both ways, a neat fit on the sides, and with top clearance. A set screw bearing in the top of the key makes the arrangement firm endwise, and conveniently movable. Such keys are less expensive than taper keys, and can be made interchangeable.

"There is one form of key which possesses all the disadvantages of any taper key, but which has peculiar merits in cases where work is sent out without knowing just where the keyed fits are going to be. It requires no seat in the shaft. It will bruise a shaft enough to spoil it for a bearing, but will not weaken it. Hubs must be reinforced to stand the strain, for such keys drive by friction entirely. It does not look as though they would do the business at all, but they will. Fig. 3 shows the form. It is very much used by the



millwrights of the Northwest. The shops up there plane their keys out concave, from a steel strip. They are then cut off, and a little draft given to them. They are tempered blue. The circle of the key should be a trifle smaller than the shaft."

SETTING CALIPERS.

"Give an ordinary lathesman a pair of inside calipers (Haswell says *calibers*, and I think he is more than half right) and a six inch scale, and tell him to stand where he is and set them at 2 inches. They will be found to be about $\frac{1}{60}$ of an inch too large. Let him try it again, but with the privilege of butting one end of his scale up against something, the planed side of the tail stock of his lathe most generally; and he will get the calipers about $\frac{1}{100}$ too large. I have noticed that good, fair workmen, who have but one end of a thing to look out for, will work just about $\frac{1}{100}$ inch too large always, and many common workmen do worse The natural suggestion to my mind is that a lathesman should have a shouldered rule, one with a flange or button on one end, similar to a lumber rule. In addition a sliding sleeve, without set screw or vernier, would help him. Spring friction, holding the sleeve where set, would allow the calipers to be set by touch, and knocked into nicety, without having to hunt up the place on the scale a dozen times. Every lathesman knows that if, in adjusting his calipers, he goes too far two or three times, he begins to loose nerve and patient vision. The tool described would be a real convenience. The suggestion is made to the Providence scale men, for what it is worth.

FRENCH CALIPERS.

"Did you ever notice the ungainly caliper gages, or rules, or whatever they may be, which the refugees bring over from Alsace and Lorraine? They are big, clumsy things, about 14 inches long, and look like shoemakers' tools; but bad as they look, they are excellent contrivances. When you hire one of these refugees, he finds that we use inches, while his pet tool is graduated by centimeters; so he regretfully locks the ugly thing up for ever." LEFTWICK.

[For the Scientific American.]

GLYCERIN.

Glycerin is one of the constituents of the fixed oils and solid fats; and although discovered by Scheele nearly a century ago (1779), it is but a few years since it has become familiar to the unscientific public. The principal reason for this was that the processes of manufacture, in use until quite recently, rendered it too expensive.

Fats consist of two substances, namely, glycerin and one or more fatty acids, usually stearic and oleic; while the fixed oils are composed chiefly of oleiç acid combined with glycerin. Palmitic acid is another of these fatty acids, and occurs in palm oil, in human fat, Chinese tallow, Japan wax, and several other substances. In the manufacture of soap a caustic alkali is added to the oil or fat, and at once takes possession of all the fatty acids present, forming with them stearates, oleates, and palmitates of soda or potash, as the case may be. These compounds we know as soaps, calling the former hard soap and the latter soft soap. In this operation the glycerin is liberated; and in order to separate the soap from the glycerin, salt was formerly added. The glycerin which remained in the lye after "salting out" was thrown away. In the manufacture of lead plaster, which is really a soap in which oxide of lead takes the place of potash or soda, the salting out is unnecessary, and it was in the residuary liquor that Scheele discovered glycerin. He gave it this name from its sweet taste, from the Greek word γλυκος, sweet. For many years all the glycerin of commerce was obtained in this manner, as it was only necessary to precipitate the lead with sulphydric acid gas and evaporate the filtrate on a water bath to obtain the glycerin.

Modern chemists consider glycerin to be an alcohol, which combines with acids to form ethers. From this point of view fats and oils are compound ethers, called glycerides, and soaps are neutral salts. The chemical formula for glycerin is $C_3H_5(OH)_3$.

The extensive use that stearic acid has found, under the name of stearin, in the manufacture of candles and for other purposes has led to the invention of several new methods for its separation from the glycerin. The best of these is the one invented by our fellow countryman of sand blast fame, Mr. Tilghman. It consists in the saponification of the fats by means of superheated steam, and is largely employed in the manufacture of stearin candles, glycerin being a secondary product. The temperature most favorable to the operation lies between 550° and 600° Fah. Glycerin is purified by distillation in steam and filtration over animal charcoal. The annual production of glycerin in Europe is now 520,000 cwt.

Glycerin, as it appears in commerce, is a sirupy liquid having a specific gravity of 1·26, colorless, inodorous, sweet to the taste, and neutral to test paper. It is combustible but not so readily as ordinary alcohol. It has been frozen when exposed to a low temperature during transportation, and then melted at 45° Fah. Under ordinary circumstances it may be cooled to zero without freezing; but if a crystal of frozen glycerin be dropped into it when cooled to 20° or 21° Fah., it will all become solid. It dissolves in all proportions in water, and thus reduces its freezing point; hence Dr. Wurz proposed in 1858 to use it in gas meters, and it is now largely employed for that purpose. It also dissolves in alcohol and chloroform, but not in ether. Its solvent powers are, however, more important and interesting.

Klever has determined the solubility of forty-eight different substances, and has found that 100 parts of glycerin will dissolve 60 parts of borax, 50 parts of tannic acid, 40 parts of alum, 30 parts of sulphate of copper, 98 parts of carbonate of soda, and various quantities of the alkaloids. When bicarbonate of soda and borax are dissolved in glycerin, effervescence takes place, the carbonic acid being expelled from the former.

The uses which have already been found for glycerin are very numerous. It is frequently applied to the skin as an emollient, and administered internally as a substitute for cod liver oil. It is used as a lubricant on clocks and for delicate machinery. As it neither evaporates nor freezes, it is well adapted for floating compasses, and has been employed for thermometers. For keeping modeling clay moist, to impart to paper the peculiarity of retaining a permanently damp condition so that it may be used in taking copies of letters, to prevent inks drying too rapidly to permit of taking press copies, to prevent printers' inking rollers becoming dry and hard, for keeping photographic plates moist during long exposures, and as a solvent for gum arabic, glycerin is particularly valuable, as also in paste, cement, mortar, mastic, etc., intended for daily use. When mixed with litharge, it forms an excellent cement. Bandages for surgical purposes are treated with glycerin to render them absorbent. It is employed instead of salt for preserving untanned skins and hides. Glycerin dissolves aniline violet, alizarin, and alcoholic madder extract, hence it finds some use in dyeing. A solution of aniline colors in glycerin is often used for stamping with a hand stamp, but cannot be employed as a transparent paint on glass because of its non-drying property. The photographer finds several uses for pure glycerin, first as a test for the purity of the silver bath, secondly (as above stated) to prevent drying of the film in wet plate photography where long exposures are necessary, as in the case of interiors of rooms or shaded nooks. In combination with acetic acid it is used as a restrainer, enabling the outdoor photographer to dispense with the use of water entirely while in the field. After exposing the plate it is developed with iron as usual, and then flowed with the restrainer. At the end of the day's work the plates are taken home, where they can be fixed and finished in the usual manner. Glycerin is employed to extract the perfume from flowers and the aromatic principle of red peppers. Wine made from inferior grapes is improved and sweetened by the addition of glycerin, and an extract of malt made with glycerin is much used by brewers.

In the chemical laboratory, it is used to prevent the precipitation of the heavy metals by the alkalies. It forms the best known blowpipe test for boron in all its compounds, as was recently discovered by Mr. M. W. Iles.

Glycerin may be employed for preserving fresh fruits and meat, and if pure imparts no disagreeable flavor. It is also used instead of alcohol for preserving anatomical specimens. In pharmacy its uses are numerous and important. For disguising medicines, especially those of an oily nature, it is unequaled. It is said that castor oil mixed with an equal part of glycerin, and one or two drops of oil of cinnamon added, has been administered to physicians without their discovering that they were taking castor oil. Cod liver oil, turpentine, etc., are more easily administered when in combination with glycerin. A very little glycerin will obviate the astringent sensation produced by the chloride of iron dissolved in sirup. Carbolic acid is now generally administered in combination with glycerin, and many other acrid substances should be administered in this way. When introduced in small quantities into pills, it prevents induration and decomposition. Vaccine lymph is frequently mixed with glycerin to preserve it. Several different glycerin lotions, ointments, and plasters are described in pharmaceutical works. Sulphate of quinine dissolves in ten parts of glycerin when hot, but when cold separates in clots, which, when triturated with the supernatant liquid, gives it the consistence of a cerate, very useful for frictions and embrocations.

Another use, quite different from the above, to which glycerin is applied is the manufacture of nitroglycerin, $C_3H_5(NO_3)_3O_3$, the most powerful and dangerous explosive employed in the arts. The process of manufacture is exceedingly simple. Strong nitric and sulphuric acids are mixed together, in the proportion of two parts of the former to four of the latter by weight. Into this is poured, with constant stirring, one part by weight of pure glycerin, the temperature of the mixture being kept below 77° Fah. by external cooling with ice. When oil drops begin to form on the surface, the mixture is poured into a large quantity of cold water. The nitroglycerin then separates and is purified by washing and drying. It is a light yellow, oily liquid, inodorous, but has a sweet pungent aromatic taste, and when placed on the tongue produces a fearfully intense headache which lasts for hours.

Its explosive properties are already too well known from the numerous fatal accidents that have recently attended its use hereabouts, to say nothing of the Bremerhaven explosion.

The complex nature of the glycerin molecule renders it peculiarly susceptible to the action of reagents; it readily forms other substitution compounds, and is general a dangerous substance to experiment with. A warm concentrated solution of permanganate of potash poured into glycerin decomposes it with explosive violence; chromic acid and glycerin are likewise explosive, facts which should be remembered when putting up prescriptions containing glycerin.

E. J. H.

A Materialized Hole.

Take a sheet of stiff writing paper and fold it into a tube an inch in diameter. Apply it to the right eye and look steadfastly through it, focussing the eye on any convenient object; keep the left eye open. Now place the left hand, held palm upward, edgeways against the side of the paper tube, and about an inch or two above its lower end. The astonishing effect will be produced of a hole, apparently of the size of the cross section of the tube, made through the left hand. This is the hole in which we propose to materialize another and smaller hole. As we need a genuine aperture, and it would be inconvenient to make one in the left hand, let a sheet of white paper be substituted therefor and similarly held. Just at the part of the paper where the hole equaling in diameter the orifice of the tube appears, make an opening $\frac{1}{4}$ inch in diameter. Now stare intently into the tube; and the second hole, defined by its difference of illumination, will be seen floating in the first hole, and yet both will be transparent. The illusion, for of course it is one of those odd pranks our binocular vision plays upon us, is certainly one of the most curious ever devised. Besides, here is the actual hole clearly visible, and yet there is no solid body to be seen to define its edges. It is not a mere spot of light, because, if a page of print be regarded, the lines within the boundaries of the little hole will not coincide at all with those surrounding it and extending to the edges of the large apparent aperture. Each eye obviously transmits an entirely different impression to the brain, and that organ, unable to disentangle them, lands us in the palpable absurdity of a materialized hole.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From August 11 to September 11, 1876, inclusive.

AIR BRAKE, ETC.—C. A. Bonton (of New York city), London, England.
ALARM PUNCH.—J. H. Small, Buffalo, N. Y.
BENDING WIRE, ETC.—H. W. Putnam, Bennington, Vt.
BOILER CIRCULATOR.—B. S. Koll, Pitsburgh, Pa.
BOOT-SEWING MACHINE.—G. McKay, Boston, Mass.
BOOT-SEWING MACHINE.—J. Cutlan, Philadelphia, Pa.
CARPET LINING, ETC.—O. Long, Brooklyn, N. Y., *et al.*
COTTON OPENER, ETC.—S. D. Keene, Providence, R. I.
CRUSHING QUARTZ, ETC.—D. D. Mallory, Mystic Bridge, Conn.
DRESSING BRISTLES, ETC.—E. B. Whiting, St. Albans, Vt.
FENCE, ETC.—L. E. Evans, New York city.
FLOOR COVERING.—J. F. Gloyn, Astoria, N. Y.
FURNACE.—A. L. Holley, Brooklyn, N. Y.
GAS GOVERNOR.—R. H. Plass, New York city.
GLOVE FASTENER.—J. Lewine, New York city.
HYDRAULIC ELEVATOR, ETC.—T. Stebins *et al.*, Boston, Mass.
KNIFE HANDLE.—J. W. Gardner, Shelburne, Mass.
KNITTING MACHINERY.—J. L. Brown, Chicago, Ill.
MAKING STEEL, ETC.—H. Schierioh, Jersey City, N. J.
MUSICAL INSTRUMENT.—C. F. Hill, Stamford, Conn.
PREVENTING SMOKE.—J. Todd, Potosi, Mo.
PRINTING TELEGRAPH.—G. M. Phelps, Brooklyn, N. Y.
PUNCH.—D. L. Kennedy *et al.*, New York city.
RAILWAY.—E. E. Lewis, Geneva, N. Y.
RAILWAY SIGNALS, ETC.—F. W. Brierley, Philadelphia, Pa.
RAILROAD TIE.—G. D. Blaisdell, Cambridge, Vt.
RAISING BLINDS, ETC.—L. H. Gano, New York city.
RIVETING MACHINE, ETC.—J. F. Allen, New York city.
ROTARY BOILER.—C. W. Pierce, New York city.
SEWING LEATHER, ETC.—E. R. Gardner, New Bedford, Mass.
SEWING LEATHER, ETC.—G. V. Sheffield *et al.*, Brooklyn, N. Y.
SEWING MACHINE.—H. P. Garland (San Francisco, Cal.), Dundee, Scotland
SMOOTHING PLANE.—C. E. Smith, Crawfordsville, Ga.
SPINNING MACHINERY.—J. Goulding, Massachusetts.
STEAM ENGINE.—G. B. Massey *et al.*, New York city.
VELOCIPEDE.—S. Glitzinger, Rondout, N. Y.

NEW BOOKS AND PUBLICATIONS.

THE CITY OF HOLYOKE, its Water Power, and its Industries. Holyoke, Mass.: Holyoke Manufacturers' Association.

We have received a superbly printed and copiously illustrated sheet bearing the above title, and designed to exhibit the industrial advantages offered by the water power system of Holyoke, Mass. By means of a gigantic dam, constructed at the rapids of the Connecticut river, a total power equal to 80,000 horse power is rendered available, and fractional portions of this are sold with mill sites. Those of our readers who may desire detailed information regarding this exceptionally favored locality would do well to send to the Holyoke Manufacturers' Association for a copy of the above named paper. The illustrations are admirably executed, and give an excellent idea of the extent of the city and its industries.

THE INVENTION OF PRINTING. By T. L. De Vinne. New York city: Francis Hart & Co., 12 College Place.

We have already reviewed the scope of this book in some detail, and need only here state that the portions as they appear fully bear out the promises of excellence made in the beginning. Paper and printing are alike admirable, the illustrations are selected from ancient sources with great discrimination, and the entire contents of the volume thus far published bear the marks of deep research into, and a thorough knowledge of, its fascinating subject. The book is one not merely valuable to the craft, but deserves a prominent place in the library of every student of the world's progress.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED SCREW PROPELLER.

Joseph G. Hill, Newark, N. J.—This is a contrivance for constructing the hub in sections, so as to attach blades of rolled plate; and it also consists of a propeller blade in half or a lesser portion of a circle, and shaped in a true flat plane, instead of the spiral shape heretofore employed, whereby it is believed that better results can be obtained than from the spiral form.

IMPROVED TURBINE WATER WHEEL.

Edward Derby, Ridgway, Pa.—The object here is to utilize the entire force of the water, and at the same time balance the thrust upon the shaft, and thus diminish friction. Two direct action wheels and a central reaction wheel are combined with the shaft and case, and the case is suitably constructed to adapt it for use with the triple wheel.

IMPROVED LABELING MACHINE.

George H. Burrows, Boston, Mass.—This relates to apparatus for labeling packages; and it consists of a combination of levers, worked by suitable gearing, and paste rollers and paste troughs, in such a way that, by moving a hand lever, the rollers charged with paste are thrown out of the paste troughs on the ends of the label and back again into the troughs. It also consists of a platform carrying the labels, which is counterbalanced by a weight in such a way that the pile of labels placed on the platform is always held by the counterbalance against a retaining lip, so that the upper label in the pile is always at a given point. It further consists of a guard thrown over the free end of the label by the action of one of the paste rollers.

IMPROVED BRAKES FOR FIRE TRUCKS AND WAGONS.

Minford S. Clark, Brooklyn, N. Y.—The first invention is an improved brake for fire trucks, that is worked by the attendant at the steering wheel. The mechanism swings in supporting arms of the fifth or steering wheel at the hind part of the truck, and is operated by intermediate crank shafts and rods, by a fulcrumed treadle from the seat of the attendant. The motion-transmitting crank shafts are swung in bearings of the fifth wheel and of the truck frame, and connected by a swivel chain. In the second invention, a forked and spring-acted lever is worked by swivel chain, crank lever connection, and treadle, from the driver's seat, to engage the tongue and prevent its backward motion when it is desired to back the vehicle.

IMPROVED PUMP.

William H. Pollard, Seneca Falls, N. Y., assignor to Gould Manufacturing Company, of same place.—The object is to provide for vessels a pump which is attached to a stationary suction pipe, extending down to the bottom of the hold of the vessel, so as to be used as a bilge pump, for removing any water which may collect in the bilges from leaks or any other cause. By means of some small changes the pump may also be used as a force pump. The invention consists, first, of the construction of the cylinder heads and supports in one piece, so as to raise the lower part of the pump, to admit the ready dropping of the bed plate for getting at the lower valves; secondly, of the combination with the suction opening of a T joint, that may be connected to the stationary suction pipe, or to a detachable sleeve to connect with an overboard suction pipe; and, lastly, of the combination of the discharge opening, with an attachment to which a hose may be applied, for using the pump as a hand fire engine.

IMPROVED DIAMOND MILLSTONE-DRESSING MACHINE.

Aaron C. Pry, Keedysville, Md.—In this invention the diamond tool is set in a vertical holder, attached to a carriage sliding longitudinally in a vertically adjustable main frame. The tool is raised and lowered by a vertical screw, commanded by a gear wheel sliding lever and spring pawl, with an adjustable gage attached to regulate their operation. The tool is adjusted laterally by means of a transverse screw, acting upon the tool holder, to which screw motion is communicated by gearing, driven by a vibrating lever having a reversible detent attached, and which, as the carriage slides back, strikes and slips over an adjustable bar fixed to the rear of the main frame; thus, by means of the gearing and transverse screw moving the tool laterally, more or less, according to the adjustment of the bar fixed to the main frame.

IMPROVED STEAM HAMMER.

William Walker, Manchester, England.—This invention consists n connecting the trip of the hammer and the spindle by a series of levers, links, and connecting rods, whereby the steam and exhaust parts may be opened and closed automatically. A dropping lever, immediately connected with the trip of the hammer, serves by its unchecked momentum (which is communicated to the valve spindle) to open the lower steam port immediately after the blow of the hammer is delivered, thus securing a dead blow, while a small projection on the trip of the hammer serves to open gradually the upper steam port as the hammer ascends.

IMPROVED CAR COUPLING.

Robert K. Welch, Philadelphia, Pa.—The end of the drawhead is made of U shape, the outermost ends being provided with inwardly projecting hooks that interlock with spring-acted coupling hooks at the end of the adjoining car. The spring hooks are fulcrumed to a casing bolted to the car frame, and forced to be outside by a spiral spring. The rear ends of the spring hooks are acted upon by an inverted cone that is keyed to a screw spindle, so as to force, when turned down by a suitable key, the rear ends of the spring hooks to the outside, and cause the front ends to approach each other until they release the interlocking hooks of the drawhead. By turning the spindle and cone back, the spring hooks assume their former position, ready to couple automatically with the drawhead when the cars approach each other.

IMPROVED SUCKER ROD EXTRACTOR.

George M. Sheffer, Emlenton, Pa.—This is an improved device for extracting sucker rods from bore holes of wells, etc.; and it consists of a spring, with toothed jaws that slide in the socket part of the extractor and bite the rod when properly applied, so as to raise the same.

IMPROVED GRATE BAR.

Lucien H. Allen and William Barton, Tamaqua, Pa.—This consists of a grate bar made of a longitudinal bearing bar and curved crossbars or ribs at both sides, which extend from the upper part of the bearing bar. The cross bars at one side alternate in breaking joints with those at the other sides.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED CHILDREN'S CARRIAGE.

Charles W. Carter, Terre Haute, Ind., and Everett E. Fox, Isle St. George, Ohio, said Carter assignor to said Fox.—This carriage is so constructed that the wheels may be turned down into a horizontal position to adapt it for use as a crib. It may also be adjusted to have greater or less elasticity.

IMPROVED CHIMNEY.

George F. Knight, Carroll, Ohio.—This invention relates to certain improvements in chimneys, designed for the better ventilation of the rooms, and the rendering of the same fireproof by providing for the easy removal of soot, and arresting the issue of sparks. It belongs to that class of chimneys which have an inner and an outer flue; and it consists in combining with the same a deflector of peculiar construction, which diverts the soot from the inner smoke flue to the outer flue, down which it falls into a removable pan at the bottom, a cage of perforated sheet metal being arranged at the top to operate as an additional security against the issue of sparks.

IMPROVED SLEEPING CAR.

Gustave Leve, Montreal, Quebec, Canada.—This invention consists in the frames, divided into two compartments by a central partition, and hinged to the side walls of a car in such a way that they may be swung in against said walls, or swung out at right angles with them. The berths may be placed in a vertical position within said frames, or turned down into a horizontal position between two adjacent frames. In the car floor are recesses at right angles with the side walls, to receive the lower ends of the hinged frames when said frames are swung outward.

IMPROVED DRAFT ATTACHMENT.

Justus P. Luther, Harrison D. Chemberlin, and Nelson De Groff, Berlin, Wis.—This device is intended to equalize the draft and steer the wagon, so as to do away with the movement of the tongue when one wheel strikes a stone. This is obtained by the leverage secured through the difference in distance from draft bolt to arms, and arms to slot. The forward end of the drawbar, being loose, is drawn toward the obstructed wheel, and the bar is caused to slide on a pin, thereby loosening the chain on the opposite side from the wheel obstructed, and giving a quartering draft to the team. This throws the direct draft of both horses upon the wheel obstructed, and lifts it over the obstruction.

IMPROVED CAR WHEEL.

Louis Le May, Hudson, N. Y.—This is an improved construction of feathered car wheels; and it consists in a car wheel in which the tire is connected to the hub, and supported by a radial spring web on the hub and tire. The hub is made of a flanged section and a removable ring section, secured by connecting bolts. This is claimed to afford a wheel of considerable strength and rigidity, but of sufficient elasticity.

NEW HOUSEHOLD INVENTIONS.

IMPROVED WASHING MACHINE.

Chester Allen, Corinth, N. Y.—In using the machine, a cylinder is rolled back and forth upon the clothes spread upon a bed rack, the water is pushed before it, flows through the holes in the end boards, passes down into the channel below the bed rack, and rises through the spaces between the cross bars before and behind the cylinder. The clothes are thus lifted from the rack, and moved so that they will be operated upon each time in a different place.

IMPROVED SADIRON HEATER.

Preston H. Sessoms and Josiah Mizell, Coleraine, N. C.—This invention consists in attaching a sadiron receptacle to the top of a combustion chamber, with its rear end formed into a flue. The combustion chamber rests upon a frame which stands over and around a lamp or other suitable heating apparatus, both frame and enclosed lamp being supported by a base plate.

IMPROVED DOOR CHECK.

James Peirce, Nora, Ill.—This consists in a spring latch attached to the base board or wall, combined with a catch and buffer that is attached to the door, so arranged that it may act as a latch and buffer combined, or as a latch alone.

IMPROVED SADIRON HEATER.

William H. Haylock, Jonesville, assignor to himself and Charles S. Pierson, Sandy Hill, N. Y.—This invention consists in combining in a sadiron heater a lamp, having diametrically opposite pins, with a ring of the leg frame. There is also a burner, provided with a partition, so that each flame will have its own separate draft or current of air.

IMPROVED FOLDING CHAIR.

Thomas M. Wyatt, Russellville, Ark.—This is an improved folding chair, designed especially for dentists. To fold the chair, the back is turned down upon the seat, the seat is closed up, the front legs are turned back between the back legs and turned up against the back, and the back legs are turned up in front, folding the chair very compactly. There is a new lateral and vertical adjustment of the head rest. A greater variety of position is obtained through the rest bar adjusting almost automatically at any desired angle.

IMPROVED GRIDIRON.

George Cornwall, Garden City, N. Y.—This consists of a close corrugated plate for supporting the meat on the upper angles of the corrugations. To this plate are applied flanges extending down from the sides and back to rest on the stove top. The space under the plate has a trough for receiving the gravy. The close plate protects the meat from the flame and smoke, and cooks the meat better by checking the intensity of the heat.

IMPROVED CLOTHES PIN.

Uriah D. Mihills, Fond Du Lac, Wis.—This consists of a clothes pin with a notched wooden cross key secured to the head of the pin. The key serves as a handle for the pin, and allows it to be brought close to the line, to prevent, by its rigid position thereon, the chafing of the clothes by the points. The projecting parts of the key also allow the pin to be more easily removed.

IMPROVED PROTECTOR FOR CHANDELIERS.

Frank J. Symmes, San Francisco, Cal.—This is composed of mica plates and a metal contrivance for suspending the device. It is so contrived as to protect the gaselier from the heat, and from the deposit which collects upon metal deflectors.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED CLASP.

Alva M. Butler, Constantine, Mich.—This is a clasp for fastening cigar boxes, etc. It is bent at right angles to fit upon the edge of a box, and has points formed upon its end parts, to enter the cover and side of said box.

IMPROVED JOINT OF PIANO ACTION.

Frank Preston, Elgin, Ill.—This consists of a pivot pin for the hammer, pointed at each end and fitted in a bush having a conical seat and screwed into the bearings, in which it was held firmly by a clamp contrivance to prevent it from turning after being adjusted. The object is to provide a joint that cannot be affected by dampness.

IMPROVED SURVEYING INSTRUMENT.

Matthew W. Venable, King's Mountain, Ky.—It is not possible to explain the construction of this instrument without drawings. It is, however, a surveyor's telescope, which may be used for setting slope stakes in a rapid manner on inclined, rough, or broken ground. It also may be used for finding the gradient between two given points, and by simple modifications may serve as a clinometer level. For railroad engineers, it appears to be a useful instrument.

IMPROVED SPINNING TOP.

Andrew Kern, Utica, N. Y.—The invention consists of a tubular handle on the upper part of the spindle of the top, within which the string for spinning the top is attached to the spindle. The handle allows the top to be held in the hand, after it has been set running, to be set down in any required place.

IMPROVED HAIR-PUFFING PIN.

Annis Hurd, Waterloo, Iowa.—This is a puffing pin with clasping spring legs and connecting spring coil, the sections of which are arranged slantingly to each other for passing a hair pin readily through either coil section.

IMPROVED FLAG SIGNALING APPARATUS.

Rufus D. Couch and Jesse M. Lamb, Sharpville, Ind.—The object of this invention is to enable the telegraph operator to signal all approaching railway trains without leaving his office, by a signal flag, which is unwound from a spring roller by a cord, and arranged in a suitable frame in conspicuous position. On releasing the cord the spring roller acts to rewind the flag.

NEW AGRICULTURAL INVENTIONS.

ROTARY SPADER, STALK CUTTER, AND FIELD ROLLER.

Peter D. Pelsor and Henry C. Pelsor, Metamora, Ind.—In the face of a large roller are formed rows of slots of such a size that the spades may fit into them, so that all the dirt that may adhere to the said spades may be scraped off every time they are drawn inward. There are devices for removing the spades or cutters; also for preventing them from getting out of place while holding them back, thus adapting the machine to be used as a field roller and enabling it to be readily drawn from place to place.

IMPROVED STUMP PULLER.

Chester C. Adams, Decatur, Mich.—By alternately driving a team of horses forward and backing them up, a succession of impulses is given to a shaft, winding the rope or chain around it and drawing the stump. The shaft is mounted in a frame and has a ratchet. The power is applied to a lever, on which is a pawl which engages with the ratchet.

IMPROVED FERTILIZER DISTRIBUTER.

Pleasant P. Linder, Alexandria, Ala.—The novel feature in this implement is a block fitted to slide on the axle, in order to act in conjunction with a slide in regulating the discharge of manure in different states of comminution.

IMPROVED PLOW.

Melvin P. Sparks, Spring Lake, Mich.—This plow embodies a new mechanical construction, which is claimed to lessen the friction against the bottom and landside of the furrow, to enable the plow to be more easily thrown out of the ground, and to work at any desired depth in or to run above the ground, and to be of lighter draft.

IMPROVED GRAIN BAND.

John H. Swihart, Upshur, Ohio.—This is a simple and ingenious little device, consisting of a wire pointed about midway its length and attached to a small plate at one end. There is a hole in the plate to receive the other end of the wire when the band is being passed around the sheaf. When the binder is released, the pressure of the bundle upon the inner end of the plate brings the said plate into an inclined position with and causes it to bind upon the wire.

IMPROVED REVOLVING GARDEN AND FIELD HOE.

David B. Sherman, Castleton, Vt.—Two side boards are connected by a board attached to their forward ends, and by a board attached to the upper edges of their rear ends. Between the side boards is pivoted a roller, to which are attached the shanks of a number of small hoes. The machine is propelled by handles attached to the side boards.

IMPROVED HARROW.

Jesse G. Stokesbary and John H. Stokesbary, Millersburg, Iowa.—This harrow embodies five new mechanical devices, which enable it to be adjusted for use as a large or as a small harrow, to be cleared of rubbish without stopping the team, and to be used for any kind of harrowing, and upon any kind of ground.

IMPROVED PLOW.

Swan N. Cedarland, Solomon Rapids, Kan.—The new feature is a flat plowshare having an angular front edge, and a cutter attached to the side thereof, the point or apex of said angle being nearer the cutter than the opposite side of the share. This tends to draw the plow into the ground.

IMPROVED COMBINED CULTIVATOR AND HARROW.

John R. Dunlap, Sherman, Ill.—By suitable construction, this implement may be guided to follow the row, however crooked it may be, the resistance of the soil against the cutters being sufficient to draw the harrow after them. By bearing down upon the rear end of a lever, the forward end of the harrow is raised from the ground, allowing any rubbish that may be caught upon the harrow teeth and the plows to drop off. The plows may be relatively adjusted as desired.

IMPROVED COMBINED PLANTER, CULTIVATOR, AND MARKER.

Joseph K. Kelly, Algonquin, Ill.—Four novel mechanical devices are here embodied, producing a machine that may be readily adjusted for use for marking off land for planting the seed, and for cultivating the plants. By an improved construction, the rubbers prevent the kernels from being injured by the movements of the dropping slides.

Notes & Queries

It has been our custom for thirty years past to devote a considerable space to the answering of questions by correspondents; so useful have these labors proved that the SCIENTIFIC AMERICAN office has become the factotum, or headquarters to which everybody sends, who wants special information upon any particular subject. So large is the number of our correspondents, so wide the range of their inquiries, so desirous are we to meet their wants and supply correct information, that we are obliged to employ the constant assistance of a considerable staff of experienced writers, who have the requisite knowledge or access to the latest and best sources of information. For example, questions relating to steam engines, boilers, boats, locomotives, railways, etc., are considered and answered by a professional engineer of distinguished ability and extensive practical experience. Enquiries relating to electricity are answered by one of the most able and prominent practical electricians in this country. Astronomical queries by a practical astronomer. Chemical enquiries by one of our most eminent and experienced professors of chemistry; and so on through all the various departments. In this way we are enabled to answer the thousands of questions and furnish the large mass of information which these correspondence columns present. The large number of questions sent—they pour in upon us from all parts of the world—renders it impossible for us to publish all. The editor selects from the mass those that he thinks most likely to be of general interest to the readers of the SCIENTIFIC AMERICAN. These, with the replies, are printed; the remainder go into the waste basket. Many of the rejected questions are of a primitive or personal nature, which should be answered by mail; in fact hundreds of correspondents desire a special reply by post, but very few of them are thoughtful enough to enclose so much as a postage stamp. We could in many cases send a brief reply by mail if the writer were to enclose a small fee, a dollar or more, according to the nature or importance of the case. When we cannot furnish the information, the money is promptly returned to the sender.

W. L. L. will find a good recipe for aquarium cement on p. 80, vol. 31. To blacken a brass microscope tube, see p. 362, vol. 25.—C. C. C. will find an explanation of duplex telegraphy on p. 235, vol. 34.—A. B. C. will find directions for browning gun barrels on p. 11, vol. 32.—A. S. should read the directions for constructing the simple battery again.—P. M. and W. M. will find directions for nickel plating cast iron and steel on p. 186, vol. 34.—C. W. T. can etch glass with hydrofluoric acid. See p. 409, vol. 31.—O. A. Jr. should read our article on the horse power of engines on p. 33, vol. 33.—C. L. P. can solder the parts of his brass oil tank together. See p. 251, vol. 28.—A. P. P. will find a recipe for a depilatory on p. 186, vol. 34.—O. J. will find a recipe for a gold solder on p. 251, vol. 28.—M. G. will find directions for making vinegar on p. 106, vol. 32.—A. R. will find full particulars of the New York canal steamer reward on pp. 288, 295, vol. 24.—H. H. can get rid of roaches and bugs by using the remedy described on p. 315, vol. 32.—G. Z. will find a recipe for a cement for joining stone, etc., on p. 251, vol. 31.—F. H. W. will find directions for lighting gas by electricity on p. 4, vol. 29.—M. will find instructions for annealing steel castings on p. 268, vol. 24.—B. will find directions for removing fruit stains from ivory on p. 10, vol. 32.—E. S. R. is assured that the pretensions of the divining rod men, for discovering water, precious metals, etc., in the earth, are all humbug.—E. B. W. will find an answer to his query as to the sinking of a body in deep water on p. 208, vol. 33.—F. C. can keep small steel articles from rusting by the method described on p. 169, vol. 33.—A. K. J. will find an article on the artificial production of cold on p. 351. vol. 34.—G. C. M. can find the power of his spring only by experiment.—F. A. P. will find directions for bronzing on iron on p. 283, vol. 31. For bronzing on brass, see p. 51, vol. 33.—Will D. W. A., of Atlanta, Ga., send us his name?—J. M. should consult a physician as to the feet troubles.—B. M. E. will find a good recipe for indelible ink on p. 129, vol. 28.—W. H. R. is informed that the shellac and alcohol preparation he mentions is French polish. See p. 11, vol. 32.—J. J. D. B. will find a recipe for a black walnut stain on p. 90, vol. 32.—D. W. D. will find a recipe for a paint for outdoor work on cement on p. 277, vol. 26.—W. T. B. will find directions for building an ice house on p. 251, vol. 31.—A. E. R. will find a description of malleable cast iron on p. 138, vol. 29.—M. G. will find an excellent article on the nature of heat on p. 325, vol. 33.—T. A. should keep the brass work on his locomotive bright by the method described on p. 102, vol. 25.—T. W. F. should put nitric acid in the porous, and salt water in the glass, cell of his battery.—L. J. W. will find directions for gilding wood on p. 90, vol. 30.—E. H. F. will find a recipe for waterproofing canvas on p. 347, vol. 31.—L. H. will find directions for building an icehouse on p. 251, vol. 31.—J. P. can attach leather to his iron pulleys by following the directions on p. 409, vol. 33.—S. A. H. can prevent the accumulation of rust on his tools by following the directions on p. 169, vol. 33.—T. S. D. will find directions for preserving birds on p. 159, vol. 32.—L. F. L. will find a recipe for bronze on brass on p. 51, vol. 33. For bronze on iron, see p. 283, vol. 31.—D. T. W. will find a recipe for indelible ink on p. 129, vol. 28.—L. D., F. P., J. H., W. S. C., J. B. H., E. G. A., G. C. M., O. H. B., R. J., H. A. M., and many others, who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) P. says: In the SCIENTIFIC AMERICAN SUPPLEMENT, August 5, No. 32, you give very minute drawings of a boiler and engine for a navy cutter, with size of boat, etc. What speed would a boat, built with such proportions, etc., attain? A. If the boat has a good model, it should attain a speed of 8½ or 9 miles an hour, in smooth water.

(2) J. A. B. says: 1. In your issue of August 9 you state that the improved Holtz electric machine has two plates that revolve in opposite directions. You tell how the collecting arms are placed, but I do not understand how the sectors are placed. What is the diameter of the plates in the best machines? Should they be of plate glass, or will the best window glass do as well? What should be the thickness of the glass to give the best effects? What published work gives the best exposition of the Holtz machine? A. You will find a full statement of the machine in Dechanel's "Natural Philosophy," which is now published in parts. Get the part on electricity and magnetism.

(3) A. S. asks: How large a vertical boiler will be needed to run two engines 8x8 inches, the boiler having plenty of heating surface, and the engines running with 100 lbs. steam? A. Make one 4½ to 5 feet in diameter and 7 feet high.

(4) A. G. W. asks: 1. How many revolutions should a 13 inch bottom runner corn mill make to give best results in quantity and quality of meal? A. From 800 to 900 a minute. 2. How much can it grind per hour with an eight horse power engine? A. From 10 to 12 bushels. 3. I wish to run a 50 saw cotton gin at the same time with the corn mill. Can the mill grind as much under such conditions as it could when I throw the gin off? A. Probably the gin will make a difference of 2 or 3 bushels an hour.

(5) F. C. says: We have a boiler that does not steam very well. The heat passes under, then back through the tubes, then over and under the top. Will turning the air from a blacksmith's fan underneath the fire make the fire burn more strongly, or should we pass it through above the fire? A. If the trouble is lack of draft, the first plan will doubtless prove serviceable.

(6) W. S. asks: What is the greatest depth of water explored with a diving bell? A. We have seen an account of a diver working at a depth of about 160 feet. Perhaps some of our readers may know of instances in which still greater depths have been reached. In the use of either the bell or diver's suit, weights are attached to make the apparatus sink, and air is forced into the interior through a flexible tube.

(7) K. W. D. says: A man weighing 200 lbs. is hung. Would a keg of nails weighing 200 lbs. exert more strain on the rope than the man, the drop being 3 feet? A. Possibly it might, being less elastic.

(8) R. W. H. says: We have a coal shaft 320 feet deep, which has a pump in the bottom: and the steam is furnished from the surface of the ground, and the pipes, both water and steam, are rusted out very fast by the water that runs down the shaft. It is salt water. Can you tell us of a remedy? A. The surest remedy would be the use of copper pipes.

(9) J. S. Jr. asks: How can I separate white lead from tallow or oil? A. Remove the oil and grease by treating with bisulphide of carbon.

(10) H. J. M. asks: 1. Is the bulk of the starch used made from corn? A. No: the greater part is made from potatoes, rice, and wheat. 2. What is the process of making starch from corn? A. The crushed grain is macerated with a weak soda lye, which dissolves the gluten and leaves the starch. 3. What percentage of starch does corn contain? A. American corn contains 50 or 60 per cent of starch. 4. Does it require a large amount of machinery and capital to engage in this business? A. Yes.

(11) H. E. asks: What can I apply to the inner surface of a hogshead to protect the wood from the action of the chloride of sodium, commonly called Javelle water? A. You probably mean the hypochlorite of sodium (*eau Javelle*). Try coating the interior of the casks with melted paraffin.

(12) H. A. S. says: 1. Which of the elements may be volatilized so as to be detected by the spectroscope in a hydrogen flame? A. Potassium, sodium, barium, strontium, and other metals forming, with oxygen, alkalies and alkaline earths. 2. Which may be detected in an oxy-hydrogen flame? A. All the metals and many of the other elements, but not so well as with the electric lamp. 3. Which may be detected in the electric sparks of different lengths? A. All the elements—the metals, the gases, and the vapors of the non-metallic elements.

(13) C. C. R. says: I have some printer's ink that takes from 24 to 36 hours to dry. Can you tell me of anything that will make it dry more quickly? A. We understand that finely powdered permanganate of potassa, introduced in small quantities, is admirably suited for this purpose.

(14) J. W. W. says: Boerrhave asserts that, by putting alcohol into an ox bladder and exposing it to the sun, he produced absolute alcohol by exosmose. Donovan disbelieves it. Who is correct? A. Absolute alcohol cannot be obtained by such a method. 2. Do whisky, brandy, and gin lose or gain in strength after they are first made? A. This depends altogether upon what condition the liquors are in when bottled. If properly prepared they seldom lose in strength.

(15) A. D. S. says: I have seen Brussels carpets scrubbed with soap and water, in which was put something that brightened the colors in the oldest carpets. Can you tell me what was used for this purpose? A. It was probably carbonate of soda or potash.

(16) J. T. S. asks: 1. What must I do to make common printing ink copyable? A. We do not think that this has ever been satisfactorily accomplished. 2. Can type metal be soldered to brass with common plumber's solder? A. Yes.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

J. S. H.—It appears to be a piece of iron slag. It is not of meteoric origin.—S. J., Frostburg, Md.—The samples became separated from the letter, and, as they were not properly marked, were lost.—M. P. T.—It is fire clay.—S. C.—No. 1 is limestone. No. 2 is felspar.—A. B.—The red rock is massive iron garnet. The other is a species of hornblende.—T. W.—The clay is of a fine quality, but does contain a small quantity of iron; otherwise it is nearly pure.—W. H. G.—It is white sulphide of iron (marcasite).—E. C.—The yellow bodies consist of clay colored by oxide of iron (yellow ocher). The dark variety might be employed as a fire clay, and for making cheap drain pipes and pottery. The other specimens are kaolin, of different grades of purity.—C. S.—It is hornblende.—W. E. D.—The water contains an injurious amount of organic matter.—M. R. H.—No. 1 is sulphide of iron and quartz.—No. 2 is quartz and mica schist. No. 3 is slate.—G. J.—No. 1 is Amazon stone, a species of orthoclase. No. 2 is yellow jasper. No. 3 is red jasper. No. 4 contains lead and silver. No 5 is smoky quartz. No. 6 is hornblende and sulphide of iron.—No. 7 is hornblende, felspar, and carbonate of copper.—R. H. F.—It is an impure clay, a silicate of alumina.—A. B. O.—The water contains a large quantity of sulphides and organic matter. It has been contaminated by contact by the cork and camphor, which the bottle previously contained.—J. H. S.—No. 1 is shale. No. 2 is sandstone containing considerable iron pyrites.—L. B. C.—The sample does not contain nickel.—J. G. W.—It is an impure clay containing small specks of iron pyrites. In order to classify the shells, it would be necessary to have more of them.—G. W. W., who asked about new nickel electrolyte, does not state what his trouble was. The ammonia used was possibly not strong enough. The bath is simply a solution of cyanide of nickel in ammonia.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Hydrophobia. By L. M. N.
On Advancing Science. By N. M. R.
On Salicylic Acid. By W. E. F.

Also inquiries and answers from the following:

H. T.—J. R.—B. L.—J. H.—J. A.—T. W.—C. W.—A. N.—A. W.—W. H. F.—M. B.—J. M.—C. A. M.—R. N.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "How can I find a partner with $5,000 capital? Who sells model steam engines? Who makes the best truss, for the relief of hernia? Who makes plate glass show cases? Who sells fireproof safes? Who sells sewing machine attachments at wholesale?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

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September 12, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city.

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9,491.—STOVES.—A. C. Barstow, Providence, R. I.
9,492.—BELT.—C. F. Brigham, Worcester, Mass.
9,493.—MUFF.—B. Lüddecke, New York city.
9,494.—IRON FENCE.—J. B. Wickersham, Philadelphia, Pa
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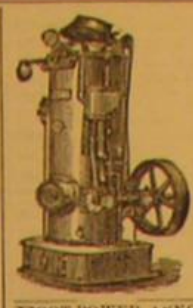

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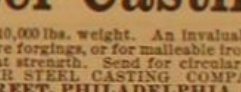
THE  BEST
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