THE
CANADIAN MAGAZINE
OF
SCIENCE AND THE INDUSTRIAL ARTS.

Patent Office Record.

Vol. XIX. AUGUST, 1891. No. 8.

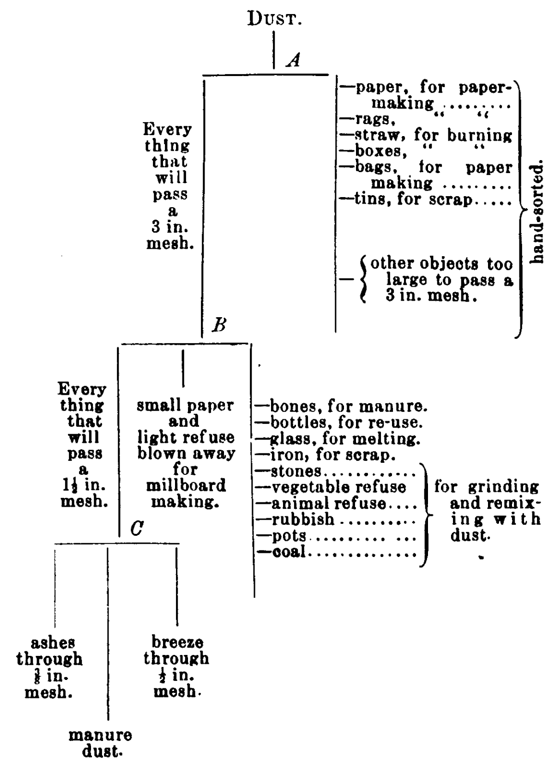
HOW TO DEAL WITH TOWN REFUSE.

The life of a vestryman would be a happy one but for "dust." Snow is only an occasional visitor. When snow comes he has three choices—to clear the snow away properly, as is done in one part of London and in one London suburb; or he can ruin the constitutions of Her Majesty's lieges and their beasts of burden by salting the thoroughfares. The third course, and safer than the last mentioned, is to do nothing. Unluckily, "dust"—in other words, the heterogeneous matter that makes up the contents of the dustbin—is always with us. Go where he will with his refuse, the vestryman is chivied elsewhere. He reads Dickens's description of the golden days of the dustmen and is happy for the moment. But what was the amount of dust of former days compared to that of these? Judged by quantity, the vestryman of to-day should accumulate his wealth in precious stones rather than in comparative valueless gold. However, dust to him is as bad as was formerly the possession of a white elephant to others, and there is little reason to doubt that he would willingly hail a saviour to get him out of his difficulty. In a novel this help would be found to turn up. But truth no doubt is stranger than fiction, and in some cases, if not in the majority of cases, the best of fiction is written from actual fact sufficiently disguised for the purposes of propriety. It is a striking, if not quite the impossible fact some might have imagined, that two men have apparently succeeded in solving the problem that the united intelligence of vestrymen has hitherto failed to solve. Things have come to the condition that we should be glad to get rid of dust at any cost, and thus escape being voted a nuisance whatever we do and wherever we go. The new process for effecting the wished-for riddance has been at work for two years at Chelsea, and is operated by what has been named the Refuse Disposal Company, Limited, of the Salopian Wharf, Lot's Road, the invention being that of Mr. Joseph Russell (Rosser & Russell, Engineers, Charing Cross) and Mr. J. C. Stanley, the success of carrying the process into practical efficiency being due to the combined experience of these gentlemen in mechanical and chemical laws respectively. Every opportunity has been given by the company for inspection of the process, and it has already commended itself highly to those who have examined as well as to those who have tried it. The process has been described in a recent issue of *Engineering* with extreme care and accuracy, and we therefore do not hesitate to give the following extract:—

A cursory inspection of the contents of a dustcart leads to the idea that they are mostly valueless and wholly offensive, or capable of becoming offensive under the influence of time and heat. But this is a mistake, due to the large bulk of the lighter and more odorous constituents. Such articles as empty meat-tins, bottles, waste paper and straw, and vegetable refuse, make a large bulk, but only weigh very little. Three-fourths of the weight of dust collected consists of fuel. A proportion of this has never been on the fire, while most of the remainder is good cinder; it has had the gases expelled, but the carbon remains, and makes capital fuel. Of course there is some thoroughly-burned ash, but it is wonderful how much less than one would expect to find. The modern servant is not addicted to the use of the riddle, and all she finds in the grate in the morning goes into the dustbin. This is well known to those interested in such matters, and the brickmakers consequently absorb many thousands of tons of breeze from the dustcarts annually, to the great annoyance of their neighbours. For although the amount of animal and vegetable refuse is relatively small, it is usually sufficient to taint all the other elements of the dust, and to render them offensive when burnt or handled.

The salient feature of Mr. Russell and Mr. Stanley's method is that the dust is dealt with immediately it arrives, and that during the whole time it is under treatment it is kept in motion, and is fully exposed to the air in thin layers. It is tipped from the cart into the first machine, and immediately commences its passage through the various sorting devices; in a few moments it has been divided into its different constituents, while all that is offensive has been intimately ground up with other material, mostly carbon, in which it is not only lost, but deodorised. The breeze and ashes find a ready sale among the brickmakers, but there is still a better outlet for them. By mixing them with pitch they can be pressed into briquettes and used for steam-raising. It can scarcely be contended that these briquettes are equal to those made from fresh Welsh coal, but they are very fair, and can be sold at a reasonable price. The liquid pitch encloses any objectionable elements they may contain, and the result is that they are inodorous. Another material of value found among dust is paper. Immense quantities of this are collected, and can be used over again for the manufacture of common brown paper for wrapping parcels. After being dried to remove the dust, and passed through the beaters to reduce it to pulp, it becomes as clean and sweet as when it came home from the grocer's or draper's. Straw can be similarly utilized for straw boards.

It is an important feature of the process that it is almost entirely mechanical, as nine-tenths of the material is never touched by hand. The dust as it arrives is tipped into a rotating cylindrical sieve; this runs on a horizontal axis, and is 12 feet in diameter by 12 feet long. The meshes are formed of bars 3 inches apart, and the progress of the tailings is regulated by an internal worm, which obliges them to make about three circuits of the screen before they can escape. A large exhaust-pipe, operated by a powerful fan, draws all the floating dust and small particles forward, and delivers them into the closed ashpit of a steam boiler. This screen is marked A on the diagram; the tailings, shown on the right, are mostly bulky articles; the paper, rags and straw usually roll into balls, although a good deal of small escapes through the meshes. Each thing that comes out is thrown on to its proper heap, while the rubbish for which no use can be found is sent to be ground under edge-runners, as will be explained presently. The articles that pass through the meshes are raised by an elevator, and delivered to a second rotating screen, B, 15 feet long, 6 feet in diameter, and $1\frac{1}{2}$-inch mesh. The tailings from this are first



subjected to a blast to take out light paper and straw, and are then dropped on to a revolving sorting-table, 15 feet in diameter. A boy sits beside it and picks out everything of value as it passes him, such as bottles, glass, iron, bones, &c. The rubbish, such as animal and vegetable refuse and broken crockery, he allows to go past him to the grinding-mill. Here everything for which no use can be found is reduced to a dry powder, which appears able to absorb all the offensive elements and render them sweet. There are no heaps labelled "miscellaneous" in these works to distract the manager and breed a nuisance; everything that is doubtful goes into the mill, which is the pot au-feu of the establishment. When it comes out it is no longer recognisable; the mixture is carried back and put into the first screen (A) to be again sorted.

Everything that will pass through a $1\frac{1}{2}$-inch mesh falls from the screen B on to a travelling band which delivers into a third screen C, 15 feet by 6 feet, covered with two meshes, $\frac{1}{2}$ inch and $\frac{3}{8}$ inch. What passes through the former is called ashes, and through the latter breeze. The tails go for steam generating. The ashes are used to mix with clay for brickmaking and the breeze for burning in the clamps, unless, as indicated above, they are pressed into briquettes, which, of course, fetch a better price. The ashes and breeze pass over a fine shaking screen, which takes out everything below $\frac{1}{8}$ inch; this is valuable as manure, being the greater part of the animal and vegetable matter ground up in the mill.

Having traced the dust through its entire passage, we must return and notice some of the tailings. As we have already said, everything for which an immediate use cannot be found is destroyed. At present straw falls into the category, although the success of foreigners in the manufacture of straw boards leads to the hope that that manufacture may be eventually established here. The straw is all burnt with special precautions to render the smoke inoffensive. An externally-fired cylindrical boiler has two grates; on the larger of these the straw is burned, while on the smaller there is a breeze-fire through which the gases from the straw are passed to complete the combustion. The paper is remade on the premises. This seems a curious industry to carry on in Chelsea, but a well has been sunk into the gravel and an ample supply of water has been obtained to keep three beaters and one paper-machine at work. This is the most valuable by-product of all; the waste is worth 10*s.* to 1*l.* a ton, while the paper made from it is worth 7*l.* to 8*l.* a ton. The special value of the process is, however, that it enables the paper to be cleansed immediately, instead of being retained until a market can be found for it.

The works naturally consume a good deal of steam, particularly for the paper-making, and this accounts for much of the fine fuel. Indeed, it is conceivable that in any general extension of the system it might be worth while to use all the fuel on the premises in winter for the production of electric lighting currents. The total cost of handling would thus be avoided, and possibly a saving of the ratepayers' money effected. To prevent the evolution of smoke and any nuisance that might arise from the nature of the fuel, the five boilers of the works have their smoke drawn by an exhaust-fan through scrubbers, in which it is thoroughly washed before it is delivered into the air. The three locomotive boilers are worked with forced draught, by which all the floating dust collected from various parts of the works is thoroughly burned up. —*Builders' Reporter*.

MODERN LIGHT.

BY LEO SILBERSTEIN*

From Grecian mythology we learn that Prometheus stole fire from Heaven where the gods guarded it jealously. Prometheus? Presumably some great discoverer, the Edison of a prehistoric age. What he then achieved may have created just as much admiration and wonder as we experience at sight of the incandescent American lamps. How have these wonders been achieved?

Even in old Homer's time tallow candles were a little-known luxury, and Ulysses returning to Ithaca to the halls of his fathers, surveys the wine stained countenances of his companions, in the ruddy glare of flickering chips and bundles of twigs. How different now! A cascade of brilliant rays radiate from flowers of fabulously wondrous beauty, with incandescent lamps in their interior, falling on facets of crystal glass, on mirrors, on gold frames, on marble statuary, and porcelain figures, covering them all with a halo of splendor. We are in the age of electricity! Electricity! The word suggests a secret revelation of the wonders that surround us—a dream of new powers with which science will invest us; a new authorization of man to assume control over nature, and to mould the conditions of his existence into richer and more attractive forms. And now, how do we produce this uncertain immaterial substance that can dazzle like the sun, and strike like lightning? Its origin is as incomprehensible as its character. The mere contact of two metals produces electricity, the friction of two bodies upon each other, whether they are hard like glass, or fluid like water, the heating of certain mineral crystals, the revolution of one glass disc upon another under certain prescribed arrangements; all these generate electricity. Everywhere in earth, air, fire, and water, we are confronted with the evidence of the presence of this uncertain force which appears only to disappear in the great body of the all-mother earth from whose womb issues all that lives or breathes; to whose womb whatever has life, or force, or energy, must sooner or later return.

For industrial and illuminating purposes, electricity is produced by dynamo machines. The fundamental idea of these wonderful contrivances is that wire spools are maintained in revolution past strong magnets. Whenever the spools approach or withdraw from the poles of the magnet, a current of electricity originates in the wire.

To keep a wire spool revolving past a magnet would be amusing child's play if there were no hin drance, and electricity might be generated very cheaply in a continuous current; but with the increase of the current in the wire spools, there is generated a corresponding antagonism between the magnetism of the iron magnet and the electricity of the wire. The wire strives to go over the shaft, but to enable it to do so, a force is required proportionate to the force of the electricity generated. This required force is supplied by motors, steam-engine, wind-mill, water wheel, or other power.

In a central station for lighting a city or quarter of a city, we witness a whole series of direct transformation of power from one form into another. Coal is burnt, and the heat thus generated converts water into steam, and gives the steam elasticity. This elasticity operates the machine, precisely as men or horses might; in fact, it performs labor; and this labor employed in revolving the wire spools, generates or is converted into electricity. This whole series of processes may be reversed and electricity converted into heat for cooking, or into power for operating machinery. Endless are the applications of which electricity is susceptible, for electricity, heat, light, steam, the chemical union of elements are all intimately related; they are capable of performing labor precisely as labor is required for their production.

Light, although seemingly so unsubstantial and powerless, is labor, and requires force to generate it as much as wood-chopping or verse making. Every ray of light that vibrates in space is as full of force and energy as the axe of the woodcutter in its swing. Every ray that comes to us is the product of chemical labor applied to distant stars by elements such as oxygen, carbonic acid, etc., in the fierce tumult of chemical union and decomposition. Even to this day, savages generate fire by the sweat of their brow through the rapid continuous friction of two bits of wood.

The day will assuredly come when electricity will be generated directly from the heat of burning coal without the intervention of steam or dynamos; something has, indeed, been already achieved in this direction.

Berlin may be said to be the birthplace of dynamo machines as well as of the electric railway, and of other achievements in electro-technology in which department the illustrious name of Siemens is unrivaled.

The Berlin Electric Works include five central stations, in which the needed electricity for the supply of the city is generated. In March, 1889, there were in the capital 3,714 arc lamps, and 62,876 incandescent lamps in operation. For motor and illuminating purposes, the five central stations distribute about 8,000 horse-power which will shortly be increased to 18,000.

Eighteen thousand horse-power! What an enormous force. To realize its immensity one requires to institute comparison with a past like that of Egypt whose mighty pyramids were erected by human hands. Such work would be merely child's play, comparatively, in this age. Why Berlin's electric force at this moment performs labor equal to that of 70,000 men. The existing steam power of the world is estimated at 6,000,000 horse-power, equal to 50,000,000 laborers. Where now would be the progress in our culture if we were dependent on muscular force? Labor is capable of producing not only physical light but, being economized may be converted into spiritual or intellectual light; thus machinery not merely economizes production but ministers to the material and intellectual progress of the race.

*Translation in the *Literary Digest*.

KEEPING UP STEAM OVER NIGHT.

An engineer has been telling a contemporary how to keep up steam in a boiler over night without banking. First, the damper is closed tightly and ashes drawn to the ash-pit door, making it air tight. Then the smoke-box door is opened a trifle, the result being that the engineer had 15 to 25 pounds pressure in the morning. With a setting that is not full of leaks, it should be easy enough to keep up pressure over night without any fuss, and if not, there is some leak somewhere that should be attended to. The leak may be of steam, through faulty connections or in a cracked setting, letting the cold air come in contact with the boiler. Then some engineers have an idea that the top of the boiler should not be covered, and here is an avenue for the heat to escape. I have let the fire under a boiler go out early Saturday afternoon, and on Sunday afternoon have found 25 pounds pressure, and nothing was done but close the damper, furnace door and ash-pit door. The best practice is to bank the fire, but when this is done, there is more to fear of a pressure too high than otherwise. Any one who has a steam pressure recorder will note that the pressure runs very high during the night, and passing through any of the city streets late at night the hiss of steam escaping from safety valves is plainly heard, and leads to the suggestion that some may be in condition less responsive to the excess in the pressure allowed.—*American Engineer.*

THE CLASSIFICATION OF APPLICATIONS AND PATENTS IN THE UNITED STATES PATENT OFFICE.

Under the patent law of the United States, a thing to be entitled to protection by letters patent must be new and must possess invention.

Most things which are new are the result of the exercise of the inventive talents, and are therefore patentable.

To determine the novelty of a device for which a patent is solicited, and hence the patentability of the same, it is provided by statute that the Commissioner of Patents shall cause an examination to be made of all previous patents relating thereto, or, as it is commonly termed, of the "state of the art."

This examination, when completed, is supposed to remove all doubts as to the novelty of the thing in question and to determine its patentability.

This examination, to be thorough, depends upon two things—the skill and honesty of the members of the examining corps and a proper classification of inventions.

A proper classification should be of such a character that the officer whose duty it is to assign applications for examination may be able to determine by a careful inspection thereof, its proper place in the arts and to what class and division it should be assigned.

While the classification now in vogue is conceded by all to be the best which has yet been devised, to any one who has carefully considered the matter it must be apparent that it has many defects and is open to improvement in many particulars.

Under this classification, applications and inventions are assigned for examination with relation to the particular specific art to which they are more closely allied.

Those inventions relating to the manipulation of metal are sent to the class of metal working; those relating to the mechanical treatment of paper to the class of paper manufactures; those relating to the treatment of leather to the class of leather working, and so on throughout the office.

An application for a patent for a machine for rolling sheet metal is assigned to the division of metal working; one for ironing cloth is sent to textiles, while one for ironing or rolling leather is sent to leather working, notwithstanding that in most cases these machines are analogous in construction and operation and can be interchangeably used.

As the courts have decided that an inventor is entitled to all the uses to which his invention can be put, a machine which has once been patented for one purpose cannot be again patented for another purpose. A machine for rolling metal or cloth can generally be used for rolling leather.

Under the present classification, these three classes of machines are in three different divisions of the office, so that to be certain that a machine of one of the classes is new, a search therefor must be carried on in each of the respective classes or divisions wherein the others are classified.

These classes are in different rooms in the Patent Office and are widely separated, on different sides and different floors of the building, so that an examiner who may be prosecuting a search for a machine of the kinds mentioned must tramp around the office from room to room and floor to floor of this great building in order to make a thorough search, consuming much valuable time in his pilgrimages, and, perhaps, being unfamiliar generally with classes other than his own, his search is rendered difficult and uncertain.

This classification undoubtedly lends an air of uncertainty to the search and to the novelty of many things, for if the examiner be a recent employe, and be therefore ignorant of the existence of analogous classes, or if he be careless, and thus through ignorance or carelessness fails to make an examination therein, duplicate patents are liable to be, and as a matter of fact are, granted.

Fortunately, the members of the examining corps are generally capable and painstaking men, who are alert and careful in the performance of their duties, protecting equally the interests of the inventor and the public, and to this fact is due the very few duplicate patents in the many thousands issued yearly.

Another defect in the present classification, and one which cannot be too strongly condemned, is the facility with which an applicant or his attorney can practically determine in what class his invention shall be examined and to locate the same therein.

The assignment of the application is, in most cases, determined by the title which is given the alleged invention or the statement of invention contained in the specification.

Let us assume, for an example, that a man has invented a machine for cutting fabric, either cloth, leather, or paper, and for some reason he desires this machine to be examined in the class of paper manufactures.

There are many reasons why he may desire this;

he may be in a hurry to get an action on his case and this division may be farther advanced in date than another, or the examiner in this class may be known to have more liberal views than another; in this case, he simply styles his machine a machine for cutting paper, when his object is obtained, the case is assigned where he wants it to go. The same is true throughout the office A machine for riveting sheet metal is assigned to metal working, but the same machine, if called simply a riveting machine, and the statement of invention should set forth that it was adapted to insert rivets in *leather* and other sheet material, would be assigned to the class of leather working.

Under the present classification, one division patents knives; another patents hay knives; another shoe knives; another woodworking knives, and still another knife erasers—five separate divisions granting patents for knives.

There are at least three divisions patenting tacking and nailing machines, differing only in the material into which they drive the tacks or nails.

There are at least three divisions patenting chains, links, etc.

Is there any wonder that duplicate patents are sometimes granted?

The remedy for this state of affairs lies in the adoption of a classification which shall classify according to mechanical constructions and the generic functions of machines and devices.

Thus machines for *cutting* fabric, whether cloth, leather, or paper, would, under this classification, all be assembled in one division or class. All riveting machines, no matter upon what material they operate; all knives; all pegging and nailing machines; all rolling machines; and all chains, would be classified under their respective generic classes, such as cutting machines, riveting machines, nailing machines, knives, chains, etc.

This classification would result in the grouping of inventions of analogous constructions and generic functions in a single division of the office and would reduce to a minimum the possibility of issuing duplicate patents. This would arise from the fact that, these generic devices all being in one division, the examiners would become more familiar with them, resulting in more certain and thorough examinations being made.

The time now spent by the examiners running around to many different divisions would be saved and utilized in the work of examining, thus materially aiding the advancement of the work of the office.

Of course it is realized that it would be almost impossible to devise a classification which would entirely do away with the overlapping of the classes, but the one suggested, it is thought, would reduce such overlapping to a very small per cent.

A change must at some time be made, for it is becoming more difficult every year, with the enormous increase in the issue of patents, to make thorough examinations.

It is realized that any change must necessarily be made gradually, in order not to greatly interfere with the work of examination; but with a competent force it could be done in a comparatively short time without retarding the work of the office.—T. H. A. in the *Scientific American.*

THE CAMERA FOR CELESTIAL PHOTOGRAPHY.

BY S. W. BURNHAM, LICK OBSERVATORY.

Every possessor of a good rectilinear lens and the ordinary landscape camera may not be aware of the fact that he has the best kind of an instrument for making pictures of the sky. The requirements in a lens for landscape photography are exactly the same as those which have to be considered in the department of celestial photography. About the same angle of aperture is desirable, and in a general way, the same class of lens as in landscape and outdoor photography. To get a satisfactory picture of a portion of the heavens at night, as we see it with the naked eye, the picture should include an angle of not less than 30° or 40°. There is this difference between terrestrial and celestial pictures: in the former we rarely get as much as we can readily see with the naked eye from the point where the picture is taken, while in the latter we can easily get infinitely more by prolonging the exposure. If the exposure is much extended in daylight work, the plate is hopelessly fogged, and instead of increasing the details in the darker portions of the picture, nearly all delicate details are lost, and the negative becomes flat and valueless; but with the plate exposed to the dark sky of a clear night, where the light emanates only from minute points, the exposure may be continued for hours, and when the plate is developed it will be almost clear glass except where those specks of light have made their impression. Negatives of this character possess this unique peculiarity, that no matter how long the exposure may be continued, they are always under-exposed with reference to the great majority of the stars shown; and at the same time, unless the exposure is very short, they are over-exposed with regard to the brighter stars visible to the eye. The longer the exposure, the more stellar points we get on the plate, and this could probably be continued far beyond the time one would be likely to give to the following of the stars, as they move across the face of the sky.

Almost every amateur photographer has a lens and camera well adapted to do this work, but unfortunately not many have the means of mounting such an instrument so as to hold the stars fixed on the plate during the necessary time of the exposure. For this purpose an equatorial mounting, driven by clock work, is indispensable. In other words, the photographer must have the use of an equatorially mounted telescope of some kind, with a driving clock so adjusted as to compensate for the revolution of the earth on its axis, and keep the camera and the stars relatively fixed, the telescope itself being used as a sort of a finder, to keep the star selected for following exactly in the same place in the instrument, by changing the position of the telescope and the camera attached to it, with the slow motions with which all such instruments are provided. No driving clock, however perfectly made and adjusted, can be trusted to hold the star exactly on the fine wire or spider web in the focus of the telescope for any considerable length of time. This must be done by watching the finder, and whenever the star shows a tendency to get ahead or fall behind the bisecting wire, bringing it back to position by the slow motions which move the instrument independently of the clock. Everything depends on careful following and keeping the images of the stars all the time on exactly the same places on the plate. If this is not attended to, the stars will be elongated in the direction of their motion across the plate, and the negative will be unsatisfactory for any purpose. In addition to this, the fainter stars will be lost by the images spreading over the greater area on the plate. If the following is perfect, and the camera is accurately focused, the smaller stars will be exceedingly minute specks, and if the exposure is an hour and upward, there will be thousands of these tiny points scattered over the plate where perhaps only a score or two of stars are visible to the naked eye, while not a dozen of them could be seen at all on the ground glass of the camera.

Of course not many photographers have the necessary facilities for making pictures of this kind. If, however, some friend or good-natured astronomer has a small telescope of the kind referred to, which can be made available, the thing is easily managed. The camera can be strapped or tied to the tube of the telescope in a few minutes, and then everything is ready to proceed with the exposure. The camera should be focused previously with the utmost care, using the full aperture on a well-defined distant object, and then marked or clamped in such a way that nothing can be changed when the camera is attached to the telescope. It is almost indispensable that the full aperture should be used if the exposure is to be continued long enough for the fainter stars, as otherwise the time would be greatly increased, with very little corresponding gain. Any good rectilinear lens will give sharp images over a sufficient portion of the plate, provided it is accurately focused. In most uses of the lense this is not an important matter, because any ordinary error is corrected by the use of stops, but in stellar pictures a small error in the position of the lens will utterly spoil a plate which otherwise would have been entirely satisfactory.

It will be found very convenient to have one of the common simple shutters attached to the camera lens, with a tube and bulb running down to the eye piece, so that the lens can be closed in an instant if anything goes wrong. The clock may need winding, and the dome shifted from time to time, and, although with a good driving clock the observer can leave the instrument long enough to attend to such matters, it is safer to be able to shut off the light in the event of the clock stopping, or any accident occurring. Then the instrument can be brought back to the original place, and when everything is all right, the exposure continued as long as may be desired.

It is perhaps now generally known that the exquisite pictures of the Milky Way, and other portions of the heavens, made by Professor E. E. Barnard, of the Lick Observatory, were made with an ordinary portrait lens tied to the tube of a six inch telescope. These pictures have never been excelled by any one, and rarely, if ever, equalled. They show, as pictures taken with no photographic telescope could, the wonderful structure of the invisible heavens, with the millions of stars lying beyond the reach of the unaided eye. The number of individual stars shown on a single 8×10 plate, and that of a region not in the Milky Way, in which but few stars are seen with the eye, is estimated to be not less than 60,000. This required an exposure of about four hours, using an aperture of about one-sixth of the focal length of the lens. Such pictures require the greatest care in making the exposure, and extreme skill in developing the plate to get the best results. But very interesting pictures can be made in less time. With an hour or an hour and a half, a vast number of telescopic stars will be shown, and such a negative of a prominent constellation, like Orion or Ursa Major, will repay the amateur for all the trouble it may cost to get it. Lantern slides from such negatives are more wonderful and interesting than any other stellar photographs. When thrown upon the screen, it is difficult for many to believe that such a wilderness of stars could be really photographed with a lens through which not one in a thousand could be seen on the ground glass.—*Anthony's International Annual of Photography*, 1891.

THE INSPECTION OF STEAM BOILERS.*

Let it be clearly understood that if there were no steam generators using steam under pressure there would be no boiler inspection, and no licensing of engineers; it requires no license to be a machinist or a machine tender, no more would a license be essential to run a steam engine, except it were connected with the boiler. The danger to the public arising from their use requires that the care and management of high pressure steam boilers shall be in hands of careful, experienced and naturally ingenious men, hence it is on the affairs of the boiler room that the first tests are made, as to the worthiness of an aspirant for an engineer's license, hence too, the success of many firemen in obtaining the preference over engine-boilers or school graduates, in the line of promotion as steam engineers.

The inspection laws of the various states and cities are framed after substantially the same leading ideas, and in presenting one, the others may be assumed to be nearly the same.

The special province of the Steam Boiler Inspection and Engineers' Bureau in the police department, in New York City, is to inspect and test all the steam boilers in the city, at certain stated periods, and to examine every applicant for the position of engineer as to his ability and qualifications for running an engine and boiler with safety.

According to the laws of the State, every owner, agent or lessee, of a steam boiler or boilers, in the city of New York, shall annually report to the board of police, the location of said boiler or boilers, and, thereupon, the officers in command of the sanitary company shall detail a practical engineer, who shall proceed to inspect such steam boiler or boilers, and all apparatus and appliances connected therewith.

When a notice is received from any owner or agent that he has one or more boilers for inspection, a printed blank is returned to him stating that on the

* From Maxims and Instructions for the Boiler Room, Part V. Published by Theo. Audel & Co., 91 Liberty St., New York. Price 25 cents each of ten parts.

day named therein the boilers will be tested, and he is asked to make full preparation for the inspection by complying with the following rules :

Be ready to test at the above named time.

Have boiler filled with water to safety valve.

Have 1½ inch connection.

Have steam gauge.

Steam allowed two-thirds amount of hydrostatic pressure.

More particularly stated, the following have been adopted by one or more Inspection Companies.

HOW TO PREPARE FOR STEAM BOILER INSPECTION.

1. Haul fires and all ashes from furnaces and ash pits.

2. If time will permit, allow boiler and settings to cool gradually until there is no steam pressure, then allow water to run out of boilers. It is best that steam pressure should not exceed ten pounds if used to blow water out.

3. Inside of boiler should be washed and dried through manholes and handholes by hose service and wiping

4. Keep safety valves and gauge cocks open.

5. Take off manhole and handhole plates as soon as possible after steam is out of boiler, that boiler may cool inside sufficiently for examination ; also keep all doors shut about boilers and settings, except the furnace and ash pit doors. Keep dampers open in pipes and chimneys.

6 Have all ashes removed from under boilers, and fire surfaces of shell and heads swept clean.

7. Have spare packing ready for use on manhole and handhole plates, if the old packing is made useless in taking off or is burned. The boiler attendant is to take off and replace these plates.

8. Keep all windows and doors to boiler room open, after fires are hauled, so that boilers and settings may cool as quickly as possible.

DIAMONDS IN METEORS.

BY H. C. HOVEY.

A remarkable paper was read at the Washington meeting of the A.A.A.S., by Prof. A. E. Foote, of Philadelphia, describing a new locality for meteoric iron near Canon Diablo, Arizona, fragments of which contained diamonds. The report at first was that a vein of pure iron, two miles long and forty feet wide, had been found, containing also gold, silver, and lead ; and that surface iron could be gathered by the carload. That was in March of the present year. Prof. Foote explored the region thoroughly in June, without finding any such vein ; but what he did find was of great geological and mineralogical interest.

Crater Mountain, 185 miles north of Tucson, is a peculiar circular elevation, strikingly like an old crater. It rises 432 feet above the surrounding plain, and its cavity is three-fourths of a mile in diameter. Its interior walls are so steep that animals once entrapped within them never escape, but leave their bleached bones at the bottom. The rim of sandstones and limestones, is uniformly uplifted on all sides at an angle of 40°, while the bottom lies at a depth of from 50 to 100 feet below the general level of the plain. Although the cavity is thus crateriform, no lava, nor obsidian, or any other volcanic product was found. Small meteoric fragments were scattered over an area about a third of a mile in length and 120 feet wide, and extending northwest and southeast. Exactly in line with it, but about two miles from the base of the crater, were found two large masses, one weighing 154 pounds and the other 201 pounds, which were on exhibition, both of them deeply pitted, and the larger one perforated in three places. The latter is now the property of the Ecole des Mines, Paris. Small masses were also found, numbering 131 in all, ranging in weight from one-sixteenth of an ounce to 6 pounds ten ounces. Several of them were coated with arragonite. About 200 pounds of angular sulphureted fragments, also of meteoric origin, were found near the base of the crater, a few of which showed a greenish stain from oxidized nickel.

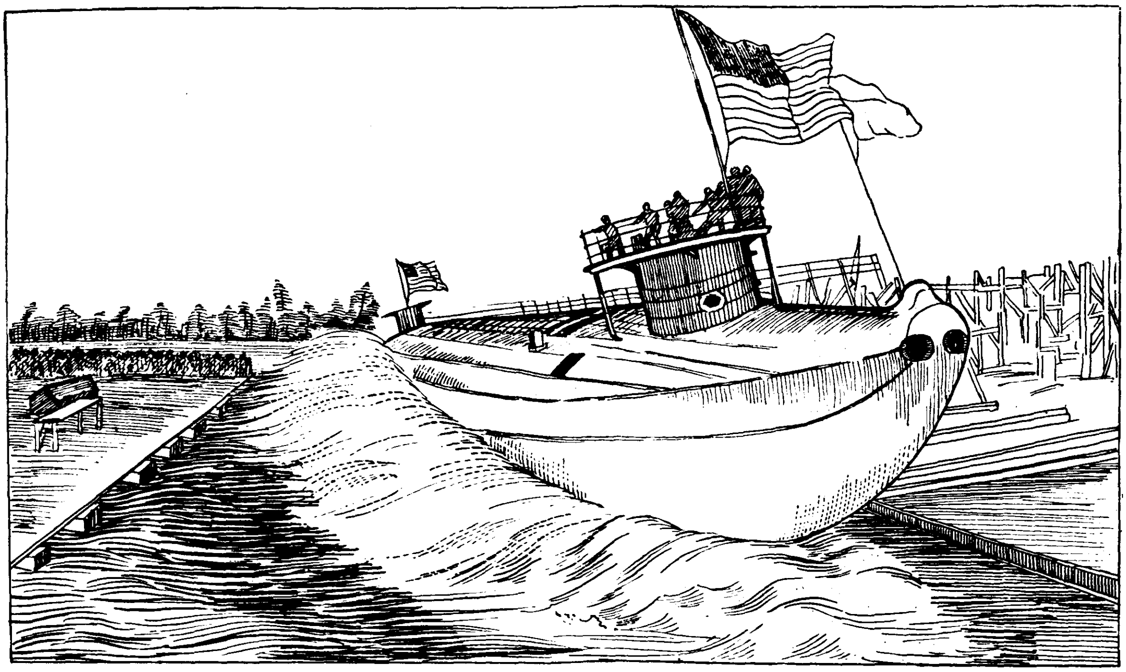
A fragment of a mass weighing 40 pounds was examined by Prof. G. A. Koering, who found it to be extremely hard, a day and a half being taken in making a section and several chisels being broken in the operation. An emery wheel was ruined in trying to polish the section. This led to closer inspection of certain exposed cavities, where small black diamonds were found that cut polished corundum as easily as a knife might cut gypsum. These diamonds are mineralogically of great interest ; the presence of such in meteoric having been unknown till 1887, when two Russian mineralogists found traces of diamonds in a meteorite mixture of olivine and bronzite. By treating with acid the amorphous carbon in the cavities a small white diamond, one-fiftieth of an inch in diameter, was found as well as troilite and daubreelite. The general mass was three per cent nickel. The Widmanstattian figures were not regular. The indications are that a large meteorite, weighing about 600 pounds, had become oxidized in passing through the air, and burst before reaching the earth. It is hardly credible that the crater could be accounted for by meteoric impact, and its origin is a problem unsolved. The fact of special interest may be accepted as proved, that diamonds have been found in meteoric fragments. The specimens were carefully examined by the geologists present at the reading of Prof. Foote's paper, and while there were many opinions expressed as to the so-called "crater," and as to its relation to the meteor, none doubted the genuineness of the diamonds.—*Scientific American*.

PILE DRIVING BY JETS.

Mr. Edward Hurst Brown gave a description before the Engineering Club, of Philadelphia, of the application of a water jet to the driving of piles for the board walk at Atlantic City, N. J.

The water was brought from the city water supply in a 2 inch pipe, extending along the line of the work. To the end of this pipe (which was extended as the work progressed) was attached a 30 foot length of rubber fire hose terminating in an ordinary brass nozzle about 4 feet long, with an opening of 1¼ inches.

The piles were swung into position by a rough but light tripod, provided with block and fall, and



LAUNCHING OF THE "JOSEPH L. COLBY," AT SUPERIOR, WIS.

steadied in place by the foreman, while one of the men held the nozzle of the hose vertically and close to the foot of the pile. Under the action of the jet, the pile was lowered into position almost as fast as the men could pay out the rope, the nozzle following it down.

To drive a pile from 6 to 10 feet into the compact beach sand required only from 30 seconds to 1 minute from the time the water was turned on the foot of the pile until the pile was finally fixed in position, the hose withdrawn, and the tripod removed.

The instant the hose was withdrawn, the sand packed at once around the pile, holding it, apparently at least, as firmly as if driven by a ram in the usual way. Should a pile be driven too far, it is easily raised while the jet is on.

The jet process has been successfully used in other parts of New Jersey, in some places through coarse gravel with stones 8 to 10 inches in diameter, but in such cases, of course, the sinking is less rapid than the beach sand.

When a city water supply is not at hand, a steam force pump is used.

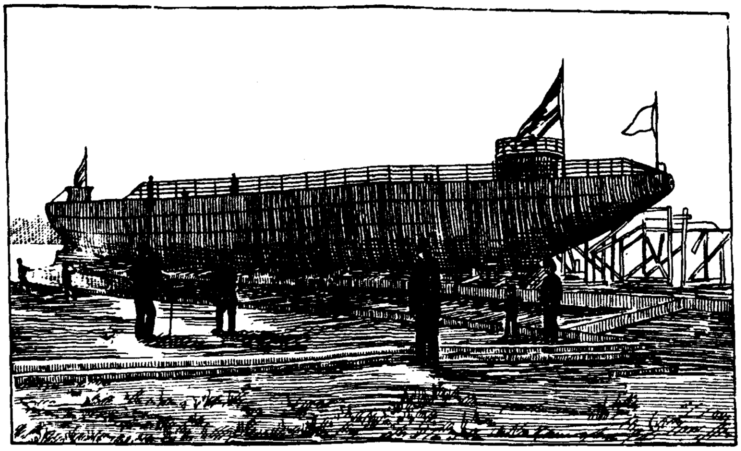
In sinking pipe wells the pipe itself may be used for the jet, but the separate nozzle appears to be preferable.—*Scientific American.*

THE McDOUGALL WHALEBACK STEEL VESSEL.

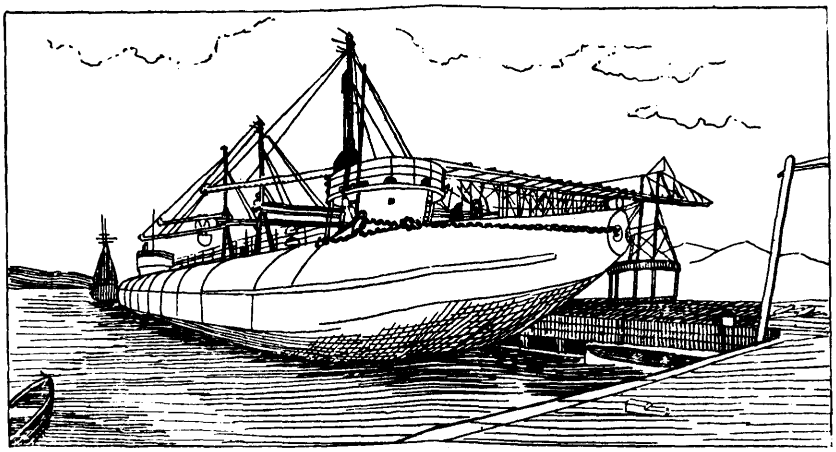
The old ballad commencing "In the North Sea Lived a Whale" has its use now in a facetious adaptation of this line to the needs of a souvenir issued by the people of Superior, Wis. in commemoration of the launching of the first two vessels of the McDougall whale-back pattern, built at the shipyard in that city, an event that took place on the afternoon of the 15th of November last. The two boats went into the water sideways, and floated in their slips as if they were in their natural element.

The somewhat surprising information to an Atlantic coast seaman is contained in the recent report of the Commissioner of Navigation, in which it is stated that the registered tonnage of the vessels inspected on the Great Lakes for the year ending October 1 was in excess of the tonnage of those inspected on the Atlantic coast, and also in excess of the tonnage of those inspected on the Pacific and Gulf coasts and all the rivers of the United States combined. The development of the shipping interests upon this arm of the Atlantic within the past three years has certainly been marvelous, and is a vast testimonial to the importance of that inter-state commerce which is largely the product of the past thirty years. Less than ten years ago a steam propeller of 1,200 tons registry was a large carrier upon the Great Lakes, and its carrying capacity was generally limited to about an even tonnage with it registry by the cumbersome power used and the amount of internal "works" deemed necessary to give it strength and solidity. But since 1885 the size of the lake steamer has gone up as high as 1,900 tons registry, and with a common though varying carrying capacity of from 2,000 to 3,000 tons, with some vessels of 4,000 tons capacity.

The sailing vessel is rapidly passing into the limbo of forgetfulness, and the deep and fast steamer is gathering to itself the business of the lake carrying trade. The lumber traffic still adheres to the sailing vessels, but iron ore, coal, wheat, flour, and merchandise go to the steamers for low rates and quick transit. And the present tonnage of the lakes is kept in an absorbing chase of distances by the enormous traffic turned over to the vessels by the railroads at deep water terminals like Chicago, Buffalo, and Superior.



THE "COLBY" IN DRY DOCK.



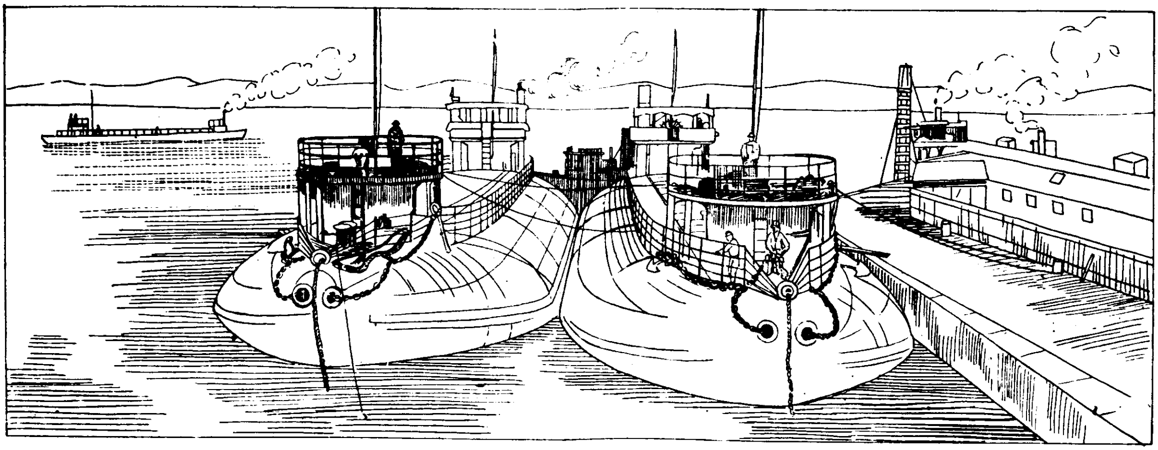
WHALEBACK BARGE NO. 104.

In the mad rush of invention upon the land, marine architecture was allowed for a quarter of a century in this country to suffer somewhat. Land transportation absorbed all the powers of men's invention. But it was only a slumber for a season. Cheap transportation between the East and West became so important a factor that human nature could not resist the pressure, and so it happens that from the deep water's end in the middle of this continent, where land and water have their final junction, so to speak, from the head of Lake Superior, within dinner call of the farmers of Minnesota and Nebraska comes the latest and most wonderful innovation on marine architecture that has met the waters since Fulton's steamboat was put afloat. Alex. McDougall, of Superior, Wis., an old lake vessel master and agent, is the inventor, and is now at the head of the practical operations of a ship yard, at that place which has keel blocks for the simultaneous construction of ten steel vessels, and from which the American Steel Barge Company, the owner of the plant and patents, expects soon to turn out 52 vessels per year, or one each week.

These vessels are built both as tow barges and as steam propellers. The first boat of the fleet (there are now eleven afloat), the tow barge "101" a small craft of 437 tons registry and 1,400 tons carrying capacity, excited unlimited ridicule and amazement among lake vessel builders, but her cost was only $45,000, and in two seasons she has netted her owners $70,000, in the face of active competition, so that the laugh is now differently located. This boat was built in the summer of 1888, and was immediately denominated "the pig" by vessel men—a name that clings to all of her kind.

The first steam propeller, the Colgate Hoyt (named after the president of the American Steel Barge Company), was built in the winter of 1889-90, and has been in successful commission during the season of 1890 in the ore, grain and coal carrying trade between Superior and Lake Erie ports. She carries 2,800 tons of iron ore on a 15 foot draught, and readily makes 12 miles an hour with a tow barge in charge carrying 2,400 tons.

The Joseph L. Colby, launched November 15, is a somewhat smaller vessel than the Colgate Hoyt, being designed for passage through the Welland Canal and St. Lawrence River to Montreal. Her dimensions are as follows: Length over all 265 feet, width of beam 36 feet, depth of hold 22 feet. All subsequent steamers of this pattern will be built 38 feet beam and 24 feet depth of hold.



TWO WHALEBACK BARGES.

The two barges 102 and 103 are of 1,132 tons registry and 3,000 tons carrying capacity; the tow barges 104, 105, 107, and 109 are each of 1,216 tons registry and 3,300 tons carrying capacity.

The Colgate Hoyt is registered at 1,008 tons, and 3,000 tons carrying capacity, with a speed of 15 knots per hour on 800 horse power. This statement will be understood when it is said that the fine steamers on the lakes of 1,800 tons registry, 15 knots speed and 3,000 tons carrying capacity, require 1,600 horse power for their work.

The "whalebacks" are all built upon the same pattern. They are round decked, flat bottomed, and ended up like the pointed end of a cigar. The wheel house on the tow barges is in a mere turret, and the men's quarters (it takes five to man one of them) are under the wheel house. On the steamers, the cabin and wheel house are set up on three turrets. These are the peculiarities that make of these boats a complete revolution in ship building. There is no ponderous bulk above the water to catch and fight the sea in a storm. The water washes over them, not against them. The round deck may make of them the most formidable naval vessel ever built. The flat bottom may make of them famous river boats.

The ship yard at Superior has six "slips" and ten piers or ways for keel blocks, so that ten of these boats can be under construction at one and the same time. And Manager McDougall speculates with some enthusiasm upon the fleet of "steam pigs" which he will send to the St. Lawrence in the fall of 1891 to engage in the Atlantic coasting trade for the winter season.

There is at present a whaleback tow barge lying on a dry dock in New York City, that was constructed at the Erie Basin for the coast and river trade, while two McDougall propellers are expected here in a short time, one of which is to be sent across to Liverpool, and one to Puget Sound on the Pacific coast.—*Scientific American.*

POINTS ON OIL ECONOMY.

To a concern employing machinery to any considerable extent, the question of oil consumption is one of the utmost importance. Carelessness in the purchase, on the one hand, or intelligent judgment based on tests on the other, in the case of this article alone, may suffice to tip the scale of fortune toward deficit or profit. There are various requirements that a good machinery oil must fill. It must be a good lubricant, must not gum, must have the proper body for the use to which it is put. That is, a heavy engine oil should not be used alone on dynamo bearings. We may mix it with paraffine to get the proper body, or better, use paraffine alone. Vice versa, a paraffine should not be used on heavy engine bearings. In the old days of animal oils, gumming was a constant source of trouble. Bearings had to be taken apart periodically to be cleaned. With the use of petroleum oils now-a-days we seldom have any such trouble.

There are many forms of apparatus designed to test these essential requirements of oils, some very complicated. A favorite and simple device is called the viscosimeter. It consists merely of a glass tube, graduated to hold a certain quantity of oil, with a small orifice at one end, designed to let the oil escape in drops. The length of time necessary for the oil to pass out through the orifice, as compared with the length of time necessary for some other oil to do the same thing, furnishes a comparison of the relative viscosity of the oils. People making this test take viscosity as their criterion, and assume that lubricating quality varies directly as the viscosity, which is perhaps true, though the tendency to gum is made no account of in this method of testing. For testing lubricating quality there are Thurston's machine, Tower's, etc. An extremely simple and efficient form of apparatus has been used by the writer for several years in a great number of experiments, with entire satisfaction. It consists of a shaft $2\frac{7}{16}$ inches diameter, revolving at any desired speed. A standard bearing is used for all oils, say a good brass. The weight is applied equally on the ends of a balanced equal-arm lever. Now then, the experiments may be performed in two days. A given quantity, or so many drops, of oil may be furnished the bearing, and the time noted which it takes for a thermometer inserted in a quarter-inch pipe screwed into the top of the bearing to show a given temperature. This gives us the resistance to heating of the oil, which varies according to its lubricating qualities. Of course the lever must be kept level, and to do this we place at a known distance from the center of the shaft a support resting on delicate scales. This support serves to keep the apparatus from overturning, and by the scales gives the moment of the friction. From the scale reading by a simple equation the co-efficient of friction of the oil, or its value as a lubricant, can be computed.

Another way that may be followed is to supply the bearing with constant lubrication by pressing against the shaft directly under the standard bearing, a quantity of waste kept saturated with oil by partial immersion in an oil cavity. A suitable arrangement may be run out of lining-metal, or be made of a wooden block hollowed to fit the shaft. This apparatus gives reliable results. Oils varying in price and true worth by only a cent per gallon, may be selected every time with accuracy. In the present state of unreliability of oils some such means of testing is indispensable. —By F. B. Flint in the *Mechanical News*.

POPULATION OF BRITISH CITIES.

The populations of some of the principal English towns, 1881 and 1891, are given below. The rates of increase between the two periods in the several towns are also given. It will be noticed that in Liverpool only is there a decrease since 1881:

	1881.	1891.	Increase per cent.
London	3,815,544	4,211,056	10·4
Liverpool	552,508	518,000	*6·2
Manchester	462,303	505,300	9·3
Birmingham	400,774	426,200	7·1
Leeds	309,119	367,500	18·9
Sheffield	284,508	324,200	14·0
Bristol	206,874	221,700	7·2
Bradford	194,495	216,300	11·2
Nottingham	186,575	212,000	13·6
Salford	176,235	198,800	12·4
Newcastle	145,359	186,300	28·2
Hull	165,690	183,800	10·9
Portsmouth	127,989	159,200	24·4
Leicester	122,376	242,100	16·1
Oldham	111,343	131,500	18·1
Sunderland	116,542	130,000	12·3
Cardiff	82,761	128,900	55·7
Blackburn	104,014	120,100	15·4
Brighton	107,546	115,400	7·3
Bolton	105,414	115,000	9 1
Preston	96,537	107,600	11·4
Norwich	87,842	100,900	14·9
Birkenhead	84,006	99,200	18·1
Huddersfield	86,502	95,400	10.3
Derby	81,168	94,100	16·0
Plymouth	73,794	84,200	14·1
Halifax	73,630	82,900	12·5
Wolverhampton	75,766	82,600	9·0

*Decrease.

YET ROOM FOR INVENTIONS.

Of all the sack-tying devices, none has proved of practical utility to the extent, at least, of supplanting the old fashioned way of tying with a string. A good sack tie would take wonderfully.

The man who invents a slow-moving feeding device for roller mills that will feed any sort of material, coarse or fine, heavy or light, will have a fortune. Of course it is claimed that there are several on the market, but there are not. Saying nothing disparaging of the many excellent machines for the purpose, they either do not do the work on soft stuff or else they run so fast that they are defective as to long life in good condition. The inventor that can get up a slow-moving, perfect feed-regulating machine will have a fortune.

In building a mill it is the case too often that not enough attention is given to the height according to the breadth. This is sure to result in too many elevations and too many choking spouts. All of which means a hard mill to run, a mill that reduces stock, improperly, by elevator and conveyor friction, and a fuel consumer to no advantageous purpose.—*The St. Louis Miller*.

PATENT RIGHTS AND WRONG.

The London *Journal of Gas Lighting*, in a recent issue, gives a review of the present patent systems, from which we abstract the following:

The British trick of grumbling at everything, and incessantly tinkering away at every established system with a view to keeping it up to popular requirements, is apparently as foreign to the American as it certainly is to the French spirit. The condition of the great American patent system is an example in point. Those who praise it in the extravagant way sometimes heard know nothing about its practical operation. As a matter of fact, it is extravagantly costly to the country, if not to the patentees, and but that any excusable outlet for revenue is desired by the Federal government, the working of the Patent Office would be speedily overhauled. The system of prior examination, of which apologists make so much, is utterly useless, since no guarantee is attached to it, and it only causes vexatious delay in obtaining protection, besides being very expensive. Then the absence of any machinery for removing merely obstructive patents has been already remarked.

The British patent system is anything but perfect, but then nobody pretends that it is. The American system is full of defects, and it is considered treasonable to hint at the existence of a single blot upon it.

We in England have not yet been persuaded by Sir Frederick Bramwell, and by those who think with him in this matter, that patented inventions are absolutely unmixed blessings, and that to invent something patentable is the first duty of man. Indeed, the day of cheap patents in which we now live has brought into prominence certain aspects of patented inventions which are not altogether pleasing to individuals or wholly subservient to the best interests of the community.

The facility with which patents can now be obtained is fostering a novel description of public nuisance—the patentee of "unconsidered trifles," several illustrations of whose vagaries have been recently brought to our notice.

A business firm will patent a variety of construction which other people would regard as a trifle or as common property.

There is yet a hazy impression upon the public mind—the remainder from an earlier state of things—that a patent article must somehow be better than one which cannot be so described. This superstition is fast dying out—thanks, mainly to the indiscriminate traders who have worked it to death by dubbing everything they sell "patent," merely by way of excuse for their dearness. Until it is quite gone, however, it is clear that a trader has a perfect right to take what advantage of it he can, by patenting all sorts of things merely for the sake of being able to advertise them as such. Thus, for example, if a stove manufacturer discovers, in the ordinary course of business, that a "patent" stove is looked upon with more favor by purchasers simply on account of this designation, he can hardly be blamed for patenting anything and everything of this class which can be made to pass muster at the office. This is a very different thing, however, from a patent for a method of constructing an engineering work, intended to restrict the liberty of designers, and make them ask permission of the patentee to be enabled to do their work in their own way. This is what we have styled a patent outrage.

When a man has invented a new and improved way of doing anything, it is but right and reasonable that he should have at least the credit for the suggestion, and as much profit as the idea can bring him. But for a man to appropriate, by the complaisance of the Patent Office, a notion which is neither better nor worse than many others of the same class or a device which is rather an alternative to ordinary methods than an improvement upon them, and to make this appropriation a means of tying the hands of designers who do not seek to captivate the market, but only to do their work after their own fashion, is a piece of impertinence that requires checking before it grows commoner than it is. It may be asked how the line is to be drawn in this regard between what is a distinct improvement and what is merely an alternative. But the distinction, if not easily defined, is easy to understand. If, for example, a gas engineer wishful to erect a gas holder is informed of a method whereby the work may be done at considerable saving of expense or of time, he may be willing to pay a reasonable proportion of the estimated saving for the privilege of using the new method, and will not object to it as being temporarily private property. Should he, on the other hand, propose, for his convenience, to make a change in the design, which is of no particular advantage in itself, he will naturally be wroth when told that some gas holder maker has appropriated the idea, and will either grant him a license to use it, for a consideration, or will graciously waive the claim upon securing the contract for the erection of the holder. This is the sort of thing that inclines people to ask whether, after all, a patent system is not of more harm than good to the public.

NERVES AND NARCOTICS.

In the May number of the Breslau *Deutsche Revue*, reproduced in the *American Analyst*, Dr. Adolph Seeligmuller discusses the universal subject of nerve troubles as follows: Excessive, exhausting, and too long-continued work, insufficient or irrational recreation, and deprivation of the right amount of sleep are some of the main causes for the increase of nerve troubles in our day. The competition in all the professions and callings is so great that for every person whose powers fail, ten are ready with fresh strength to perform the same or greater labor for the same or even a smaller remuneration. All exciting and weakening amusements should be done away with, and the quiet joys of family intercourse, the conversation of intimate friends, and sociable walks in the fields and woods should take the place of brilliant evening assemblies. Then every person should pursue some agreeable occupation besides his regular profession, and in the latter he ought to have frequent hours of relaxation to relieve the strain. Mental application, even for healthy adult persons, ought not to be continued for more than three or four hours at a time, and nightwork it would be best to avoid altogether, as the excitement is apt to interfere with sleep.

All who follow intellectual pursuits ought to have several weeks of complete rest at least once a year. Sleep is, however, the principal agent of recuperation. The amount of sleep needed is different for different persons. For the ordinary worker from six to eight hours is absolutely necessary; yet how often, in the battle for existence in our time, is the desire for sleep forcibly suppressed and the night's rest improperly shortened. Sooner or later insomnia wreaks its vengeance on the offender. Many a person who once robbed himself of the necessary amount of sleep would gladly sleep now, but cannot. I do not hesitate to say that nerve troubles first develop into disease when joined with sleeplessness. It appears as a latter symptom of a long-standing nervous disturbance, but to the lay mind it appears as the first sign of disorder, and is frequently taken to be the cause. The worker of the nineteenth century works beyond his strength, and in order to keep it up he resorts to stimulants—coffee, tea, spices, alcohol, tobacco. These produce a super-excitation of the nerves, which brings in its train insomnia; and to overcome this he resorts to narcotics. The life of many of our contemporaries consists in taking artificial stimulants to enable them to perform their work, and then resorting to powerful narcotics that can counteract the artificial stimulation and produce rest and sleep.

Any one can see that this alternation of stimulation and depression at least once every twenty-four hours must weaken the nervous system. Coffee is a powerful stimulant for the heart, and, therefore, those who suffer from palpitation, from hysterical conditions, or from insomnia should avoid its use. Tea in day time acts more mildly on most people; but taken evenings it drives away sleep. The spices are less active nerve stimulants; yet pepper, especially, and some of the others affect the nerves of the digestive organs powerfully, and their liberal use in modern cookery has something to do with the epidemic insomnia. Of the injurious, the actually destructive effects of alcohol taken in excess little need be said. We physicians are not a little to blame in that we insist on giving large quantities of alcohol in fevers and conditions of exhaustion, not to speak of the methods used to cure the morphine habit, until patients often acquire the drinking habit. The evil results of the abuse of alcohol are not often apparent. Long before *delirium tremens* or other serious brain diseases appear, they are preceded by manifold nervous disturbances, the real cause of which is not often understood. I have frequently found that rheumatic pains that were ascribed to a cold were nothing but alcohol neutritis, a mild form of inflammation of the nerves resulting from the use of alcohol, which disappeared when the practice was given up, only to return with the slightest repetition of the indulgence. Most habitual drinkers, and some of them very early, are subject to changes in the vascular organs, such as fatty degeneration of the heart and arterio-sclerosis, which lead to grave affections of the nervous system, like apoplexy and softening of the brain. Finally, it may be taken as proved that the children of drunkards, if they are not carried off prematurely by brain troubles, are frequently afflicted with serious nervous ailments, such as epilepsy, idiocy, and the like.

Tobacco has come to be in our time a national poison in many countries, and most especially in Germany. As sequels of chronic nicotine intoxication may be noted without fear of contradiction: Palpitation and weakness of the heart; irregularity of the pulse, of which heart pang or *angina pectoris* is an acute symptom; general nervous debility; tremulousness; disturbances of vision, even to the point of blindness; and hypochondriacal depression even to the degree of melancholia. The fear-inspiring intermission of the pulse is a freqnent cause of inveterate insomnia. That the children of heavy smokers suffer with uncommon frequency from nervous diseases is an established fact.

And now for the narcotics, at the head of which stands morphine. The great danger of falling into the habitual use of this drug arises from the cowardice and degeneracy of our times. No one will suffer pain, no matter how slight or transitory. Not a tooth can be drawn, not a child born into the world without the use of an anodyne, and when death comes we must have euthanasia. It is said that many physicians lend their hands too willingly and are ready with the injecting needle to check a pain that could easily be borne, not reflecting that it is immoral to encourage effeminacy and a dangerous thing to plant the germ of the morphine habit, a terrible passion that leads inevitably to physical and spiritual debility and to death. The same is true of the constantly increasing cocainism and hasheesh intoxication. Our generation demands above everything narcotics to produce the sleep that first we drive from us, and afterward so fondly desire; opium, morphine, chloral, bromide of sodium, paraldehyde, hydrate of amyl, urethan, sulfonal, hypnon, somnal, and whatever are all their names—one would think names would soon give out, so fast are these children born. But how can we sleep without resorting to soporifics? Just as the life of the soul during the day is reflected in dreams, so the conditions of sleep are determined by all that we do when awake. The chief rule is to so act waking that you can sleep. Begin by accustoming yourself to do without excitants. Many a case of sleeplessness I have seen yield, when all other means failed, to restricting or totally abandoning for a time the use of spirituous drinks, coffee, tea, and tobacco.

There is a tower in Tokio, Japan, in which the tourist is carried skyward on an electric elevator.

GUTTA PERCHA.

The price of gutta percha has nearly doubled in two years, and now rules at $1.30 per pound. This remarkable advance in the price of the article is attributed to two causes—the large quantities required in the manufacture of electric and other modern devices and the reckless destruction of the trees from which the gum is obtained. Gutta is the Malayan term for gum and percha is the name of the tree from which it is obtained; therefore the name may be translated, gum of the percha tree. This gum or sap is not obtained by merely tapping the trees, as is done by the gatherers of crude rubber along the Amazon and its tributaries, but the Malays and natives of Borneo who collect gutta percha fell each tree from which gum is to be extracted, and thus the destruction of the trees and consequent scarcity of the product is explained. From 1854 to 1875, 90,000 piculs, weighing 133⅓ pounds each, of gutta percha were exported from Sarawak alone, and this meant the death of 3,000,000 trees. As no trees are planted, the only thing which has saved this species of plant from annihilation is that it does not produce the gum in paying quantities until it is twenty-five to thirty years old.

The method pursued in felling the trees is as follows: A staging is erected from fourteen to sixteen feet high, which enables the workman to cut the trees just above the buttresses or banees as they are called. The tools used in felling are either "billiongs" or "parangs." A billiong is a kind of axe used by the Malays in felling, building and the like. The blade is of a chisel-like form, and the tang is secured at right angles to a handle by means of a lashing of rattan or cane. The parang looks more like a sword bayonet, and in the hands of a Malay is said to be a box of tools in itself, as with it he can cut up his food, fell a tree, build a house or defend himself. After the tree is cut down, some natives beat the bark with mallets to accelerate the flow of the sap, which usually runs slowly, changing colour meanwhile. It concretes rapidly.

The sap is boiled either with water, lime juice, or cocoa nut oil, and it is generally run into moulds which sometimes produce forms of the hardened material resembling various animals in shape.

The gutta percha tree, the vernacular name of which is taban, also bears a fruit about an inch long, ovoid in shape, which is eaten by the natives. In Siak, Sumatra, a vegetable butter is prepared from the seeds of this fruit The trees attain to a height of from 60 to 80 feet, with a diameter of from 2 to 4 feet. The wood is soft, fibrous, spongy, of a pale colour, marked with black lines, these being the reservoirs of the gutta percha. The yield of a well-grown tree of the best variety is from 2 to 3 pounds of gutta percha, such a tree being about 30 years old, 30 to 40 feet high, and 1½ to 3 feet in circumference.

Gutta percha is used in a multitude of different ways. It has been found to be the best non-conductor of electricity and most perfect insulator that has yet been discovered. A wholesale dealer in the article recently stated that scarcely a week passes but some one calls upon him claiming to have found a substitute for gutta percha, but none of the substitutes so far offered has been able to meet the requirements.

No other substance has been found so efficient for submarine cables, and according to a statement recently published in the New York *Sun*, the Atlantic cable laid in 1857 is still preserved by its gutta percha covering.

This article retains its form at a temperature below 115° F. It is insoluble in water, even in salt water, and it is also insoluble in alkaline solutions and various acids, and is, therefore, made into vessels to contain these substances. By mixing bisulphate of carbon with gutta percha, a liquid cement is produced which is employed in putting patches upon shoes, thus dispensing with sewing and securing a neater appearance on the shoe. The same cement is also used in repairing rabbit skins. These skins are weak and are easily torn; but by backing them with this cement they are made tougher, and are sold in some cases by unscrupulous dealers for squirrel skins. Another use to which gutta percha has been put is placing it around the bottoms of pantaloons to protect them from wear. It has been made so thin that a yard of it weighed only 7 to 8 pounds. A piece of this was placed around the bottom of the garment, then an inch of cloth was turned in on top of the gutta percha, a hot iron was passed over it, which rendered it secure, thus saving the expense of sewing to the manufacturer.

Since gutta percha has advanced so greatly in price, it has been found impracticable to use it for this and many other purposes, in fact it has been stated that a large engineering firm in the United States proposed to enter upon the manufacture of submarine cables on an extensive scale, but were unable to carry out their purpose, on account of the scarcity and the difficulty of obtaining gutta percha.

Efforts have been made to check the destruction of this most useful tree by substituting tapping for felling, but the greed of the natives is so great that they adhere to the latter method, because it gives them more of the sap for immediate marketing, being regardless of the fact that the trees are being exterminated. The only remedy for the great scarcity of the article seems to be the cultivation of the tree, and measures of this kind will have to be adopted if gutta percha, which seems to be an article entirely indispensable in some lines of manufacture, retains its place in the commerce of the world.—*Scientific American.*

STEEL PIPES.

The use of riveted steel pipes is superseding that of wrought iron pipes. It was found in America that cast iron pipes imported from Great Britain were more expensive than wrought iron plates, hence these plates were made into water mains. In this country cast iron pipes still maintain their supremacy, partially because of the plentiful supply of metal and the access to foundries; while in America the use of wrought iron plates has developed facilities for the manufacture of pipes of this description made of small plates. The Steel Pipe Company, of Kirkaldy, have done something towards showing the advantages possessed by steel over wrought iron pipes. It is stated by Mr. D. J. Russell Duncan, Assoc. M. Inst. C. E., that wrought iron or steel pipes can be produced at a less cost per unit of length than cast iron pipes. A pipe built of steel can be made at a less cost of labour than one of wrought iron, on account of the reduction in the number of plates and rivets, and, therefore, of caulking and punching. Being less liable to corrosion than pipes of wrought or cast iron, the durability of steel is insured. It is stated by one authority that the best precaution is to have the pipes galvanized, then coated with natural asphaltum or with a composition of pitch, tar, petroleum, linseed oil, and chalk. This solution is heated in a bath to a temperature of 250 deg., and the pipes immersed till they acquire the same temperature as the composition. The pipes should also be coated as they are laid in the trench. As regards strength the steel pipe is much superior to glazed stoneware or cast iron, or about three and a half times stronger than the latter. Mr. Duncan says: "As steel is on an average 1.3 times stronger than wrought iron, it is clear that for pipes of equal strength of plate, and allowing that the riveted or welded seams are of equal strength on both, the thickness of mild steel need only be about 0.77 of the thickness of wrought iron." This economy of material can be effected by using open-hearth mill steel of the highest possible tensile strength, and of having less riveting than usual in American practice by reducing the number of the plates. Various methods of jointing pipes are shown by Mr. Duncan, who recommends the Schulz joint and one invented by himself, in which the socket can be of rolled steel of greater thickness than the pipe.—*Building News.*

[We do not quite follow our contemporary as to steel pipes being "less liable to corrosion than those of iron." In the vicinity of the sea or of salt soil steel corrodes more quickly than iron.—*Ed. Invention.*]

GETTING INTO PRINT.

Mr. John H. Reed, of Chicago, contributes the following interesting article to *The Writer*:—

Taking it for granted that journalism is a school of literature, it would seem advisable for the young aspirant to literary fame to enter that field before looking elsewhere. Certain it is that there he will stand more chance of success. Metropolitan daily papers are always willing to pay for well-written "specials" of local interest, and to an observant person it is no difficult matter to procure material for such articles, as there is always something going on in large cities to inspire him with ideas.

A "special writer," or "space worker," should be well informed on all local matters. He should read the daily papers carefully, spend a great deal of his time in the street, visit parks and public institutions, attend police court trials, in fact be everywhere and see everything that is likely to be useful in writing his sketches. Such writers carry note-books and never fail to record anything that may be of future service to them.

When the novice has found something that he thinks suitable for an article or sketch, he should get to work at once and put his ideas together. The introduction to his article should be short and to the point, giving a good idea of what is embodied in the remainder of it. The editor of a daily paper has no time to waste on "long-winded" introductions, nor will he do so; and unless an article is from a regular contributor, if an introduction does not lead him to believe that it is of interest to his readers, he will decorate it with his initials ("N. G.") forthwith. But if he reads on, using his blue pencil the while, your "copy" will stand a fair chance of being sent to the composing room.

On whatever subject you may be writing, not a single sentence should be lacking in interest. Regarding the length of the article, you must use your own judgment, and that must be good. Don't waste your time in "coloring" your article, and do not moralize. People who like this kind of reading do not look for it in daily papers.

Another point to be considered is the closing of your article. When you have said all you have to say, close your article as quickly as possible, being careful, however, not to do so abruptly, or the article will seem unfinished.

Preparing copy for the daily press is also attended with its peculiarities. It makes little difference what quality of paper is used; the cheapest kind of print paper is used by most reporters. Neither does the size of the paper make any material difference, about 6 x 9 inches, however, being preferable to other sizes. Begin your article about half-way down the page, thus leaving ample room for headings. Most newspaper men number the first page as well as the succeeding pages of their copy. This should always be done when more than one article is submitted at the same time. Write with a pencil, and do not be particular about using an eraser every time you make a mistake. Cancel wrongly-written words with your pencil and go ahead. Newspaper copy need not be as dainty as a maiden's love-letter.

When your manuscript is ready for the editor, write your name and address on the first page, and send it to the editor's office by a messenger or take it yourself. If you do take it yourself, don't bore the editor by telling him what it is and who you are, but place it on his desk, saying that it is offered for sale, and depart. Leave a stamped and addressed envelope for the return of the article if it is not accepted; and if it comes back to you try it somewhere else. Keep on writing.

After you have had, say, half a dozen "specials" published, your name as well as your ability will be known to the editor, and that would be the time for you to apply for a position on the regular staff. At any rate, you will probably be assigned to some extra work, and if you prove competent, you will be called upon to fill the first vacancy. After that everything will be easy sailing.

It is not the intention of this article to encourage young men to enter into the already overcrowded field of literature, but simply to point out one of the many paths which lead to the pinnacle of literary fame and fortune.

TREASURES OF EARTH'S INTERIOR.

A scientific scheme of much importance has been agitated in Washington recently. During the last two Congresses there have been a number of representatives and two or three senators who have used their influence in favor of an appropriation for boring a hole in the earth several miles in depth. It has long been recognized that an inconceivable amount of value in the shape of precious metals and other mineral substances is locked up out of reach beneath the crust of this planet. All the riches dug out of it represent merely the most superficial and ineffective scratching of the surface. Once render accessible the internal recesses of the sphere, and it is plain that every human being might be a thousand times a Monte Cristo.

Geologists are agreed that the interior of the earth is largely composed of metals. Whereas the surface matter of the planet weighs only about two and one-half times as much as water, it is known as a fact that toward the center the average weight of things is eleven times that of water. This is due to the circumstance that while this sublunary orb was cooling and condensing, the heavier particles sought the middle. Therefore it is probable that the great mass of the sphere is iron. But there are other metals more heavy than iron, and these would naturally form an accumulation immediately about the center of the globe. Among them may be mentioned most importantly gold. Geologist Gilbert, of the Geological Survey, said the other day that he would rather expect to find a vast accumulation of gold at that point than anywhere else, his notion being that such of the yellow metal as is found on the surface of the earth is only an accidental detritus. However, there are two or three substances known even more weighty than gold, and one of them is platinum, which has doubled in market value within the last year or two, owing to the increased cost of production.

So it is not unreasonable that certain members of Congress and other persons of keen judgment should consider the advisability of boring a hole in the earth for the purpose of extracting some of its metallic contents. For scientific purposes a pit has recently been sunk at Speling, in Germany, to the depth of a mile. Unfortunately, water has been struck, and no results which add very materially to human knowledge have thus far been obtained. Another well has been driven at Wheeling, West Va., as far down as three-quarters of a mile. It is dry, and the boring process is proceeding at the rate of about ten feet a day. The management will be disgusted if oil or something is not struck before the hole comes out at the antipodes and somebody tumbles into it at the other end.

No really scientific person has been so foolish as to imagine that possible results, commercially speaking, could be secured without digging much further than this. Estimate is made that at twenty miles from the surface of the earth every known substance—metals, rocks, and all—becomes fused and liquid. Once let this point be reached, and naturally whatever is below must spout up of its own accord, without expense of mining. Immediately the price of metals in the market would be reduced to little or nothing, and a new age would dawn upon civilization. It has been suggested that such an artificial conduit would be, to all intents and purposes, a volcano, but any dangers which it would otherwise threaten might be obviated easily by establishing the works on an open prairie.—*Washington Star.*

ELECTRICAL.

McGill University has been presented with a valuable electric light plant, consisting of the "Wood" dynamo and arc lamps. This is a very fine addition to the new electrical engineering course.

One of the features of the Royal Naval Exhibition in London is a five million candle power electric arc lamp, shedding its magnificent rays around the exhibition from the top of a model Eddystone light house. This is the largest electric light on record.

The chair of electrical engineering at McGill University, established through the beneficence of Mr. McDonald, will probably be one of the finest equipped courses of electricity in the world. We shall be pleased in another number to give our readers full and complete descriptions of this fine new course, when all arrangements are completed.

We understand that the University of Pennsylvania has increased its courses in mechanical and electrical engineering to four years. The studies in the fourth year of electrical engineering will consist of dynamo-electric machinery, accumulators, photometry, telephony, and testing of dynamos, motors, storage batteries, etc.

That electrical science is becoming of more and more importance is manifested in our colleges and schools, where departments and courses are being established in the interests of electricity, or, where already established, increased to meet the requirements of the overflowing classes of students, whose numbers increase yearly. That the demand for good and efficient electrical experts is large just now is evident, but what it will be in the near future is a question which can only be answered by the way in which our schools and colleges educate them. The practical man to-day starting an electrical enterprise will state that he does not want a college graduate for his electrical expert: what he wants is a man who has had plenty of practical knowledge, and who can apply his practical knowledge, as in an electric light plant, to the wiring and construction of the dynamos; in an electric street railway, to the construction of the road and the equipment of the cars. It is evident then that our colleges should spend considerable time in fitting the coming electrical engineer with sound practical knowledge, which when combined with the theory will form a well equipped engineer.

The University of Helsingfors has lately been the scene of some very interesting experiments on the influence of electricity on plants. These experiments have been conducted by Professor Lemstrom who, employing the current from Holtz machines, connected the positive pole to a network of wires stretched above the plants on poles, while the negative pole to a zinc plate buried in the soil. In order to have as was desired an electrified atmosphere around the plants, points were placed about a meter apart. By means of these points the electricity supplied by the Holtz machines was constantly making its escape to the ground. The effect of this electrified atmosphere on the plants was interesting, not so much on the growth, as the yield of many species, increasing in some cases, barley and wheat, by one half. The same experiments were tried on the plants in the hot house, where the benefit to the strawberries was very marked.

The result shows that the electrical influence is likely to prove injurious in a very hot sun, and that two groups of plants might be made: first, those favorably influenced, a few of which are wheat, rye, barley, oats, red and white beets, potatoes, parsnips, celery, raspberries, strawberries, beans, and leeks; second, those unfavorably influenced, among the most common being tobacco, white cabbage, peas, turnips, and carrots. This is a very novel use to put electricity to, and, as has been seen, has proved in many instances beneficial to plant life.

It would seem that of all the uses to which electricity has lately been put, there is none so interesting and yet so revolting as that of electro-plating the dead. Nevertheless this process does not seem to be of such recent invention as was first supposed. Mr. Tanner, in an article in *Modern Light and Heat*, says that the patent for a process similar to this was issued to Eugène T. Noualhier on the 5th of July, 1856, and was known by the title "Application of Galvano-plating to the Human Flesh, for Replacing Embalming of Bodies," and that it does not appear that the patent was ever practically applied. He further on gives a free translation of the specification:

"I proceed as follows with the cadaver after it is placed into my hands in order to produce the desired result. First, I commence by closing all the organs by means of molten wax; then I cause the body to assume the position it is to retain, and metallize it with a solution of nitrate of silver, which is spread on the previously greased surface of the body. The latter is then placed in a bath of sulphate of copper, and I proceed in the same manner as in ordinary galvanoplating operations. After the subject is galvanized, I polish it, and it can then be bronzed, silvered or gilded. The body is thus kept from putrefaction, and it always preserves the same traits and all the finish possible."

As a scientific means for preventing the decay of animal tissue after death it is undoubtedly a valuable discovery, but to have ones friends converted into bronze and silver plated statues would indeed be almost returning to former barbarism. Some great lord in the future will be able to exhibit his ancestral hall to the rising generation, adorned with the electroplated bodies of his ancestors. Interesting indeed! but not very conducive to lively spirits.

ELECTRICITY OR GAS.

In the heat of discussion much has been said of the complete superiority of electricity over the use of gas —yet, whatever may eventually take place, it must be conceded that there are purposes, which under existing methods of generation, electricity cannot so economically serve. If gas cannot rival electricity for lighting, it is superior, from an economical point of view only, at present at least, as a medium of heating, to anything which electricity has produced. In this contention, there are mistakes on both sides. They are in error who think that gas is likely to be wholly superseded and who therefore endeavor to discourage its use — and on the other hand, those are behind the age who disparage the growing uses of electricity as involving danger. Interested parties on either side may easily criticize unwisely the respective merits of the two systems of comfort and industry.

It is now well demonstrated that for streets and public buildings, and to some extent for private dwellings, the electric light will yield to no competitor at present known. It has the advantage of brilliancy, convenience, and safety. It neither heats nor vitiates the air, and, by the incandescent burner can be made agreeable and non-injurious to a degree impossible with gas. But for heating purposes and while, as at present, electricity is generated by indirect methods — coal into heat, heat into steam, steam into mechanical energy, mechanical energy into electric energy, and this back again into heat — the immense advantage remains to the use of gas. Thus a very little gas may be made to produce a great deal of heat by means of the simple asbestos grate. Should it be possible ever to obtain electricity directly from coal, the result would be in its favor. But this has been so far impracticable.

We think that a much larger field for heating by gas is opening before us, and considering its greater economy and comparative cleanliness, we believe that so efficient a method will come widely into vogue. Even though — as is not likely — the gaslight should become obsolete, it will remain true, unless some now unknown and economical means of the direct production of electricity should be discovered — of which as yet there is no sign — that the gas stove and grate will come into increasing use. One can hardly overestimate the advantage which would be gained could the cumbersome coal furnaces and ranges be discarded, with their noxious dust, and inconvenient accumulation of ashes. The following paragraph from the *American Gas Light Journal* will perhaps surprise many who have hastily assumed that the day of lighting and heating by gas is nearly over:

"In a circular recently issued to the shareholders of the Standard Gas Light Company, of this city, we find it stated that President Andrews, at the last annual meeting asserted, that statistics proved that the growth of gas consumption in New York City, for forty years prior to the introduction of electricity for lighting purposes, averaged about ten per cent. per annum. That is, the gas output doubled every ten years, and that the city had doubled in population every seventeen years. Since the first introduction of the electric light, however, the increase in New York of the consumption of gas has been much more rapid. It almost immediately jumped up to twelve per cent. per annum, and in 1887 showed a growth equal to about fourteen per cent. per annum, a ratio of growth that was still further exceeded in the years 1888–89–90. In fact, he was willing to stand by the statement that the gas output of New York was doubling itself now in a period of six and one-half years, instead of ten years, as before. He thought one reason for this very rapid increase was due to the fact that the electric light had educated the human eye "in the aggregate" for a demand for more light, and that people are not at all satisfied with the volume of light that formerly satisfied them. Again, a more luxurious mode of living is constantly prevailing in the city, as in all great cities, which is shown in the great increase in the use of gas for cooking and heating purposes. In conclusion, President Andrews thought it was safe to say that at no time in the history of the gas industry, from its beginning in this country some sixty odd years ago to the present time, has the outlook been more promising. Indeed, at no time has it been so inviting for the investment of capital as at present, and it may be stated as a settled fact that the electric light, at least in New York City, is not at all a competitor with gas to the injury of the latter."

THE PHONOGRAPH IN BUSINESS.

BY F. R. COLVIN.

It is unfortunate that the phonograph is regarded by the public — particularly by the commercial part of it — as only a wonderful toy, furnishing an evening's entertainment under skilful manipulation, though lately having risen to the utility of a "nickel-in-the-slot" machine. With this opinion prevailing, it is difficult to make the average business man believe that with an hour's practice he can make the phonograph a simple, reliable and indispensable adjunct to his office equipment. It is interesting to note that when the nature of the phonograph was first known, prediction was at once made that stenography would succumb to the machine; on the contrary, the phonograph has come to be the stenographer's best friend. Returning from the court room or lecture at any hour of the day or night, he can easily dictate his notes into it at a speed of 250 words per minute, and have a dozen typewriters, if necessary, simultaneously transcribing them the next morning before he has made his appearance at his office, or while working on another case.

My purpose is, however, to indicate the true function of the phonograph in daily business use as impressed upon me by my acquaintance with this acquisition in the office of *The Electrical Engineer*. We do not use it in lieu of, but in connection with, the stenographer. During the last hour of each day, our phonograph receives dictation for transcription early the following morning. The cylinders accumulating from this dictation are transcribed while the mail is being opened and distributed, and before it is time for the regular dictation of the day's mail to begin. The distinctive advantage in the use of the phonograph in letter dictation is that the simultaneous presence and work of two persons are not necessary. One wishes to rush off certain matter and leave the office for an hour—no stenographer is immediately available; Miss A. may be receiving dictation; Miss B. may be preparing something for the editorial department that must be ready by a given time; Miss C. may be out at lunch. The phonograph, however, is always ready — a cylinder is quickly adjusted and the matter dictated, a note being left in the office to the effect that cylinders Nos. 1, 2, 3, 4 and 5 are to be transcribed and the letters must be ready by 5 p. m. On returning to the office the letters are ready, awaiting signature. It frequently happens that manuscript must be copied at once and sent away; it sometimes occurs that important work has to be suspended to admit of such copying. A man brings something into our office of which we wish a copy, and says, "You could have a copy only, I haven't time to wait—I must take it with me." We ask him if he can wait while we read it. "Yes," he says. "All right, we will read it aloud into the phonograph." This being done, our friend may leave with his precious paper at pleasure, and the matter may be copied off from the machine the next day or the next week—whenever most convenient. How often it happens that a manager thinks of a letter which should be written at once, but which waits over until the next day or perhaps is never written, simply because no stenographer is conveniently available at the time; he may make a note to write the letter and lose the note or tear it up upon second thought. It is unnecessary to point out the value of the phonograph in this connection in petrifying and preserving impulse. It is, perhaps, true that phonographs have been placed on trial in some business offices and returned to the company with the verdict of "failure." The verdict was, no doubt, a just one; but it was not "failure" of the machine, it was "failure" of the man. Speech will not come out of a phonograph more clearly than it goes in. One should spell out queer proper names and unusual words just as he would to his stenographer in ordinary dictation. He should speak moderately loud and remember that he is talking to a machine that is a merciless critic and a truthful one whose motives cannot be impugned.

Simple routine letters, such as those of acknowledgment and the great mass of short letters we all handle from day to day, can be rattled off into the phonograph with short practice; but there are few people living who can compose a smooth letter of considerable length and dictate it continuously into the machine without hesitation. A feeling of solitary stage fright comes over one at first which takes time to dispel; in the presence of this eternal echo one hears his imperfect self, recognizes his shortcomings of diction and ought to be frightened. It is well, then, to make a skeleton, either on paper or in the mind, of long letters and then read them into the phonograph as rapidly as is desired.

The phonograph is, therefore, a great doctor for the hesitating dictator who has not digested what he intends to say. This dyspepsia of dictation however readily yields to the pepsin of practice and the pancreatin of persistence. The phonograph also makes itself felt in our office on the occasion of the impending absence from the city of the manager. A larger number of cylinders is "loaded up" on such an occasion than usual, to be written out at leisure during the next day or two. This particular use of the machine might be availed of in the case of *The Electrical Engineer* to a greater extent, were it not for the simultaneous use made of the long distance telephone, which keeps the phonograph busy even in the absence of the writer. Whether I am in Philadelphia, Washington or Baltimore, in Erie or Buffalo, in Rochester or Boston, the morning mail is read to me over the long distance telephone from New York by one of our stenographers, and the answers taken down in short hand at the New York end of the wire. Ten minutes after I hang up the telephone in Buffalo or Washington, the stenographer is reading his "overflow" notes into the phonograph for distribution, and the mail dictated over a wire from two to five hundred miles long in the morning, goes out of our office in the evening just as though I had been there all day. This is not a dream or a future possibility; it is what is done in this office as frequently as absence makes it necessary, and what many more houses are doing from day to day as the advantages of modern electrical facilities are more appreciated and understood.

For the benefit of those more or less unfamiliar with the phonograph, I would say that there are three sources of power in use, any one of which is suitable for the propulsion of the phonograph motor. First, electric light mains; second, storage batteries; third, primary batteries of great length of life and absolute constancy. Where power is derived from the electric light mains, a specially wound motor is furnished. The use of the phonograph on a large scale probably most nearly approaches perfection in one of the large electrical offices where no fewer than 30 of these instruments are in constant daily operation. Here heads of different departments and their assistants dictate all their mail into phonographs alongside their desks and send the loaded cylinders to the phonograph room of their department to be transcribed by one of half a dozen or more typewriters, who also are provided with phonographs on which cylinders are placed and worked off as soon as received. The cylinders are then sent to another phonograph, which is kept busy all day shaving them, after which they are returned for use again. The question is always asked: "How much do these cylinders cost, how many letters will they take apiece, and what do you do with them after using?" They cost 20 cents apiece, will receive easily from six to ten letters of less than a page length, are furnished promptly by the phonograph company either on written or telephonic order. They are shaved by simply setting a little knife or plane and turning on the current. In my office the tonsorial part is satisfactorily presided over by an office boy, so it will be seen the process does not involve the intricate. A dozen cylinders shaved once a day will take care of a good sized correspondence of from fifty to one hundred letters per day, according to their length and the practice of the operator. The yearly rental of the phonograph alone is $40. Where a primary battery is provided and kept charged by the company, the rental is $55. Where current from the mains is used, one pays $40 per year for the machine and settles with the electric light company for the current used as per meter. This is the best and cheapest way.

The day is, I believe, coming, when fifty out of one hundred offices having typewriting machines will use this instrument, and when the veil of mystery will no longer conceal in its voluminous folds the true uses and possibilities of the Edison Phonograph.—*Electrical Engineer.*

ELECTRICITY AS A MOTIVE POWER IN DENTISTRY.*

BY PETER BROWN, L. D. S.

The question of providing some motive power for the dental engine has led many inventors to investigate the merits of the electro motor in its application to the dental engine. Electricity is coming rapidly to the front as a motive power, and the rapid strides made in its various applications have not been lost sight of by those interested in applying this wonderful agent to various uses in dentistry.

The electro motor has many advantages, strongly indicating it as the only perfect machine for applying power to the dental engine.

Prominent among these is the small space required, comparing it with other motors (as an illustration, it may be mentioned that a one H. P. motor requires a floor space of only 20 inches square); then it can be placed out of sight of the patient; it is noiseless, clean, and requires very little attention.

To dentists living in cities or towns where a supply of electric power cannot be obtained from a central power station, the use of batteries must be resorted to, but this must not be looked upon as a very great objection. Many improvements have been made in the construction and durability of galvanic cells, rendering them much more cleanly and free from unpleasant odors, and less troublesome to keep in proper order, than the form of cell heretofore in use. Batteries can be obtained to-day that will supply for a month or more, without any further attention than the addition of a little water occasionally, all the power required in operating a dental engine.

Where a supply of electricity can be taken from a power station, it may be put to endless uses in the dental laboratory.

With an electric motor properly adjusted to the engine, one may work through the most fatiguing operation with ease. With the foot-power it is necessary, as we know, to stand on one foot while using the engine, which is a very tiresome position in itself, but when the other foot is obliged to work the treadle of the engine, it is doubly tiresome. While with the motor you may take any position the nature of the operation will allow you, and at the end of a long day's work, you will look upon the electro motor as one of the greatest boons that modern invention and science have given us.

Another advantage of the electro motor, is the perfect steadiness it gives the cutting instrument. There is no swaying of the body as there is when moving a treadle, and it can be run slowly without that decidedly unpleasant jar the instrument receives every time the crank of the driving-wheel passes over the centre.

It is maintained by good authorities that one of the best methods of excavating sensitive dentine with a minimum of pain, is by the use of a very sharp bur run at a high speed. Now, in order to get a high speed with the ordinary engine we have to exert quite a little force, and in doing so the body is moved about, and the steadiness required is much disturbed; while with the motor a speed of from 2,000 to 5,000 revolutions per minute can be easily obtained by the simple operation of closing a switch, leaving the operator perfectly steady and at rest.

Many will object to introducing the electro motor so near to the chair, saying that it looks too much like machinery; but were there not objections on the same ground made to the dental engine itself on its first introduction, and how many dentists are there to-day without that valuable instrument? When the advantages of the electro motor become better known among the dental profession, there will be few who will be without it.

Then there is the objection of introducing the electric current from a power station into our houses, on the grounds that it is dangerous to life and property. The dangers from this source have been very much exaggerated; the low tension current is not at all dangerous when properly insulated. We have a deadly agent in our houses now in the form of illuminating gas, and serious consequences may result from a leaky joint or improperly closed tap. Yet we do not go about with fear and trembling when we use this agent in our houses. When electric wires are covered with proper insulating material, the fluid they carry is as safely confined as the gas or water in their respective pipes. The amount of knowledge required for the successful operation of electrical appliances in dentistry is not necessarily very great. Certainly, a fair amount of information will help one wonderfully out of a difficulty, and will prove valuable in successfully using electricity in practice.

This force is coming into such general favor and use, that every one should have a little general knowledge of it, which may be easily obtained from one of the numerous text-books on the subject. The time is not far distant when we shall have our houses heated, lighted and ventilated by electricity; the obnoxious gas jet will give way to the clear and steady light of the incandescent lamp, which gives us light with a minimum of heat, and does not vitiate the atmosphere of our rooms, and fill our lungs with carbon. This lamp is to be strongly recommended in making examinations of the teeth, or in operating on dark or cloudy days when the light is unsteady. With proper fixtures the lamp may be made to concentrate its light on the mouth, and also shaded from the eyes of the operator. The incandescent current may also be used to run the electric mallet, the electro cautery; and applied to a fine platinum point is the best means of drying out root canals before filling.

* Paper read before the Odontological Society, Montreal.

EXPLANATION OF ELECTRICAL WORDS, TERMS, AND PHRASES.

(From Houston's Dictionary.)

B. A. U.—A contraction sometimes employed for the British Association Unit or Ohm.

Bell, Extension Call—A device for prolonging the sound of a magneto call, and for sounding signals at some distant point.

An alarm-bell is connected with the circuit of a local battery by the current generated by the magneto call, and continues sounding after the current of the magneto call has ceased.

Bell, Magneto Call—Telephone Call—A call-bell operated by currents generated by the rotation of an armature in a magnetic field.

Bells, Relay—Bells used in the early forms of acoustic telegraphs as employed in England with relay sounders.

The dots and dashes of the Morse alphabet were indicated by the sounds of a bell, a tap on one bell indicating a dot, and a tap on the other a dash. This system is now almost abandoned.

Bias of Relay Tongue.—A term to signify the adjustment of a polarized relay such that, on the cessation of the working current, the relay tongue shall always rest against the insulated contact and not against the other contact, or vice versa.

Sometimes, as in the split-battery-duplex, the bias is toward the uninsulated contact.

Bi-Filar Winding of Coils.—A winding of a coil of wire such that, instead of winding it in one continuous length, the wire is doubled in itself and then wound.

This method is employed in resistance coils, so as to avoid disturbing effects on neighbouring instruments.

Binding Posts, or Binding Screws.—Devices for connecting the terminals of an electric source with those of an electro-receptive device, or for connecting different parts of an electric apparatus with one another.

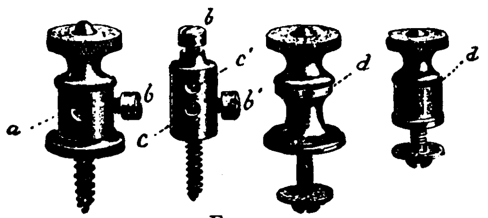


FIG. 52.

The conducting or circuit wire is either introduced in the opening *a*, Fig. 52, and clamped by the screw *b*; or is placed in the space, *d d*, and kept in place by means of a thumb-screw. Sometimes two openings are provided at *c* and *c'* for the purpose of connecting two wires together.

Bleaching, Electric—Bleaching processes in which the bleaching agents are liberated as required by the agency of *electrolytic decomposition*.

In the process of Naudin and Bidet, the current from a dynamo-electric machine, is passed through a solution of common salt between two closely approached electrodes. The chlorine and sodium thus liberated react on each other and form sodium hyphochloride, which is drawn off by means of a pump and used for bleaching.

Blow-pipe, Electric—A blow-pipe in which the air-blast is supplied by the stream of air particles produced at the point of a charged conductor by the convection discharge.

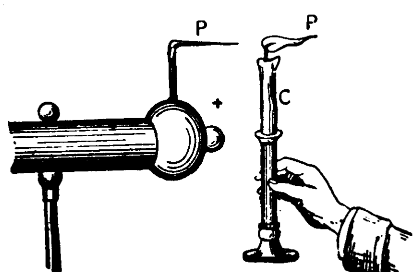


FIG. 56.

The candle flame Fig. 56, is blown in the direction shown by the stream of air particles passing off from the point P.

Blow-Pipe Electric Arc—A device of Werdermann for cutting rocks, or other refractory substances, in which the heat of the voltaic arc is directed by means of a magnet or blast of air, against the substance to be cut.

The carbons are placed parallel, so as to readily enter the cavity thus cut or fused. This invention has never been introduced into extensive practice.

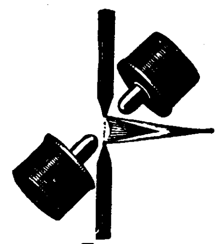


FIG. 57.

As shown in Fig. 57 the voltaic arc, taken between two vertical carbon electrodes, is deflected into a horizontal position under the influence of the inclined poles of a powerful electro-magnet.

The highly heated carbon vapor that constitutes the voltaic arc is deflected by the magnet in the same direction as would be any other movable circuit or current.

Board, Multiple Switch—A board to which the numerous circuits employed in systems of telegraphy, telephony, annunciator, or electric light and power circuits are connected.

Various devices are employed for closing these circuits, or for connecting, or cross-connecting, them with one another, or with neighbouring circuits.

A multiple switch board, for example, for a telephone exchange, will enable the operator to connect any subscriber on the line with any other subscriber on that line, or on another neighbouring line provided with a multiple switch board. To this end the following parts are necessary :

(1) Devices whereby each line entering the exchange can readily have inserted in its circuit a loop connecting it with another line. This is accomplished by placing on the switch-board a separate *spring-jack* connection for each separate line. This connection consists essentially of one or two springs made of any conducting metal, which are kept in metallic contact but which can be separated from one another by the introduction of the *plug-key*, Fig. 58, the terminals, *a* and *b* of which are insulated from each other, and are connected to the ends of a loop coming from another line. As the key is

FIG. 58.

inserted, the metallic spring or springs of the spring-jack are separated, and the metallic pieces, *a* and *b*, brought into good sliding contact therewith, thus introducing the loop into the circuit.

(2) As many separate Annunciator Drops as there are separate subscribers. These are provided so as to notify the Central Office of the particular subscriber who desires a connection. Alarm-bells, to call the operator's attention to the calling subscriber, or to the falling of a drop, are generally added,

(3) Connecting Cords and Keys for connecting the operator's telephone, and means for ringing subscribers' bells and clearing out drops.

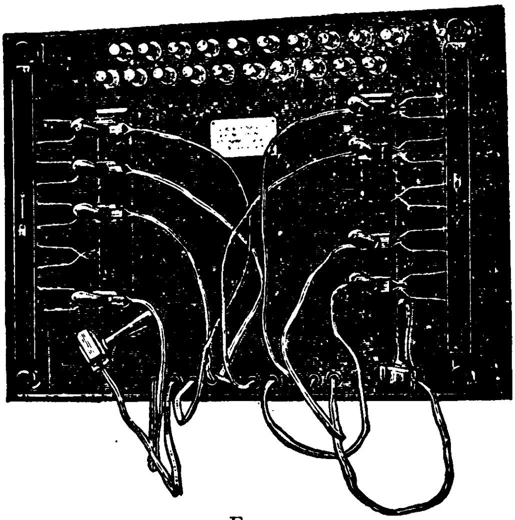


FIG. 59.

In *Electric Light Switch-Boards*, or *Distributing Switches*, spring-jack contacts are connected with the terminals of different circuits, and plug-switches with the dynamo terminals. By these means, any dynamo can be connected with any circuit, or a number of circuits can be connected with the same dynamo, or a number of separate dynamos can be placed in the same circuit, without interference with the lights.

Boat, Electric—A boat provided with electric motive power.

Electric power has been applied both to ordinary vessels and for sub-marine torpedo boats.

Body Protector, Electric—A device for protecting the human body against the accidental passage of an electric discharge.

To protect the human body from the accidental passage through it of dangerous electric currents, Delany places a light, flexible, conducting wire, A A B L L, in the position shown in Fig. 60, for the purpose of leading the greater part of the current around instead of through the body.

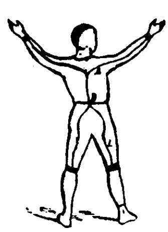


FIG. 60.

Inside insulating shoe-soles for lessening the danger from accidental contacts through grounded circuits have also been proposed.

Boiler-Feed, Electric—A device for automatically opening a boiler-feed apparatus electrically, when the water in the boiler falls to a certain predetermined point.

Bole.—A unit recently proposed by the British Association. One bole is equal to one gramme-kine.

Bolometer, or Langley's Thermic Balance.—An apparatus for determining small differences of temperature, constructed on the principle of the *differential galvanometer*.

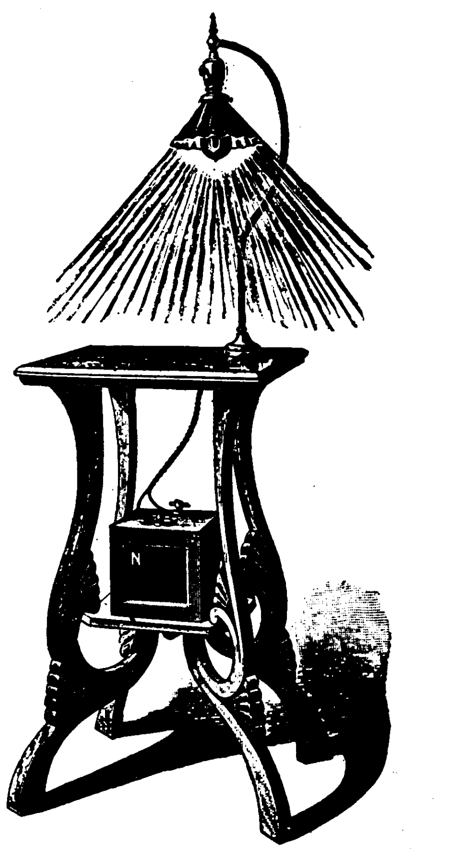
A coil composed of two separate insulated wires, wound together, is suspended in a magnetic field, and has a current sent through it. Under normal conditions, the current separates into two equal parts, and runs through the wires in opposite directions. It therefore produces no sensible field, and suffers no deflection by the field in which it is suspended.

Any local application of heat, however, causing a difference in resistance, prevents this equality. A field is therefore produced in the suspended coil, which, though extremely small, is rendered measurable by means of the powerful field produced in the coil, within which the double coil is suspended.

Differences of temperature as small as $\frac{1}{1000}$ degree F. are detected by the instrument.

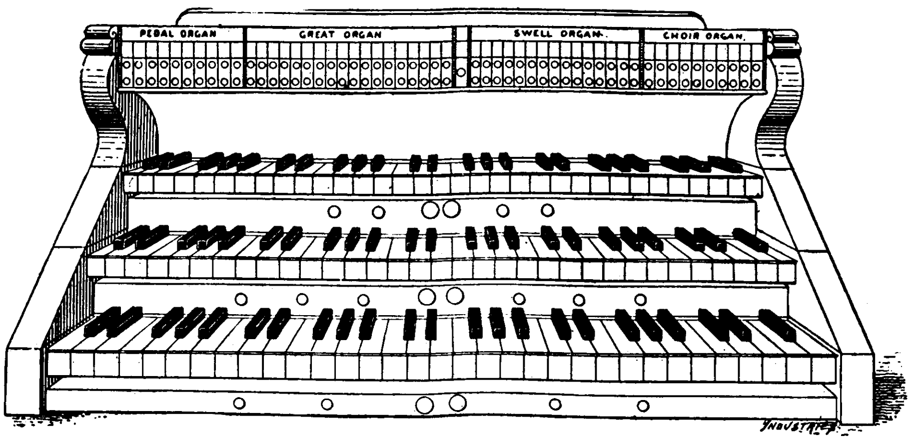
NEW APPLICATIONS OF THE CROWDUS CONSTANT PRIMARY BATTERY.

By recent important and novel improvements made by Mr. Walter A. Crowdus the output of the primary battery has been so increased that quite a powerful and constant battery is made to occupy a very small space. An idea of this power is best obtained by a comparison with the well known bluestone gravity cell. The Crowdus type of battery, 6 inches square, will, it is stated, develop a current equal to that of 200 bluestone cells, each 6 x 8 inches. Of course the total life of the



CROWDUS BATTERY WITH LAMP.

200 bluestone batteries would exceed considerably that of the Crowdus type; but the attention and handling demanded by the 200 batteries would be far in excess of the small one, doing the



CONSOLE OF THE ORGAN AT ST. JOHN'S, BIRKENHEAD.

same work, hence the comparison has many points in favor of the new type. The Crowdus batteries are all made up in hard rubber cases, practically sealed, as far as handling is concerned, and are portable, there being no glass or loose porous cups in them. We have had occasion to illustrate these small batteries as they are now made up in hand and vase lamps. In this shape they are no larger than a coal oil lamp and give greater light.

We illustrate this week another design and application of this battery. The engraving shows a small, square table with a 7-inch square battery placed upon the shelf beneath, with wire leading up to a portable or drop light placed upon the table. This outfit will give a 16 c. p. light for one evening, on one charge, at a cost of $1\frac{1}{2}$ c. to 2c. an hour.

One very practical feature of this battery is that no electrical connections have to be studied out or attended to, and the only metal parts exposed are the two terminal knobs, which serve the double purpose of handles for transporting the battery and electrical terminals.

The fan outfits are finding ready sale, even in offices located in the center of electric power districts.

The Crowdus Chemical-Electric Co., Memphis, Tenn., owners of, and manufacturers under, Mr. Crowdus' patents, are also adapting these batteries to train lighting, and have a passenger train running regularly fully equipped with electric light, including head light, supplied from their battery, the light being much brighter than was obtained from the oil lamps. Concerning this, however, we shall have more to say, as it is a departure of much importance.—*Electrical Engineer.*

ELECTRIC ORGANS.

BY JAMES SWINBURNE.

The idea, and to some extent the application, of electricity to the mechanism of organs is not new. Gauntlett proposed to build models of various celebrated organs at the London Exhibition of 1815, and to connect them all to one console. Barker, the inventor of the pneumatic pallet, worked out what was probably the earliest practical system of electrically controlled organs.

An organ consists essentially of three or four independent instruments. Each instrument is composed of sets of pipes, called stops, arranged in rows, say, crosswise, on what is known as the "soundboard," probably because it is not a soundboard. The pipes are also arranged in rows from back to front, each row corresponding to a key on the keyboard belonging to that organ. Each key commands a valve, or pallet, letting wind into a channel under all the front to back row belonging to it. Each stop has a long perforated slip or slider running under it, which can be moved so that the holes correspond or not with those leading to the pipes. These sliders are controlled by the draw-stops. A fourfold organ has one pedal and three manual keyboards, called "great," "swell," and "choir." Further mechanism is necessary to connect various keyboards, and to admit of rapid changes of the arrangement of the draw-stops. This appears very simple, but when an organ has about forty stops, and over fifty draw-stops, it becomes very complicated. The first trouble is that it soon becomes almost impossible for the fingers of the left hand to work air valves or pallets large enough to control the wind for twenty or thirty large pipes, even if equilibrium valves are used. I am, as far as possible, using engineering, and not organ building nomenclature. To get over this, the air relay, or pneumatic pallet, has been adopted in large organs. The finger then controls a tiny equilibrium valve, which controls an air bellows that does all the work. When this system is applied to the great organ of a small instrument, it is generally arranged to work the "choir" and "swell," too, when coupled to the "great."

There is still another difficulty. In large instruments the pneumatic pallets frequently have to be a long way off the player, and the connections are apt to alter in length and get out of adjustment. In All Saints' Church, Manchester, there is, or was, an organ played from near the reading desk, placed high up on each side of the chancel, 70ft. off. It has mechanical connections, but they are not heavy, and seem to work very well. Generally, an arrangement like that used in pneumatic bells is used, and known as the tubular pneumatic system. Barker, however, controlled his little air relay valves electrically, and realized the advantages of electrical connections in admitting of great simplicity in coupling and key mechanism, as well as ease in connecting distant organs. The electric action, as it is called, has developed especially abroad. Messrs. Bryceson have done a great deal, and many English organs have electric connection. In France there are a large number of these combined electric and air relay mechanisms. M. Carré describes several in a valuable article in *La Lumière Electrique*. Roosevelt, in America, has not only developed pneumatic actions thoroughly, but has employed electricity too. The three-manual organ at Trinity Church, Boston, has not only pneumatic action for the keys, but a pneumatic stop action which admits of an exceedingly convenient composition pedal arrangement. The pedal on being pressed and hitched down draws its corresponding set of stops, and shuts them off again when allowed to rise, without interfering with any arrangement that has already been made. There is also an electric solo organ, but it was out of order when I tried the instrument. There is a concert organ by the same makers in Boston with a set of composition pedals, each with a complete set of draw-stops, which can be arranged beforehand, and come into use when the pedal is pressed. I believe the new Riga organ is electrical.

Mr. Hope-Jones has recently paid great attention to the subject of electric actions. Being an electrical engineer and an organist, he is well fitted for tackling such a difficult subject. There is given above an illustration of the console of the organ of St. John's Church, Birkenhead, where Mr. Hope-Jones is organist. Instead of draw-stops at the sides of the player there are rows of little tumblers just under the music. A touch at the top or bottom puts the stop in or out. This organ, if arranged in the ordinary way, would have about forty draw-stops. By the use of electric gear, Mr. Hope-Jones produces an organ which has the same effect as an instrument of fifty-three with the ease of manipulation of one of twenty draw-stops. In addition, it has a whole host of composition buttons, crescendo arrangements, and other accessories.

So far electricity seems to have been used to work an air relay only. The use of electricity may easily be carried very much farther than this. The difficulty has been the supply of electrical energy, and batteries have been used. Mr. Hope-Jones, who has had experience in telephone work, has probably reduced the energy needed to a minimum. It seems obvious, however, that to use electricity to work an air relay for working a valve needing a pull of a pound or two through half an inch is absurd; and our electrical readers may well study the question, as given, say, twenty watts available, the whole mechanism of the ordinary organ might be swept away, and an infinitely more convenient and much less costly instrument devised. It is easy to get the power. In England the blower, who does the whole of the work when air relays are used, works a thing like a pump handle up and down. In France he works two levers with his feet. Sometimes the blower is a water motor or a gas engine. All that is wanted is rotary motion. Even if rotary motion is provided, by means of hand cranks, water motors, or gas engines, the feeders are generally on the principle of a smith's bellows. We would suggest that such a machine as the Baker positive blower would be very much cheaper and better, giving a uniform supply without beating. The electric power can then be supplied by a very small magneto machine. This need have no commutator, it may supply alternating currents of low enough frequency to be silent. There is then nothing to get out of order, and owing to hysteresis, if closed circuit electromagnets be used, there is practically no sparking at the various contacts. Organ music is limited entirely by the mechanism of the organ and develops with it. In Germany they have only one sort of organ music, of which the works of Merkel, Rheinberger, and perhaps Mendelssohn may be taken as examples. This needs no accessory mechanism, and even modern German organs have, we believe, little as a rule. The well known organ at Tyne Dock, by Schultze, has no composition pedals, and, if I remember aright, no couplers. In France the organ intersperses showy scraps during church service; and many of the organs are not designed for solid playing. The large organ at St. Eustache, for instance, has the pedals so arranged that the player cannot reach them without sliding along the seat. They have all sorts of arrangements for meretricious effects—tremulants, fancy reeds, and "effets d'orage." In England and the United States organ playing has got as far as it can without a change in organ construction. The average church organ spends its time in the monotonous accompaniment of hymns and chants, but the concert instrument plays German fugue music, German chorale organ music or the resulting German organ sonata; then it plays Guilmant and light French music; and then it indulges in a development which is essentially English, the organ arrangement. As much of an orchestral movement as can possibly be compressed into the region of ten fingers and two feet is crammed on three staves, and the organist has to change his stops as best he can. It is probably only in England and America that such things as the overtures to "Der Freischütz" or "A Midsummer Night's Dream" are played on organs. It is only because the mechanism does not give the right combinations quickly enough, if at all, that the overture to "Tannhaüser" does not figure on recital programmes.

It is difficult to think of all that can be done easily and cheaply by direct electric mechanism. If each key makes circuit with a set of small electric valves, one to each pipe, and if the returns to each stop are controlled by what corresponds to the draw-stop, all the ordinary mechanism of pneumatic pallets, expensive sound-boards—which sometimes warp—trackers, sliders, rollers, &c., may be swept off. It may be remarked parenthetically that the abolition of pneumatic pallets is itself most desirable. Apart from expense, they tend to develop a bad style of playing. The organ cannot accent a note by playing it louder, so emphasis is given to it by clipping the note before it a little short. Phrasing thus depends on perfect instantaneousness of the action which is not always found with the air relay. In a cathedral, organ music gets mixed up into a sort of roar which rolls down the aisles in a way poets like, and slovenly phrasing does not matter, but in a concert room an organist accustomed to a large instrument generally bears evidences of it. With electric mechanism, any stop may be drawn on any manual, or prearranged for any manual and composition button. Any grouping may thus be adopted. In orchestral music, though there are about twenty staves in the score, the instruments fall roughly into a few groups. It should be easy to group the corresponding stops on the organ in the same way for playing orchestral music. This can be done by electricity. Again, in playing from the ordinary piano score of oratorios, there are four lines of voice parts, which demand one keyboard, and two lines of condensed accompaniment, which demand one or two keyboards, which must be coupled instantly to the voice keyboard when there are no hands available to play them. Existing organs generally meet these last requirements. Electric action admits of still another development. In a medium sized hall, one manaul may be an ordinary grand piano. A piano could not be combined with an ordinary organ, because the touch is different; but if the console is detached from the organ so as to give breathing room for the piano, the addition of the contacts to the keys will not interfere with the touch of the piano at all. This suggestion will strike many as odd, some may say barbarous, but the harp may almost be considered part of the modern orchestra, and apart from concertos, the piano might also be absorbed too, especially if it were more portable, and several could be employed together.

Enough has been said to show the enormous advantages of simple organ mechanism. One great difficulty will probably be in organ builders themselves. They are often too apt to regard electric action as complicated, untrustworthy, and expensive. It must be remembered that electric work has advanced enormously within the last few years; and if electricity can sweep away the whole of the rest of the action mechanism from organs it is certainly worth consideration. The excellence of the organ at Birkenhead points to the advisability of organ builders going to electricians to get the electrical part of their actions put right, instead of designing it themselves, and then rejecting it as costly or untrustworthy. —*Industries.*

HOMELIKE HOUSES.*

The love of home is an instinct possessed by man and the greater part of the animal world alike. It is, perhaps, the only sentiment which the reticent Englishman is not ashamed to confess to; indeed, it is his boast that the English language alone possesses the word "home" in its fullest sense. Is it not strange, therefore, that while all possess this instinct the large majority of people are content to live in houses which are quite unworthy shrines of the household gods? The love of home exists still, but the love of the house has almost died out, or is lavished on a building which is quite undeserving. We have only to look round us and contrast the old houses with the new in order to see the truth of this.

Let us picture to ourselves the old Elizabethan house, quiet, dignified and stately, as befits the age. It is early morning on a bright summer day; the master of the house paces the long alley guarded by yew and box, or turns into the flower garden, where the flowers, drenched with dew, give out a sweet, fresh scent; or it is late afternoon, and we see the head of the house sitting with his wife in the shaded arcade, while the children play on the terrace. The air is full of the scent of roses and musical with the hum of bees; the shadows lengthen, the rooks sail slowly through the air; part of the house is in deep, cool shadow, and chimneys and gable-tops begin to glow like burnished gold. There is a sense of perfect rest and contentment; cares are forgotten for a time. Would it be wonderful if, in homes like this, men should grow noble and true, and the love of their home should become a passion? Can we wonder that they should cling to such homes, and feel that here, indeed, there is peace? It is not only the mansion that fills its owner with delight. Take the farmhouse on a summer evening, when the farmer is coming in weary with a day's toil in the fields. The cows are just being driven out into the fields after milking, and he hears the musical clatter of the milkpails as he walks up the path, lined on either side with simple homely flowers in rich profusion. How cool the shaded kitchen looks, and how delicious is the faint smell of wood-smoke! He drops into his chair and is refreshed by the peace and quiet of home. Old houses are all alike in this respect. How well we know the little prim house on the outskirts of a country town, standing back from the road, with a wall in front and a high narrow iron gate with a straight path to the door. We grasp the spirit of the place at once, and know exactly what the owner is like; we can see all the furniture and china and even smell the lavender and rose-leaves. As we continue our walk it is the same thing over again. There is the lawyer's house, and we know without being told that every room is panelled, and that there is a delicious garden at the back of it with fine old trees, and an octagonal white painted summer-house somewhere at the end of a long path, and roses and lilacs and a hundred other sweet-smelling flowers and shrubs.

I can imagine nothing which can give so keen a sense of pleasure as looking at an old English country-house on a summer evening as the sun is setting. Then one can realise best the beauty of colour and proportion. The house and the garden seem the very incarnation of the spirit of home; all sounds are hushed, and peace and quiet reign supreme. How different is the modern "mansion." Let us take one haphazard; there is no lack of examples. First of all the entrance gate, red-hot with paint and gilding, with stone piers, topped either with lamp-posts or a borrowed crest. This opens into a drive aptly termed "serpentine," and presently the house comes into view. We seem to be able to tell at a glance the character of the owner of this house. Wealthy he undoubtedly is, and the house is apparently designed to advertise the fact to the world in general. The enormous conservatory is an outward and visible sign that priceless orchids are grown within, and many tropical plants whose names and natures are unknown to anyone but the gardener. The windows blink and stare at the sun, and the great sheets of plate glass look like molten brass. The drawing-room is furnished *en suite* in blue or crimson, and he is a bold man who would dare to sit uninvited on any of the gorgeous chairs or sofas. See the garden from the windows: curved paths streaming like ribbons in all directions, manufactured undulations, "specimen" trees and carpet beds, everything baking in the sunlight, and as neat and trim as three gardeners and a boy can make it. No one can feel that this is homelike. The melancholy thing is that this result is not brought about accidentally; it is all deliberately planned and thought out, and may be taken as expressing exactly the spirit of the age. The owner is proud of it, and so, in a measure is the neighbourhood.

Even more depressing than this is a walk in the suburbs of London. North, south, east or west, they are all the same. There are only two styles of suburban houses, the gabled and the ungabled. The gabled is the most popular. Take any one and examine it a little in detail. The height is generally considerably greater than the width. The windows, of which the front mainly consists, are of impossible proportions. There are, of course, a stone bay, with wooden sashes; a porch, rich with brown graining, going half-way up the house; and bricks the colour of a London fog, with wiry streaks of red running through at intervals. A purple slate roof, with a formidable spiky iron ridge, tops the whole, and the house is complete. Houses of this kind are stereotyped, and have enclosed London like a forest; thousands of people live in them and call them home, and I suppose they may also be considered as expressing the spirit of the age. In every age and in every country the spirit of the time is shown in the homes of the people, and I am afraid that when future generations read our history from our houses, they will not see in them anything to increase their admiration for the spirit of the nineteenth century. The house is so often built with too much regard to economy—thin walls and floors, and a too close apportionment of space; or, on the other hand, it is loaded with ornament inside and out, and is more a vehicle for the display of the owner's wealth than a home. It is difficult to say what it is that gives a house its particular character of homeliness; the character is there, but it is impossible to dissect the building and say, it is here or it is there; the home feeling is everywhere alike. Breadth, is, perhaps, the most marked feature in a home-like house—the long, low building seems to fit better into the landscape than the house of many storeys. The

* A paper by Mr. Ernest Newton, architect, read at the last meeting of the Architectural Association, London.

tower speaks of war and strife; and the nearer we approach to that form of building, the less is the air of homeliness. To build a homelike house we must have the home feeling strong within us. It is no good to study old houses merely as pieces of architecture, sketching a corner here, or measuring a moulding there, and reproducing them more or less correctly. We must study the soul of the building as well as the body; indeed, it is the more important study of the two. Let us once grasp the spirit of the old homes, and we may express it in any outward form we please.

And, now, having settled in our minds the ideal home, let us see how we should proceed to realize it. We will begin with the obstacles. First, the person for whom the house is to be built may be presumed to have no sympathy with our ideal; his wish is solely to provide a covering for himself and family which shall be convenient and economical. He will no doubt say, as so many do, that he is going to live inside his house and not outside; he will also have various ideas as to the disposition of certain rooms and other matters of detail. As to these last, it is important to note any strongly-marked individuality and, if it is at all possible, to emphasise it and let it appear in the house. We will, then, suppose that you have been able to show him that a home must be more than four walls and a roof, and brought him into full sympathy with yourself. It is important to do all this, but everyone must do it in his own way; no one can lay down rules for the guidance of another. Then we must see the place where it is proposed to build the house, and if we don't grasp it at once we must go again and again till we do. It is generally while we are looking at the site for the house, its prospect and aspect, the slope of the land, the positions of trees, roads and neighbouring meadows, that a half-formed idea of the kind of house that would fit this spot floats into our minds; it is, of course, very vague and shadowy, but it is sufficient to turn our minds in a certain direction. Having got a motive our next step is to work it out, quite roughly at first. Above all things we should avoid looking on a house as consisting of two parts—plans and elevations. The outside and inside must be considered absolutely as one, and it should be impossible for us to say that the outside suggested the inside, or the inside the outside. We should now let our rough studies simmer a little, and then go more seriously to work. The actual drawings should be looked upon merely as diagrams, and we must avoid being led into the mistake of supposing that things which look well when well drawn will also look well in solid materials; everything should be thought of as built before we draw it, and if we have thoroughly made up our minds that this is what we are going to do let us then draw it as well as possible. Drawing carefully will make us think carefully.

And now as to the general character of the house. Home means, as I have said before, rest, quiet, and simplicity. Our house must, therefore, be restful, quiet and simple. It does not matter how small it is, it can always be treated in a broad and simple manner, and have a quiet dignity of its own. A glance at any country cottage is sufficient to convince us of this. I don't mean to say that a house must necessarily be bare and simple in every part, but simplicity must be the keynote. Certain parts, both inside and out, can of course be elaborately treated; but it must seem natural and not an isolated piece of work, and the reason for the elaboration must be apparent. It must, too, be borne in mind (although it sounds paradoxical) that elaboration to be effective must be simple, at any rate, in its main lines. Another danger to be avoided is the deliberate planning of odd nooks and corners; let them come if they will naturally, like they did in old houses, and they will be very charming; but where they are purposely and consciously planned, they always destroy the repose of the house, and make one feel that it required an effort to produce them. I am not saying anything about the convenient arrangement of the house: it goes without saying that a house must be convenient, but mere convenience is not sufficient. We must do much more for our house than that. It is unfortunate perhaps that the elaborate way in which we live nowadays demands a more complicated plan, and a greater subdivision of the house into various departments, than formerly. Absolute privacy, when required, is undoubtedly necessary, and is in fact one of the charms of home; but it is a question whether we do not lose a great deal of picturesqueness by so entirely shutting off the working part of the house as we do. The furnishing of the home should not be left to chance. We must contrive to arrange this as well as the house; the homelike character of rooms can very soon be destroyed. The garden, too, must be planned and schemed it is as much a part of the home as the house itself.

In conclusion, I should like to emphasise a few of the remarks I have made previously, especially those bearing upon the home feeling. Unless we have this very strongly, it seems to me that it is impossible to give a house any life at all. Let us study old houses, not as inanimate buildings of more or less architectural beauty, but as expressing the most valuable and beautiful of human sentiments—the love of home. Nowadays, when all religions are assailed, and we believe in nothing very strongly, it is almost impossible to make our churches express anything more than a sort of galvanized enthusiasm; we reproduce old forms as symbolical of certain legends, although we are not quite sure whether we believe them or not (I am only speaking generally, of course, as there are still many who believe strongly, and whose buildings express this belief very clearly.) Belief in the sacredness of home-life, however, is still left to us, and is itself a religion, pure and easy to believe. It requires no elaborate creeds, its worship is the simplest, its discipline the gentlest and its rewards are peace and contentment.

SAFETY IN OCEAN TRAVELLING.

At the present time, when we hear so much about swift ocean travelling, and when proposals are being made to still further increase the speed of steamers, it is well to consider the question from the side of safety, so that the public may form some idea of the probability of increased danger, which is usually supposed to accompany increased speed. Few persons would be inclined to shorten an ocean voyage if they ran a great risk of suddenly ending their days by so doing. Therefore a glance at the past history of the subject may be interesting. From the time of the inauguration of Atlantic Ocean transit in 1838, until 1879, 144 steamers of all classes were lost in that trade. Some of these, however, were not very important. The first which was lost was the "President," which disappeared mysteriously in 1841. It is a somewhat noteworthy fact that during the next thirteen years only one life was lost through the loss of an Atlantic steamer, and that was in the "Columbia," of the Cunard Line, which went ashore in 1843. From 1854 the losses became very frequent, and are probably to be accounted for by the change which was being made from sailing vessels to steamers, and the want of experience, not only of the officers in charge, but also of the shipbuilders and engineers who were responsible for the construction of the ships and engines. In 1854 the steamship "City of Glasgow," with about 480 persons on board, disappeared, leaving no trace behind, and in the same year the "Arctic," of the Collins Line, and one of the fastest steamers then afloat, was sunk in a collision off Cape Race, and 562 persons perished. Two years later the "Pacific," of the same line, disappeared, leaving no trace behind. A remarkable fact in the history of the Allan Line is that, between 1857 and 1864, it lost no fewer than nine steamers. The Hamburg-American steamer "Austria" was, in 1858, burned at sea, with a loss of 471 lives. Of the more remarkable losses since that date may be mentioned the Inman liner, the "City of Boston," in 1870, the White Star liner "Atlantic," the German steamer "Schiller," the North German Lloyd steamer "Deutschland," the Hamburg-American steamer "Pomerania," and the French steamer "Ville du Havre." When we analyse the causes of the losses up to 1879 we find that twenty-four vessels never reached the ports for which they sailed, their fate being veiled in mystery, ten were burned at sea, eight were sunk in collisions, and three were sunk by ice. Since 1879 it is satisfactory to find that the number of losses have not been nearly so numerous. The most memorable are the burning at sea of the "Egypt," of the National Line, and the "City of Montreal," of the Inman Line, both without loss of life; the stranding of the "State of Virginia," and the sinking of the "State of Florida," by collision with a sailing ship, and of the "Oregon," in collision with a coal schooner. These facts are so far satisfactory that they show a great decrease in the list of accidents during what may be considered the modern period of the steamship. This may be accounted for by the fact that, having passed the transition period, the officers in charge were more thoroughly acquainted with their duties, and the ships and engines were more efficiently constructed. The record of last year is of a most satisfactory kind. Notwithstanding all the risks from collisions, hurricanes, icebergs, and other causes, we find that nearly 2,000 trips were made from New York alone to various European ports, and that about 200,000 cabin passengers were carried, in addition to 372,000 immigrants, all without any accident. The risk of collision has been very much reduced by the adoption of the system of "steam lanes," suggested by Professor M. F. Maury—that is, of having definite courses for the steamers, based on calculations as to probable areas of fog and ice. If any accident should occur to a steamer there is thus every probability that assistance will be rendered by one of her companion ships.

The improvements which have taken place in the methods and appliances of navigation have, no doubt, added much to the safety of the ships, and this has been increased also by the higher standard of education, and consequently of intelligence, than formerly was found, both among officers and men. Sir William Thomson, in a volume of papers recently published, has said: "It is a common saying that sailors are stupid; but I thoroughly and heartily repudiate this statement, not from any sentimental fancy, but from practical experience. No other class of artisan is more intelligent; and, moreover, sailors' wits are kept sharp by the ever nearness of difficulties and dangers to be met by ready and quick action." Sir William himself has done much to improve navigation, not only by his writings on subjects directly connected with it, but also by his inventions. His improved compass and his sounding apparatus are to be found in all first-class steamers, and his influence has been felt in many direct and indirect ways. We would refer to the volume of papers above mentioned on subjects relating to navigation for full details regarding these, and also for suggestions which may come to be of great practical utility in the future. He expresses the opinion that the regulations for preventing collisions at sea contain everything that human wisdom has been able to devise for diminishing the chances of collision. The action of the recent Maritime Conference at Washington showed that the members agreed with this opinion, as they proved very conservative in their policy. They declined to adopt a large number of resolutions sent in from more than one country of importance, and contented themselves with a number of not very important amendments, and with the passing of some new rules for the marking of wrecks and the removal or destruction of derelicts. Considerable improvements have been made in recent years in lighthouse arrangements, but Sir William Thomson would like to see all the lighthouses flashing out their characters like electric signals, instead of the present rather slow revolving method. A certain advance has been made in another direction in the application of the Morse alphabet to marine signalling by sounds. Sir William is anxious that lighthouses should be able to flash light signals. He says that a lighthouse, to fulfil the reason of its existence, must not only be seen, it must be recognized when seen. He argues that there has not hitherto been amongst lighthouse authorities quite enough determination to make every effort to give a distinctive character to coast lights which science and common sense have placed at their disposal. The dangers from collisions with icebergs have been reduced by the useful charts which are issued by the Hydrographic Bureau at Washington. From the records of this Office it appears that from 1882 to 1890 thirty-six steamers were more or less injured by ice in the North Atlantic, although some of these were freighting and coasting vessels. Probably the commonest explanation of the fate of missing ships is collision with ice in fog or in the darkness of the night. In case of accident, the number of boats now available is much larger than formerly, but to ensure that all the passengers in one of the large Atlantic steamers should be accommodated would require a very great amount of space.

We need not go into details of the improvements which have taken place in the construction of the ships and engines, as we have drawn attention to them from time to time. A large number of bulkheads is the most important point which requires attention in order that safety may be ensured, and, in fact, these and double bottoms are prime necessities. The bulkheads should not only be transverse, but also longitudinal, so that the engines driving separate screws may be quite self-contained. There can be no doubt that the bulkheads saved the "City of Paris" last year, and that was the case in spite of the fact that the longitudinal one was damaged by the breakage of the engines. It seems rather odd that the twin-screw and separate engines did not commend themselves to shipowners and shipbuilders at an earlier period, as they had been in common use in the Royal Navy. Of course in the Navy the arrangement was adopted on account of its advantage in manœuvring, but the security afforded by it in case of accident to one set of the engines is a sufficient reason for its being adopted in large passenger steamers. This has already been recognized by the proprietors of some of the most influential lines. The improvement in the quality of the materials used in the construction of ships and engines, as well as the methods of working them, hss done much to lessen danger, and we are convinced that our shipbuilders and naval engineers are now in a position to take a considerable step in advance as regards speed without lessening the safety of ocean travelling.—*Industries.*

There are 7,671 engineers employed on the great Pennsylvania railroad system.

A CHAPTER OF DON'TS.

Which is another way of repeating what has already been said.

1. *Don't* empty the boiler when the brick work is hot.
2. *Don't* pump cold water into a hot boiler.
3. *Don't* allow filth of any kind to accumulate around the boiler or boiler room.
4. *Don't* leave your shovel or any other tool out of its appointed place when not in use.
5. *Don't* fail to keep all the bright work about the boiler neat and "shiny."
6. *Don't* forget that negligence causes great loss and danger.
7. *Don't* fail to be alert and ready-minded and ready-headed about the boiler and furnace.
8. *Don't* read newspapers when on duty.
9. *Don't* fire up too quickly.
10. *Don't* let any water or dampness come on the outside of your boiler.
11. *Don't* let any dampness get into the boiler and pipe coverings.
12. *Don't* fail to see that you have plenty of water in the boiler in the morning.
13. *Don't* fail to keep the water at the same height in the boiler all day.
14. *Don't* let any one talk to you when firing.
15. *Don't* allow water to remain on the floor about the boiler.
16. *Don't* fail to blow off steam once or twice per day, according as the water is more or less pure.
17. *Don't* fail to close the blow-off cock, when blowing off, when the water in the boiler has sunk one to one and a half inches.
18. *Don't* fail, while cleaning the boiler, to examine and clean all cocks, valves, and pipes, and look to all joints and packings.

The above is a sample page (44) of "Maxims and Instructions for the Boiler Room," from the "Hand-Book of Calculations for Engineers," sold by Theo. Audel & Co., New York.

HOW TO PRESERVE HEALTH.

One of the best ways to keep in good health, says the *Monthly Bulletin*, is not to think or worry too much about it. If you feel strong and well, don't imagine that some insidious disease may be secretly attacking your constitution. Many people are like the inexperienced traveler, who anxiously inquired about the symptoms of sea-sickness, and how he should know when he had it. One generally knows when he is sick, and frequently many supposably alarming symptoms prove, upon investigation, to be either perfectly natural occurrences or of very slight importance.

Eat and drink what you desire, as long as it agrees with you. Your stomach knows pretty well what it can digest. Plain, simple food is desirable, as a general thing, but the luxuries of the table, in moderation, will do no harm.

Alcoholic beverages are not fit for habitual use. They are true medicines, and should only be used like any other medicines—under the advice of a physician. As a regular beverage they can do no good, but will almost certainly do harm.

Take all the sleep you can get, but remember that the necessary amount varies greatly for different persons. Some must sleep at least nine hours, while others thrive under six. Only don't rob yourself of what you really need. The "midnight oil" is a terribly expensive illuminant to burn either for purposes of labor or study.

Always treat a common cold with great respect. Ninety-nine times out of a hundred it will get well any way, but the hundredth cold, if neglected, may lead to bronchitis, pneumonia, or consumption. It is best to take no such chances.

If you are sick enough to need any medicine at all, beyond the simple remedies familiar to all, you are sick enough to need the attendance of a physician.

By all means take as much exercise as you can, and be in the open air as much as possible. Out-door life is the natural condition of mankind, and the more one can have of it, the better. The practice must not be carried to extremes, however. There are many days when one is much better off in a warm, comfortable, well-ventilated house than trying to take out-door exercise in a mid-winter storm, or under a July sun, and no one ever strengthened his constitution by sleeping with his bed-room window open with the outside temperature at zero, or allowing the snow to drift in upon his pillow.

Fresh air, sunlight, good and sufficient food, pure water, out-door exercise, temperance in all things, and a cheerful disposition, are the chief remedies in nature's dispensatory, and are worth more than all the drugs and medicines of the shops. Dr. Holmes has truly said that if nine-tenths of all the medicines, patent, proprietary and otherwise, in the world were poured into the ocean, it would be all the better for mankind and all the worse for the fishes; and the best physician can do little without good nursing, and thus aid nature in throwing off disease.

TAKING TIME FROM THE STARS.

No time-piece is perfect, and there are no means on earth of keeping perfect time. The stars, however, furnish the necessary means. At the observatory in Cambridge there are two principal clocks employed in keeping the standard time—the standard mean time clock, which telegraphs its signals over the surrounding country, and the normal sidereal clock, which is the main standard at the observatory, to which everything is referred. The sidereal clock, as its name implies, keeps sidereal or star time, which gains about three minutes and fifty-eight seconds per day over solar time, with which we are all familiar.

The clock is of the finest workmanship, and is kept in a brick vault, underneath the observatory, where the temperature is as nearly constant as possible.

Every effort is made to protect it from any influence which might affect its "rate," or, in other words, the amount of its gain or loss per day. This is necessary in order that the "rate" may be depended upon to give the correct time during spells of cloudy weather, when no observations can be made.

On every clear morning the error of this clock is carefully determined by observing certain bright stars with an instrument known as the meridian circle.

This instrument consists of a telescope mounted on trunnions like a cannon and supported by a pier of solid masonry. It is so arranged that it can be directed toward any point of the meridian line. On looking into the eye-piece of this telescope one sees a series of fine parallel lines running north and south across the field of view, the middle line marking the meridian.

When a time observation is to be made, the observer first selects a suitable star from a printed star list, which gives the exact time at which each of the principal stars crosses the meridian. He then sets the telescope at the proper points on the meridian to intercept the star, and, putting his eye to the eye-piece, waits for the star to appear.

As the star crosses each of the lines before mentioned he presses an electric key which he holds in his hand. The signals thus given are recorded electrically on a registering instrument called a chronograph, on which are also being recorded the seconds of the sidereal clock. The chronograph consists of a cylinder made to revolve by clockwork at the rate of about once a minute.

A paper wrapped around this cylinder receives the record traced by a pencil, which is connected by an electric magnet in such a manner that any signal, made either by the operator or by the clock, causes the pen to make a mark on the paper.

By examining this paper the observer is able to tell within the tenth of a second the time which the normal clock indicated when the star crossed the meridian.

Comparing this with the time taken from the star list shows the error of the clock. A comparison is then made between the sidereal and mean time clocks, which, after allowing for the difference between the mean and sidereal time, shows the error of the mean time clock.

If the clock is slow, a slight weight is placed on the top of the pendulum bob, which causes the clock to gain slightly. If, on the other hand, the clock is found to be fast, a corresponding weight is removed, making the clock lose slowly. In this way the standard signals are kept within a few tenths of a second of the correct time.—*The Ohio Valley Manufacturer.*

THE ORIGIN OF METEORITES.

In former times it was thought that meteorites were of terrestrial origin, thrown out by volcanoes, or condensed vapors, or else that they hailed from the moon.

These suppositions do not hold good when we consider the enormous initial velocity, the great number, direction and periodical recurrences of these phenomena. For the same reasons, is it impossible that they should be fragments of a destroyed satellite—a second moon—supposed to have revolved around our planet in past ages, or yet that they are diminutive, independent planets of our solar system.

The hypothesis that they are identical with shooting stars and comets is the one accepted almost universally by scientific men.

Most important discoveries tending to prove this assumption were made by Schiaparelli, showing that shooting stars, as well as meteorites, are solid bodies, which enter the atmosphere of our earth with an immense velocity and become luminous because of the resistance offered by the air.

It has been calculated that they usually appear at a height of about seventy miles above the earth and disappear at a height of fifty miles. The cause of their disappearance or extinguishing is to be looked for either in their once more leaving our atmosphere, or that they are atomized by the fierce heat generated by their extremely rapid flight and the great resistance offered by the atmosphere. The latter assumption would account for the continuous fall of cosmic dust upon the surface of our globe.

The velocity with which they enter and pass through our atmosphere is enormous. It is many times faster than sound, the flight of a cannon ball, and even the planets revolving around the sun.

The earth travels through space at the rate of 19 miles per second. Mercury, the fastest planet, covers 29.87 miles per second, while a meteorite which fell at Pultusk, Russia, had a velocity of 33·78 miles per second, although it had to overcome the resistance of the air. In space, consequently, it must have travelled still faster.

To clearly understand the high degree of velocity implied by these figures, it is well to add that the fastest cyclone scarcely reaches 150 feet per second, at which rate it exerts a pressure of about fifty pounds per square foot.

It now remains to explain the assumption that meteorites and shooting stars are identical, and to quote the facts upon which this assumption is based.

We know that both are solid bodies which enter our atmosphere from without, and that they become luminous for the same reason. Furthermore, the cosmic iron dust observed in localities where its origin could not be doubted has been found to have the same chemical composition as larger pieces of meteoric iron seen to fall by unimpeachable witnesses.

It cannot be denied that there is a very great contrast between the little star that silently glides through space and noiselessly disappears and the terrifying appearance of a ball of fire, that, approaching with deafening detonations, sends down on us a hail of stones.

Both spectacles, however, are but the extremes of a chain of closely connected phenomena. Considering with what extreme velocity these bodies pass through the atmosphere, it is not difficult to comprehend that particles, and those having the greatest momentum, are destroyed long before they reach the earth, and at such a height that the noise of their passage and disintegration becomes inaudible to us here below.

We find a further confirmation for the belief that both of these phenomena have the same source in the well established fact, proved in many instances, that the direction of the meteorites corresponds to that of shooting stars observed at the same time, and points to a common point of radiation.

The detonations accompanying the fall of a meteorite have three distinct causes: The whizzing is caused by its rapid passage through the air; the crackling, by the combustion of the materials composing it; and the thundering, by columns of air rushing into the vacuum which it leaves behind.—*F. C. Von Petersdorf, in Great Divide.*

WONDERS IN BONES.

Exhibited in a glass case at the National Museum, in Washington, there is a bone—a human tibia—tied in a knot. It has been rendered thus flexible by soaking it in acid, which has dissolved out of it all its mineral parts, leaving only the animal portion. This portion makes about one third of the bone, which fact might surprise some people who suppose that their bones are almost wholly lime.

"There are funny things about bones other than funny bones," said an osteologist connected with the Smithsonian Institution to a writer for the *Washington Star*. "For example, the bones of birds are hollow and filled with warm air from the lungs, so it may be said that a bird breathes down to its very toes and to the tips of its wings. In fact, if you break off the wing of a duck the animal can actually breathe through the broken end of the bone though you hold its head under water. Some of the gigantic reptiles of the mesozoic epoch, which some scientists claim to have been the ancestors of man, had hollow bones similarly filled with air from the lungs, for the support of their bodies in the water while they browsed upon seaweeds near shore, their massive and solid leg bones serving them as anchors, at a depth about sufficient to cover their backs.

"People continually imagine that their bones are of solid mineral construction without any feeling in them. No one who has ever had a leg or an arm cut off is likely to indulge such a mistaken notion. Comparatively speaking, little pain is felt when the flesh is being cut through, but when the bone is attacked by the saw, oh my!

"You see, as a matter of fact, there are blood vessels and nerves inside the bones, just as there are outside. Anyone who has purchased a beefsteak at the market knows about the marrow in the bone. It is the same with other animals than the beef, including human beings. Through the marrow run the nerves and blood vessels, entering the bones from the flesh without by little holes, which you can see for yourself any time by examining a skeleton or part of one. When the disease called rheumatism, which no physician understands, affects the nerves within the bones no way has been discovered for treating it successfully. It does not do to smile when a person says that he feels a thing in his bones.

"Nature adapts the bony structure of various animals to their habits in a very interesting manner. Sluggish creatures like the sloth have solid bones, whereas the bones of the deer and the antelope are comparatively light, so that they may run fast, and the leg bones of the ostrich are hollow. You will find in the bones of any skeleton the application of mechanical principles which have only become known to man through the processes of laborious and long considered invention. In your own shoulder you have a most beautiful and perfect illustration of the 'ball-and-socket joint,' while at your elbow there is a combination of the hinge and ball and socket which in its way surpasses anything that human invention has been able to accomplish thus far. But these are simple things compared with the hand, the bones of which exhibit the most perfect and complete apparatus, in its adaptation to the purposes for which it is intended, that has ever been imagined. How is it possible for any one who has studied the structure of his own hand to say that there is no God?"—*World's Progress.*

WHAT KEEPS THE BICYCLE UPRIGHT.

Let us suppose a 'cyclist mounted on his wheel and riding, say toward the north. He finds himself beginning to tilt toward his right. He is now going not only north with his machine, but east also. He turns the wheel eastward. The point of support must of necessity travel in the plane of the wheel; hence it at once begins to go eastward, and as it moves much faster than the rider tilts, it quickly gets under him, and the machine is again upright. To one standing at a distance, in front or rear, the bottom of the wheel will be seen to move right and left.

I conclude, then, that the stability of the bicycle is due to turning the wheel to the right or left, whichever way the leaning is, and thus keeping the point of support under the rider, just as a boy keeps upright on his finger a broomstick standing on its smallest end.—*Popular Science Monthly* for April.

A "COUNTRY GENTLEMAN" INVENTS A ROTARY EXPANSIVE STEAM ENGINE.

As reported in the *Glasgow Herald*, a really economical rotary engine, combining the advantages of strength, durability, lightness, small bulk, and accurate workmanship, has just been produced by Mr. A. F. G. Brown, of Swindridgemuir, Dalry, Ayrshire. Mr. Brown is not an ordinary mechanic, or an engineer by trade, but a country gentleman, having a natural inventive turn of mind, and being impressed by the fact that the designs of Watt and the Earl of Dundonald were frustrated in a great measure by their inability to produce a machine of the above-mentioned qualities, due to the rough tools they had to work with and the then current abhorrence against high-pressure steam.

Mr. Brown's engine consists of a cylinder, truly bored and ground to gauge, in which revolves a piston of peculiar shape, keyed to a central shaft which protrudes through the cylinder cover stuffing boxes and glands at each end. On one outer end of this shaft is fixed the valve gearing, and on the other an overhanging fly-wheel, which may be coupled direct or through the intervention of belting to any machine which it is desired to drive. The valve gearing consists either of eccentric motion or of three toothed wheels, of which the central one is keyed to the central shaft, and it drives the two outside wheels, which are fixed to rotating valves placed respectively between the boiler steam pipe inlet, and oscillating doors. These doors form when closed, part of the inner circumferential surface of the cylinder. The two outside wheels may be so adjusted with respect to the central one that the steam can be cut off at any desired part of the piston's revolution, or they may be connected to a governor, so as to cause a constant speed to be maintained under widely different loads and steam pressures. The steam inlet doors to the cylinder always bear steam tight against the revolving piston, and are automatically opened by the pressure of steam acting behind them whenever the piston comes to the point where admission of steam should take place. They are also automatically closed during the time that exhaust takes place by the piston. It will thus be seen that there are very few working parts, and that those which exist are of such a nature as not likely to get out of order, or to become leaky owing to the clever device of spring-adjusted fitting strips proportioned to the pressure and space through which the moving parts have to work. The cylinder receives steam twice during each revolution of the piston, and the higher the speed the greater is the economy, as proved by a set of brake horse-power and indicator diagram trials. The size of the cylinder employed in this instance was 10½ inches diameter by 8⅝ inches long, with a piston occupying half the volume of the cylinder. The engine gave by indicator cards 29 indicated horse-power and a mean of 20.78 brake horse-power throughout five hours' run at 574.5 revolutions per minute, with an initial steam pressure in the cylinder of 80 lbs. per square inch. The economy of steam is greater than any recorded results of any other rotary steam engine, and quite equal to the best performances of William's famous engines of the simple, single-cylinder, non-condensing type, for the gross weight of feed-water used per indicated horse-power-hour was only 27.2 lbs. This consumption would have been still less had it not been for the type of boiler used, the right-angle bends in the steam pipes, and the neglect to have these pipes properly lagged and the cylinder jacketed; for, 30 per cent. of the weight of steam used passed into the cylinder as water held in suspension and form initial condensation.—*American Engineer.*