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SCIENTIFIC CANADIAN
MECHANICS' MAGAZINE
AND
PATENT OFFICE RECORD

Vol. 10. MAY, 1882. No. 5.

CHARLES ROBERT DARWIN.

THIS renowned naturalist, whose theory respecting the origin of man has been the occasion of so much animated controversy, died on Thursday, April 20, at his residence Down House, near Orpington, England. He was the son of Robert Waring Darwin, and was born at Shrewsbury on February 12, 1809. Mr. Darwin was educated first at Shrewsbury School, under Dr. Butler, afterward Bishop of Lichfield; he went to the University of Edinburgh in 1825, remained there two years, and was next entered at Christ's College, Cambridge, where he took his B A. degree in 1831. His hereditary aptitude for the study of natural science must have been early perceived by his instructors. The Rev. Mr. Henslow, Professor of Botany at Cambridge, recommended him, therefore to Captain Fitzroy and the Lords of the Admiralty in 1831, when a naturalist was to be chosen to accompany the second surveying expedition of H.M.S. *Beagle* in the Southern seas.

The first expedition, that of the *Adventure* and *Beagle*, 1826 to 1830, had explored the coasts of Patagonia; the *Beagle*, which sailed again December 27, 1831, and returned to England October 22nd, 1836, made a scientific circumnavigation of the globe. Its main object was, by a continuous series of chronometrical measurements, to procure a complete chain of meridian distances; there were also important magnetic observations, but the zoology, botany, and geology of the different countries visited were examined by Mr. Darwin. He served without salary, and partly paid his own expenses, on condition that he should have the entire disposal of his collections.

Mr. Darwin discovered in South America three new genera of extinct animals. The President of the Geological Society declared that his voyage was one of the most important events for that science that had occurred for many years. To the general reader few books of travel can be more attractive than Mr. Darwin's *Journal* of this expedition, which he first published in 1839, and which has since gone through many editions. A delightful book for young readers has been compiled from his *Journal*, and published with many illustrations by Harper & Brothers.

Since the voyage of the *Beagle*, we believe, Mr. Darwin has not personally engaged in any distant explorations. He has resided during many years past in Kent, having married his cousin, Miss Emma Wedgwood, by whom he had a large family. The honors of several British and foreign scientific societies have been conferred upon him—the Royal medal and Copley medal by the Royal Society—and he has been created, by the King of Prussia, Knight of the order of Merit. He has frequently contributed to the transactions of the Geological, Zoological, the Linnæan, and other botanical societies, and his treatise on the Cirripœdia, published by the Ray Society, is one of his works held in much esteem. Botanists have appreciated his observations of the habits of climbing plants, and his very interesting book, published in 1862, upon the methods by which the fertilization of orchids is effected through the agency of certain insects. Mr. Darwin's reputation is thus independent of the philosophical theory which he propounds in his essay "On the Origin of Species by Means of Natural Selection." That bold and ingenious essay, which first appeared in 1859, has been printed by tens of thousans of copies, and translated into French, German, Italian, Spanish, and other European languages.

This is not the place to enter upon the discussion of a subject which has excited the most bitter controversy in scientific circles; but we may state that the great objection to the Darwinian theory is the want of that direct evidence of facts in its support which would surely be forthcoming if it were true. Geology bears record, in its fossils, of the existence during thousands of past centuries of many species now extinct; but we do not learn from the geologists that they have detected any one species in the act of transforming itself into any other. Within the range even of human observation of some living creatures, it might have been expected that, seeing the rapidity of their generations succeeding each other, short-lived as they are, we should find some recorded instances of such mutation. But the animals which old Egypt worshipped and those of which we read in old Egypt's fables were such as we now meet. Allowing, however, the lapse of hundreds of millions of years, antecedent to all geological dates, for the change from the simplest to the most complete living form, it is scarcely credible that the modification of a vegetating structure has produced in animals such an organ as the eye, much less the brain.

THE ENGINES OF THE "PARISIAN."

In our last issue we illustrated, as an example of one of the latest types of English marine engines, the powerful and compact engines built by, R. Napier and Sons, Glasgow, for the steamship Parisian—taken from the *Engineer*. This vessel is 450 feet long and 46 feet wide. and has 10,000 tons displacement.

The engines are vertical compounds, of the "tandem" type; that is, with the cylinders in line with the keel. In the previous illustration only the rear of the engines was shown. The accompanying engraving represents the front, and shows the valve and pump gear.

There are three cylinders, one high pressure and two low pressure, which are 60 inches and 85 inches respectively, with 5 feet stroke of piston. The crank shaft is of steel, 20 inches diameter; the crank pins are 21 inches diameter, by the same length. Steam of 75 pounds pressure is used.

The construction and arrangement of the engines is so well shown in the engraving, that we need add but little by way of explanation. The piston valves are worked by a link motion, which is peculiar in some details, especially the rock shaft and levers which connect the link motion with the valve stems.

These engines are handled for reversing or going ahead by a single steam cylinder, which is located behind the central main cylinder, connecting directly by a rod with the reverse shaft, the arm of which is shown in the engraving of the main engines, instead of by a separate engine.

These engines were run at 85 revolutions per minute, at which speed they indicated 6,020 horse power. This very high piston speed shows to what perfection modern workmanship has attained when it is possible for even so short a time.

THE AMERICAN WORKINGMEN.

Dr. Lyon Playfair, one of the most prominent of English men of science, and a member of Parliament, who lately returned to his native country from a tour in the United States, has published some of the results of his observation of men and things in this country, which convey some very instructive and suggestive statements bearing upon the industrial future of the United States. Coming as they do from a representative Englishman, of large views, thoroughly competent by reason of his intimate familiarity with the industries of his own country, and favored with every facility for obtaining accurate information, Mr. Playfair's opinions are of special interest.

Mr. Playfair publishes in a recent number of *Macmillan's Magazine*, entitled "Industries of the United States in Relation to the Tariff," in which we find some material for future consideration, and some comments on the position of the workingman in the manufacturing States, which last specially interests us here. We shall give, therefore, in the following a brief summary of the author's impression on this subject.

Mr. Playfair states that the true American mechanic, by descent, education and training, is excellently adapted to his work. His chief centre is in New England, though he is rapidly spreading everywhere. The original settlers in New England were men of strong will, and above the average of the Old Country in education and enterprise. Their early love for education is shown in the fact that soon after their settlement, they established Harvard College. These men landed on a rough, inhospitable coast, covered with wood, and they had few tools with which to conquer nature. They were obliged to be men of many resources. In possession perhaps of a single tool, they turned it to many purposes, and if it did not suit, they altered it. Thus reliance, inventiveness and industrial application developed together.

The soil of the New England States is the poorest for agricultural purposes, while the climate is not sufficiently changeable for a large variety of crops. The rocky and poor soil upon which the early settlers landed, forced the increasing population into manufactures and commerce, so that they acquired habits of industry and thrift. As they gradually extended westwards and southwards, better climate, land and raw material opened up new sources of wealth, and the qualities acquired by the first colonists enabled their descendants to take advantage of improved conditions.

The New Englanders never forgot that their superior education had been of powerful assistance to them as early settlers, and they kept up knowledge among their descendants. It is a rule among Americans that the schoolhouse must precede the factory, and that capital applied to industry without knowledge is worthless.

Even the Puritan sense of religion, Mr. Playfair believes, has had great effect on manufactures. The commandment, "Thou shalt not steal," is carried out in manufactures. When cotton goods are sold, the material is wholly cotton, and is not weighted with China clay or sulphate of baryta. The 600,000 muskets sent out to Turkey during the war, were made to shoot and not to sell.

American goods, he affirms, are dear, but they are true and good. The example of New England spreads over the Union, and has produced an honest and efficient workman everywhere. The high price of labor gave a great stimulus to the invention of labor-saving machinery, while the patent laws wisely encouraged inventions.

Thus, the true American mechanic is generally superior to, though not dearer, than the mechanics who enter by immigration. He is too dear for inferior work. But even in the case of imported labor, American industry has a great advantage over other countries. The emigrant arrives in the full power of production, while the country which sent him forth had to pay for his childhood, during the years in which he possessed no productive value.—*Manufacturer and Builder*.

A WESTERN writer tells the story, which no other would be likely to do with equal felicity, of a tree recently brought from Australia to Nevada, "which has been in the habit, at night, of going to roost like the chickens. The leaves fold together, and the ends of the tender twigs coil themselves up like the tail of a well conditioned pig. After one of the twigs have been stroked or handled the leaves move uneasily and are in a sort of mild commotion for a minute or more. Indignant at having been transplanted the other day, it had hardly been placed in its new quarters before the leaves began to stand up like the hair of an angry cat, and soon the whole plant was in a quiver. It gave out a most pungent odor, which filled the house, and was so sickening that it was found necessary to upon the doors and windows. It was fully an hour before the plant calmed and folded its leaves in peace. It would probably not have given up the fight then had it not been that its time for going to roost had arrived. The whole household now stand in awe of that plant."

SALYCICLIC ACID AS A DYSINFECTANT for cattle care is said to be far preferable to carbolic acid, as it is quite as energetic, and leaves no unpleasant smell behind. It is employed largely abroad by veterinary surgeons as a curative agent for many diseases to which animals are subject, and is found useful in checking the spread of contagion among them. Its most important use, however, is for the preservation of food. During the prevalence of hot weather, meat, fish, etc., can be preserved by its use for several days.

Engineering, Civil & Mechanical.

ELECTRIC RAILWAYS.

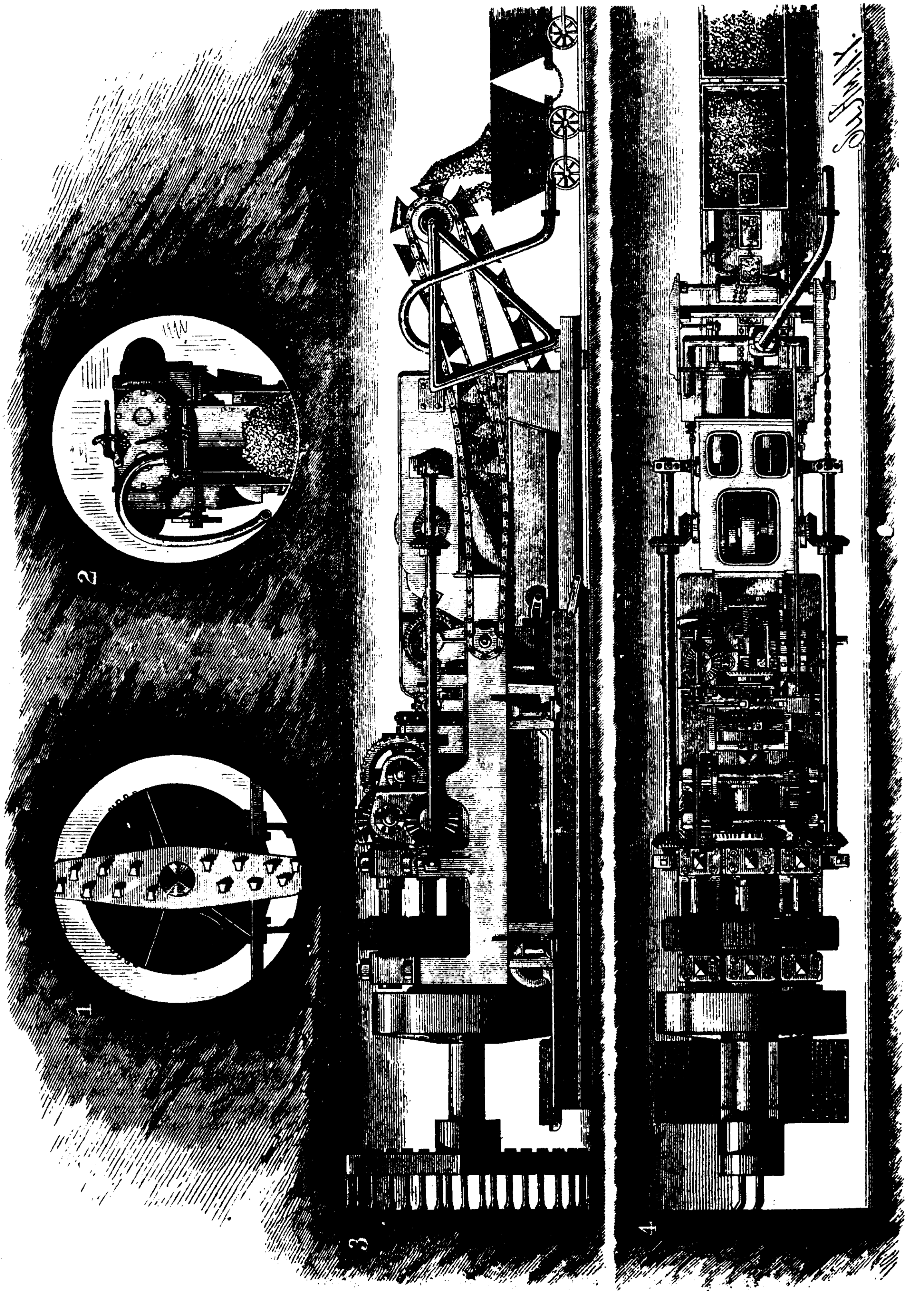
A lecture on the utilization of electricity for working railways was recently delivered before the Birmingham and Midland Institute, by Prof. Ayrton, F. R. S., who, in conjunction with Prof. Perry, has been making a special study of the subject. Engineers, said Prof. Ayrton, had been turning their attention to the consideration whether electricity might not supplant steam or compressed air for trains and tramcars. The question was mainly one of expense, and what they had to consider was whether electric transmission of power would lead to greater economy than was possible to be obtained with an ordinary locomotive. The weight of a railway carriage filled with people was about seven tons, while the weight of a locomotive engine varied from twenty to sixty tons. Therefore the average weight of every engine might be taken as being equal to six carriages full of people. Ten carriages usually formed a train; therefore the presence of the locomotive necessitated the expenditure of at least fifty per cent. more power than would be necessary, merely to pull the train along. A still more serious objection to the use of the locomotive was that every bridge must be made many times stronger than would be necessary merely to carry railway carriages; and the repairs were many times as expensive. Compressed air had enabled the railway companies very successfully to apply brake-power to every wheel of a train; but it was to electricity that they must look to drive the train, by power applied to every pair of wheels. The electrical energy, however, must be produced either from the burning of coal, from the energy of the mountain stream, the force stored up in chemicals, or the energy of the wind. At the present time it was the first of these—namely, the potential energy of coal, which was applied to railway propulsion; and it was that form which would still be employed even when they had electric railways, as it was found that the driving of a dynamo-electric machine by a stationary steam-engine would produce electricity more economically than it could be produced by the burning of zinc in a galvanic battery. By means of a small gas-engine, driving a Gramme machine, the lecturer showed how power was produced which could be transmitted by wires, and made to work a lathe, a drill, or other apparatus at a distant point, and he explained that this method of producing electricity was the more economical by the fact that a pound of zinc only contained about one-seventh of the energy contained in a pound of coal, while the former was about twenty-five times as expensive. In employing electricity to drive a drill, flexible wires could be used to convey the current; but to drive a carriage along a railway, the simplest plan was to use the rails as the two wires, the one rail acting as the going wire, and the other as the returning wire—the electricity being taken into the electro-motor by the wheels on one side and sent back by the wheels on the other. The rails, however, must be insulated from one another, or the electricity would pass from the one to the other instead of going through the motor. It had been found hitherto impossible to insulate a long line of rails sufficiently to prevent excessive waste from leakage, and his colleague, Professor Perry, and himself had spent considerable time in devising methods to overcome this difficulty without adopting the method, which, however, had been successfully used for tramway purposes, or taking a supply of electricity with the conveyance by means of a Faure's accumulator. Instead of supplying electricity to a very long and badly insulated rail, their plan was to place by the side of the line a well-insulated cable, by means of which the electricity was supplied to a comparatively small section of the railway over which the train was at the time running. As the train left one section and passed on to the next, a brush attached to it came in contact with a mechanical contrivance which transferred the electric current to the next section, and so on throughout the number of sections of which the line might be composed. Dr. Siemens had shown practically that an electric railway would answer over short distances, and the lecturer submitted that by making up the line of short lengths, each of which was automatically rendered electrical in its turn, the difficulty arising from leakage over an extended line was overcome. He showed the working of the system by means of a model circular railway about 10 ft. in diameter, divided into four sections; and he pointed out that its arrangement afforded means by which an apparatus in a signal-box would show over what section a train was moving.—*English Mechanic.*

COMPRESSED-AIR MACHINE USED IN THE CHANNEL TUNNEL.

The length of the Submarine Continental Railway Company's Tunnel, under sea, from the English to the French shore, will be twenty-two miles; and, taking the shore approaches at four miles on each side, there will be a total length of thirty miles of tunnelling. The approach tunnel descends from the day light surface by an inclosed gallery, with an incline of 1 in 80, toward Dover, to a point on the Southern Railway-Company's line, about two miles and a half from Folkestone. The exact point is at the western end of the Abbot's Cliff tunnel, at which point the gault clay outcrops to the sea level. Half a mile of heading has been driven, by machinery, from this point; after which the works were suspended to enable them to be resumed at a point nearer to Shakespeare's Cliff, where the tunnel passes under the sea. The shaft at this point is 160 feet deep. It is sunk close to the western end of Shakespeare's Cliff. The shaft passes through about 40 feet of overlying *débris*; it then just touches the white chalk, which is pervious to water, after which it goes down to the beginning of the tunnel, which is here 100 feet below the surface of the sea. A heading, now three quarters of a mile long, has been driven in the direction of the head of the Admiralty Pier, entirely in the gray chalk, near its base, and a few feet above the impermeable strata formed by the gault clay. The idea of the projectors is so to localize the tunnel, not only in the part already made, but also when it passes out under the sea, that it shall have the body of the gray chalk above it and that of the gault clay below it, both these strata being in themselves impervious to water, and both alike having heavily watered strata on each side of them; namely, the white chalk above the gray chalk, and the lower greensand below the gault clay. This condition, together with that of providing sufficient roof between the top of the tunnel and the sea, which roof has a thickness of 150 feet, will necessitate the tunnel being turned in a curved line.

The present heading is 7 feet in diameter. Machinery is being constructed by which this 7 foot hole can be enlarged to 14 feet, by cutting an annular space, 3 feet 6 inches wide, around it. This will be done by machinery similar to that already described, but furnished with an upper bore head, suitable for dealing with chalk, to make an annular cutting, instead of acting like the first machine, which makes the 7 foot cutting. The one machine will follow the other, at a proper interval; and the *débris* from the cutting by the first will be passed out through the second machine. The compressed air, likewise, which is necessary to work the advanced machine, will be similarly passed through the machine coming behind. There will be no difficulty in speeding the machine so that they shall work along the tunnel at the same rate of progress; and the larger machine can, as well as the smaller one, do its work with a minimum of manual labor; only two men are at present needed for each machine.

The engraving shows the Beaumont & English compressed-air boring machine at work. The length of this machine from the borer to the tail end is about 33 feet. Its work is done by the cutting action of short steel cutters fixed in two revolving arms, seven cutters in each, the upper portion of the frame in which the borer is fixed moving forward five-sixteenths of an inch with every complete revolution of the cutters. In this way a thin paring from the whole face of the chalk in front is cut away with every turn of the borer. A circular tunnel is formed having a diameter of 7 feet. A man in front shovels the crumbled *débris* into small buckets, which, traveling on an endless band, shoot the dirt into a "skip" tended by another man. The skip, when filled, is run along a tramway to the mouth of the shaft. At present these trolleys, each holding about one-third of a cubic yard, are drawn by men, but before long it is hoped that small compressed air-engines will be used for traction. The rate of progress made with the machine is about one hundred yards per week, but will soon be much accelerated. As worked at present, the number of revolutions it makes is two or three per minute, which, as the advance by each revolution is five-sixteenths of an inch, amounts to boring nearly an inch a minute while the machine is at work. But Colonel Beaumont anticipates no difficulty in making the machine cut its way at the rate of three-eighths of an inch per revolution, and getting five revolutions per minute, which would give a rate of advance of two inches per minute. A very important question has been raised with regard to the supply of compressed air. Carried in four-inch iron pipes, it now reaches the machine with a pressure of about 30 lb., the pressure at the compressor at the shaft mouth being from 30 lb. to



BEAUMONT AND ENGLISH'S COMPRESSED-AIR TUNNELING MACHINE EMPLOYED IN THE CHANNEL TUNNEL

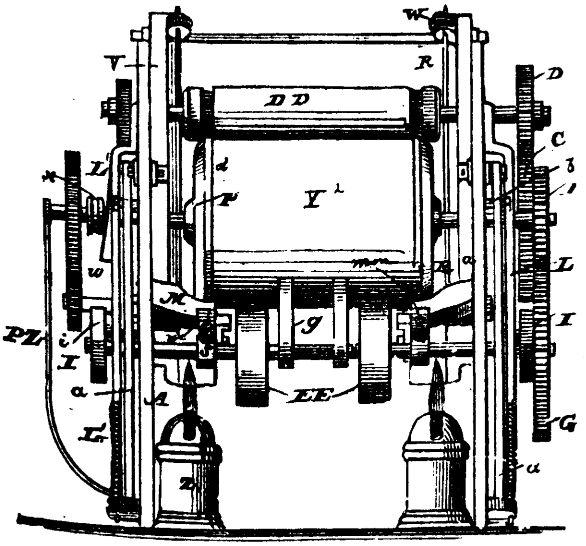


FIG. 2.—AUTOMATIC SOLDERING MACHINE.

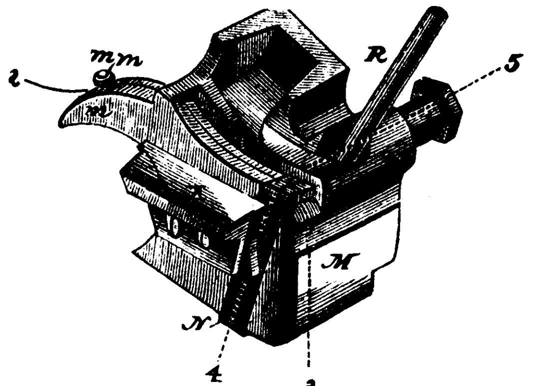


FIG. 3.—AUTOMATIC SOLDERING MACHINE.

45 lb.; but by increasing the diameter of the supply pipe to eight inches the loss of working value by friction would be greatly diminished, if not rendered inappreciable. The boring has now advanced to the length of 1,250 yards, or, say, three-quarters of a mile, and it is going on at the rate of three miles a year. Simultaneous borings from the French side at the same rate would give six miles a year, or a complete tunnel underneath and across the Channel in three years and a half.

The shape which the completed tunnel will assume will probably be a circle 14 feet in diameter, but flattened at the bottom to receive the rails. It will be lined with two feet thickness of cement concrete; not that this is necessary to insure the stability of the work, but to prevent accidental falls of chalk. The concrete will be made of shingle from Dungeness, and of cement formed from the gray chalk excavated from the tunnel itself. In this manner the tunnel will afford the means of its own lining at a cheap rate. The gradients will be 1 in 80, on each side, until the depth 150 feet below the bottom of the sea is reached; after which the line may be said to be level, subject only to a very slight inclination from the center outward, to prevent the lodging of water.—*Scientific American.*

AUTOMATIC SOLDERING MACHINE.

Messrs. Williams and Forbes, of Dover, Del., have recently made useful improvements in that kind of machinery designed to be used for soldering to the bodies of tin cans. This is accomplished by certain devices which operate automatically, thus saving hand labor in the soldering operation as well as in the delivery and removal of the cans.

Fig. 1 is a side view of the machine. Fig. 2 is an end view. Fig. 8 is a perspective view of the iron M, and the copper bar N, by which the molten solder is held and applied.

The operation of the machine is as follows: Power being applied to the crank or belt wheel Q on shaft S1 of Fig. 1, is imparted to the various wheels and shafts. The roller D D is lifted and disk P is withdrawn. A can Y, is now placed on the feed board O, rolls over the pulleys E E, and rests immediately upon E E and the roller C C and the copper bars N at each end. The bar L now descending, the can is firmly gripped between the disk P at each end, and the roller D D above C C and E E below. At the same time the disk P is pressed firmly against the head of Y by the action of the spring P Z upon the end of the shaft S4. The disks and rollers give a powerful rotary movement to the can. Bits of solder from the cutting apparatus have already been dropped from the tube V upon the irons M and M. When melted the solder flows down into the curved part of the iron M. This curved upper edge of M forms a small reservoir for the melted solder. Each head of the can runs over one of these reservoirs and upon the point of the bar N. During the rotation of the can the back ends of the irons M are gradually raised by the scroll cams *s*, thus pouring the molten solder forward to the point of contact between Y and N, and the friction between N and the seam of the can applies the solder evenly to all parts of the seam. The soldering operation being completed by one or more rotations of the can, the roller D D is again lifted, the disk P withdrawn, the arm *g* throws the soldered can off the iron M upon the chain K in time for the introduction of another can before the roller D D descends, and the operation is repeated without loss of time or stoppage of the machinery. The sagging belt or brake S B, by its contact with the cans upon the carrier, K, retards their forward movement and continues their rotary movement until the solder is entirely cooled.—*American Inventor.*

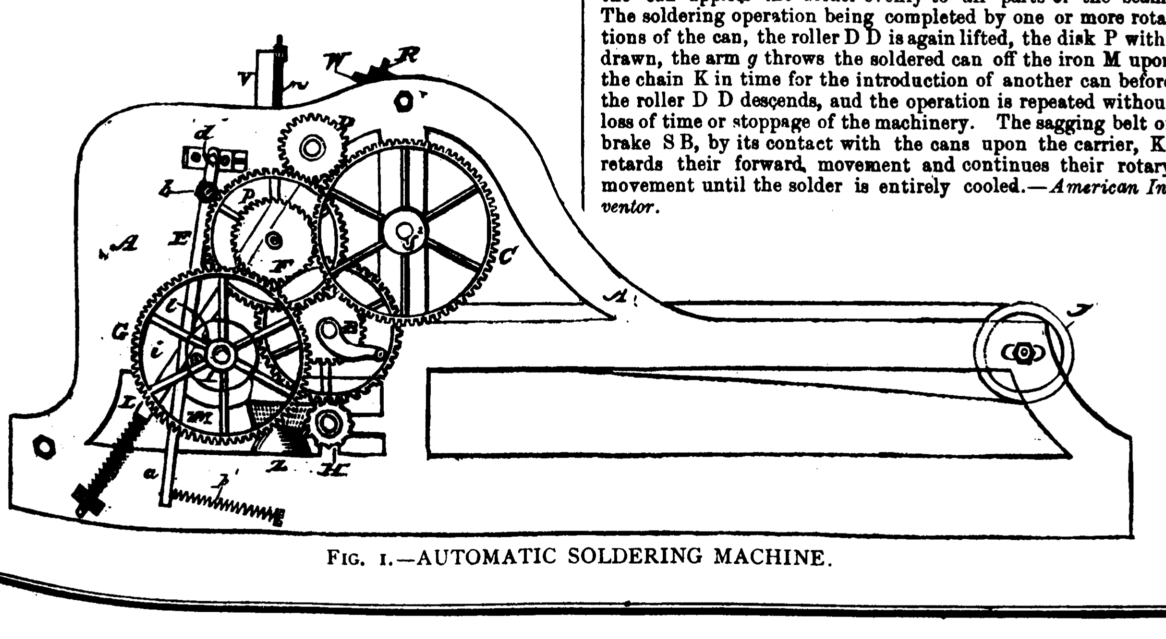


FIG. 1.—AUTOMATIC SOLDERING MACHINE.

THE MOTIVE POWER OF THE FUTURE.

If we read aright the signs of the times, the industrial world is to-day standing on the threshold of a revolution as profound as that which was ushered in with the advent of steam as a motive power. From all quarters we hear of new advances in the modes and appliances for generating and utilizing electricity for the most diverse purposes; and enough has been achieved within the past few years to render it almost certain that the close of the present century will find it as universally applied in the arts and industries as is steam at the present time.

From the calculations of one of the most distinguished English scientists, it would appear that the world has used up during the past hundred years more of the energy stored up in the earth than in all the ages that have preceded them. This assertion, startling as it may seem, does not appear unlikely or overdrawn when we come to figure up the enormous yearly drains made upon the stored energy of the earth by the ever expanding demands of the arts and manufactures. In all civilized countries the annual consumption of coal is steadily on the increase. In the year 1881, the estimated production of coal in Great Britain alone was 150,000,000 tons; in 1880 it was 140,000,000; and in 1877 the annual out-put was 125,000,000. We have here an average yearly increase of 6,500,000 tons. The yearly production of Germany and Austria is estimated at 73,500,000 tons; that of France and Belgium, 32,000,000; and for the other countries of Europe the aggregate is figured at 6,500,000 more. Adding these quantities together, we have a yearly production for Europe alone of 262,000,000 tons. Turning to this country, we find the annual production of anthracite coal in 1881 reached the hitherto unprecedented figures of 30,000,000 tons, while that of bituminous and other forms of fossil fuel was not less than 40,000,000, giving a total of 70,000,000. Adding together these figures, we have the grand aggregate of nearly 350,000,000 tons of coal, representing the world's consumption for one year.

There is no danger, even with these enormous quantities, and providing for their increase at the same rate at which they have increased in the past, that the supplies of this fuel will give out for centuries to come But one of the most noticeable things in connection with these facts, is the enormous wastefulness of our methods of mining and consuming coal. Every ton of coal put into the market represents a ton left in the mines, or at the breakers where it is prepared for use; and from every ton of coal consumed we have thus far been able, even with the most approved appliances, to realize scarcely one-quarter of its stored up energy, measured by the amount of work we are able to get from it.

It will be apparent from these statements that it is only the abundance of the material that makes it available as a source of power. Were it otherwise than plentiful, the enormous wastefulness attending its production and use would make it valueless to us.

There are, besides all this, serious objections that necessarily accompany the use of coal as a source of power. It is bulky and requires enormous labor to transport it to market. It gives off vast volumes of deleterious gases and soot in its combustion, which poison the atmosphere, and it leaves behind vast quantities of ashes which must be laboriously removed.

As regards steam, through which the stored up energy of coal is made available for doing work, the apparatus and machinery necessary for employing it are cumbersome and expensive, and the steam boiler which is as necessary to the smallest steam engine as to the largest, is no freer from the danger of explosion than a century ago.

From all these disadvantages and drawbacks electricity is free. Silent, rapid and powerful, it makes no dirt or ashes, evolves no noxious gases, may be transmitted over incredible distances without serious loss, through small metallic wires, that when once in place require nothing for their maintenance, and yield us light as well as power.

When the vast natural resources of power—the wind, the waves, the tides, the river currents and waterfalls—are considered, that are now allowed to run to waste, a faint idea is had of the possibilities that are within the grasp of mankind, and that doubtless will be realized by future generations. When these enormous and exhaustless floods of wasted forces are coerced into the service of man and made to do his bidding, the aggregate of power at his disposal will be almost infinitely increased over what it now is; nor will he be using up the world's energy the more speedily, for the sun will be its perpetual regenerator.

The utilization of some of these natural forces on a large scale, with electricity as the agent for transmitting and developing their energy, is among the possibilities of the immediate future, and no one can foretell the magnitude of the changes that it may be destined to carry with it.—*Manufacturer and Builder.*

IRON AND WOODEN BRIDGES.

The recent accident on the Boston and Maine railroad, where a passenger train broke through the iron bridge, has called out some comments in the press concerning the relative value of iron and wooden structures. The position taken that there is yet considerable doubt in the minds of conservative railroad managers whether the change from the earlier types of wooden bridges, which have been worn out in service, to the later, and certainly more pleasing in appearance, iron bridges has been attended with due economy, all things considered or attended with greater or even equal safety. The question of economy does not admit of the same general treatment that other branches of the subject do, although the substitution of iron for wood by nearly all the leading railroads of this country speaks very well for the economy of the change.

In no other country has wood been employed in bridges so much as with us. The success of American engineers with wooden bridges has been the subject of admiration of the engineering profession the world over. Why they were led to develop this class of bridge, perhaps, arose from the necessity of building cheap bridges when railroads could not pay for any other. It is hardly fair to assume that engineers who have done so well with a material like wood cannot distinguish themselves to the same extent in the construction of iron and steel bridges. In fact, with the many fine examples of engineering skill in large span iron bridges, this cannot be considered an open question.

A margin of safety of five is one that is very often supposed to be employed. It is comparatively easy to provide just that margin in the full section of the different tension members. Some uncertainty may exist with the compression members, but greatest of all is the difficulty of getting the joints throughout to have their proportional strength.

The facility with which iron can be brought into various shapes is an advantage not possessed by wood. The shearing strength of timber is so slow, as compared with its tensible strength, that it becomes quite a problem how to make use of the greater part of its tensible value. So far as we have actual proof of the ability of the material to do its work, the advantage is on the side of the iron. It is claimed in favor of wooden bridges that they give premonitory signs of failure, that engine-drivers will discover these signs in running over the bridges early enough to have the necessary repairs made. But a locomotive and well-filled train of passengers cars is a startling kind of test to apply to a decrepit wooden bridge! If we are to rely upon such tests, let us hope the engine-drivers are men of more than ordinary judgment.

As to the durability of iron, it has been found by German experiments, extending over a term of years, that iron is practically indestructible when strained within the limits bridge engineers require of their metal.

Tests of iron from old bridges that have been strained repeatedly as high as 20,000 pounds per square inch, have not shown the metal injured. The durability of wood has not been the object of such searching investigation. The difficulty of getting several large sticks uniform in quality upon which to make a series of experiments, interferes with the success of such an undertaking. Data that are available upon this subject, go to show that wood, under high strains, has very little durability. Boston *Journal of Commerce.*

Removing Paint from Carved Oak.—Wet the oak with naphtha until the paint begins to dissolve, and when it softens take away the paint with a palette knife. The process is a tedious one, since much care is required to prevent the wood being scraped away with the paint, but it can be done. If a great amount of carving has to be cleaned, the labor may be lessened by dissolving the paint by a spirit lamp instead of naphtha. The lamp has a jet of a peculiar structure, which flattens the flame and disperses the heat over a large surface. It is held to the paint, and, when the paint softens, it is scraped away with a blunt-pointed palette knife. It must be used carefully, or the carving may be burnt.

THE FLANNERY BOILER SETTING FOR THE PREVENTION OF SMOKE.

Under this title, Mr. Chas. A. Ashburner read a paper at the last meeting of the American Institute of Mining Engineers, which we deem to possess so much of interest to our mechanical readers that we present the substance of the paper in our columns. For the use of the engravings we are indebted to the courtesy of the secretary, Dr. T. M. Drown.

In introducing his description, Mr. Ashburner refers to the innumerable appliances that have been proposed and modifications of boiler furnaces that have been devised, for the prevention of the smoke nuisance. He then proceeds to explain that the Flannery boiler-setting contains probably no original device, but is rather a new combination of parts, which in its practical working, effectually prevents smoke from being thrown off from the chimney, and utilizes the heat units contained in the products generally lost. The quantity of fuel required to produce a given result is in consequence reduced.

In his explanation of the character of combustion, and of the products of combustion in the ordinary furnace grate, Mr. Ashburn states that the products of bituminous coal on a furnace fire-grate are generally considered to be steam, carbonic acid, carbonic oxide and soot. Of the first, two are incombustible, and the last two combustible. To these four products may be added the nitrogen of the air. In cases, even where the draught of air through the grate bars is not excessive, there is a certain amount of unconsumed oxygen which passes through the boiler flues with the products of combustion. Absolutely perfect combustion of bituminous coal, says Mr. Ashburner, whose description we shall now follow, produces only steam and carbonic acid. The more nearly a furnace approaches this result, the more efficient is it in economizing fuel and in the prevention of smoke, or, more strictly speaking, soot, which is the solid carbon contained in smoke.

The economy of combustion in the Flannery furnace lies in the fact that the soot and carbonic oxide (which pass off through the chimney of an ordinary furnace) are almost entirely converted into carbonic acid before leaving the boiler flues. It is not my purpose to claim for this furnace the greatest economy of construction or duty, or even to make comparisons with other furnaces or boiler-settings which have been devised to accomplish the same end, but merely to describe a boiler-setting, which, by experience, has been found to be practical and economical, and which seems to accomplish all that the designer claims for it. It is impossible to state in precise terms the value of the increase of heat obtained. As a rule, practical results differ so widely from theoretical computations that they can best be made after the determination of empirical values. The most important results to be noted, where this furnace is at present being used, are: The total absence of smoke where a dirty and highly bituminous coal is being consumed, a total saving of about 33 per cent. of the coal required in an ordinary boiler-setting with the use of the same boiler and engine, and a great saving in the labor required to keep the flues clean.

The front portion of the furnace may be constructed after any of the ordinary designs which are applicable to a plain cylinder, cylinder-flue, cylinder-tubular, or the other general forms of steam boilers in common use. The boiler which is illustrated by the accompanying drawings is an ordinary cylinder-tubular boiler, which is being erected at Beloit, Wis., for the Rock River Paper Company. The most important points to be noticed in this boiler, are, the gas flues at G, Fig. 1, where the temperature of the products are equalized; the secondary grate A, with incandescent coals through which the products are passed, and the air ducts C above this grate, where heated air is introduced, whereby combustion is completed in the chamber I. After combustion has taken place at the front grate N, the products resulting therefrom pass under the boiler and over the bridge wall M. At the rear end of what is called the combustion flue, and a short distance (about 1 foot) back of the end of the boiler, the gases and soot are deflected by a fire-brick wall downwards and caused to pass through 25 circular flues in the lower part (Figs. 4 and 5). These flues are 3 inches in diameter and 1 foot 3 inches long. In the furnace which has been working for some time at Akron, Ohio, there is but one large opening in this wall, but the substitution of a number of smaller flues is thought to be a decided improvement. The flues are cleaned when necessary from the ash door E, or, better, from the door H, which is placed for this purpose. In practice the flues do not become coated with soot.

After going through these flues, the products pass up through the water grate A, which is covered with incandescent coal. The fuel here may consist of wood or anthracite coal or, better still, coke. The grate is surrounded by a fire-brick wall perforated by holes B, which lead into an air duct opening at the doors B', Fig. 2. This air duct is only used in kindling or when the fire on the secondary grate becomes dead. In cases where limestone water is only to be had, a tile grate is employed instead of a water grate (see Fig. 5). The latter is, however, adjustable and can be easily replaced when the pipes become coated with lime or burnt. Immediately above the surface of the incandescent fuel there is a second air duct C C', which is similar to the first, and which admits of the constant influx of air. The air is heated before entering the surface by a free circulation around the wall confining the incandescent coals. The charging door for this grate is at F; I is the combustion chamber, from where the ultimate products pass through the boiler flues and are carried off by the chimney located at the front end of the boiler.

The principles involved in the working of this furnace are familiar ones. When atmospheric air enters the incandescent coal on the front grate its oxygen unites with the carbon of the coal and forms carbonic oxide. The excess of air becomes heated, and, if the temperature is sufficiently high, a union of the carbonic oxide with the oxygen of the air takes place and carbonic acid results. This is the case only in perfect combustion. In experience it is found that the gases above the grate and in the combustion flue beyond the bridge wall are carbonic oxide and air which have not united, in addition to the carbonic acid. The products of combustion which come from the front gate and enter the restoring flues G, are, therefore, a mixture of carbonic acid, carbonic oxide, air, soot and steam.

In substituting a number of flues for one large one, a greater surface is gained and the gases are more homogeneously heated. Of course these flues cannot give out any more heat than they absorb from the heated products as they come from the first grate. As the heat of these products is variable, due to firing and other causes, the heat of the flues will be an average of the heat of the products, and the gases as they enter the ash pit of the second grate will have a more uniform heat than before entering the flues. When these products enter the incandescent coal on the second grate the carbonic acid unites with a portion of the carbon of the fuel and forms carbonic oxide. This is a direct loss of heat units. The heat, however, is regained by the carbonic oxide thus formed uniting with the oxygen of the air introduced through the ducts C, C', and carbonic acid results. The carbonic oxide which comes from the front grate is raised above the point of ignition by the incandescent fuel and unites with the oxygen of the introduced air and forms carbonic acid. The excess of air enters the coals on the second grate and undergoes the same conversion as that which took place with the air entering the first grate. The particles of carbon forming the soot from the first grate are raised to incandescence and, uniting with the air from the ducts C' C'. form carbonic acid.

The steam is decomposed in passing through the coals on the second grate, the oxygen uniting with the carbon forming carbonic oxide, which is afterwards converted into carbonic acid above the surface of the coals. The liberated hydrogen unites with the oxygen of the air introduced through the ducts C, C', and again forms water. The ultimate products resulting from combustion in the Flannery furnace are thus carbonic acid, steam and a small amount of carbonic oxide, but no soot.

The gases which go off in the chimney are of a higher temperature than in an ordinary furnace-setting, and this fact very materially assists the draught. At the Akron water works the chimney is erected at the rear of the boiler, and, although the gases are returned from the smoke-arch the entire length of the boiler, a sufficient draught has always been maintained.

A number of the Flannery furnace-settings have been constructed, and, after a trial extending over several months, have produced more than anticipated results in economizing fuel, in the consumption of soot and consequent prevention of smoke, and in a reduction in the labor, especially in that required to clean the flues.

At the Akron water works, recently constructed, two tubular boilers, 5 by 18 feet with 64 4-inch flues each, have been set on the Flannery system. Two Worthington pumps have been erected, one a compound high pressure, the other a compound condensing. Up to the present time the high-pressure pump and one boiler have alone been in service. The facts which have been noted in regard to the efficiency of the furnace have been very general, but they are such as to indi-

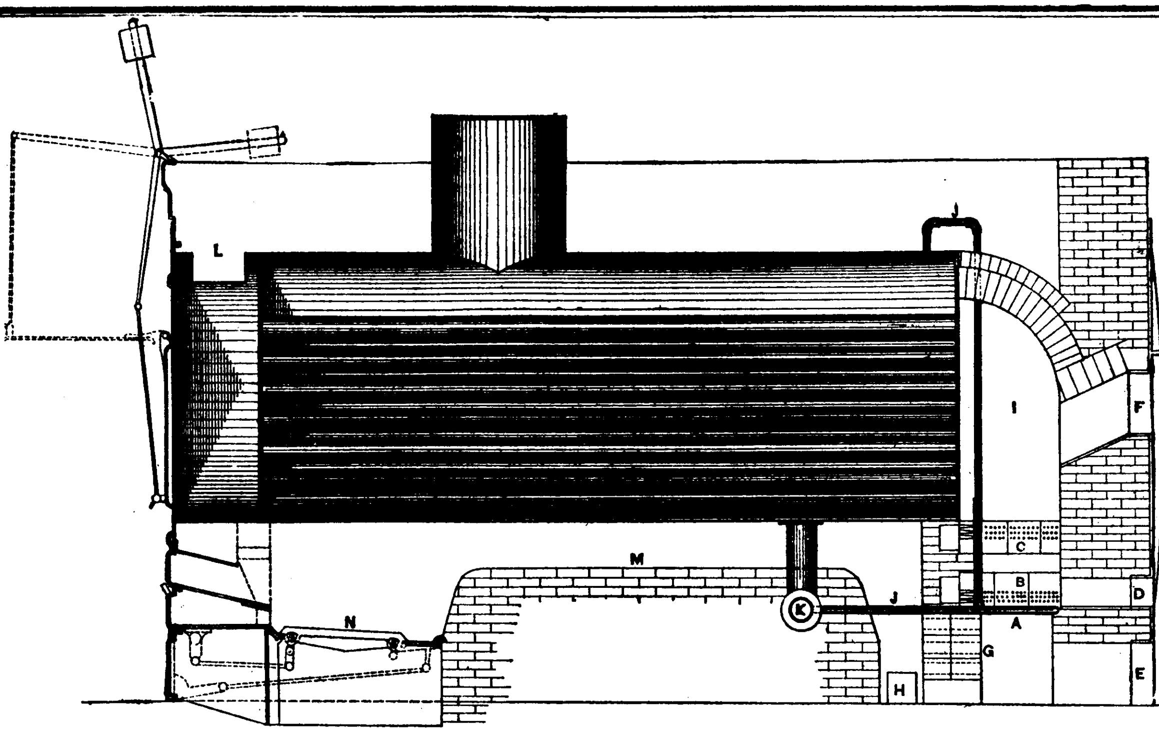


Fig. 1.—LONGITUDINAL SECTION.

cate its economy. The furnace has been fired, day and night, for eleven days, with 14 tons of a dirty, bituminous slack coal, which is mined in the vicinity of Akron, and sold at the works for $1 per ton. On the second grate Connellsville coke has been used, costing $6 per ton. For every ton of coal burned 300 pounds of coke have been used, the coke costing 90 cents per ton of coal consumed. The total cost of fuel for eleven days was $26.60.

The reservoir attached to the works is 210 feet above the pumps and 2,700 feet distant. The consumption of water has been about 1,000,000 gallons per diem. To do the same work the boiler with the usual setting would have required at least 35 tons of coal, at a cost of $35.

The average saving which would result in most cases from the use of the Flannery furnace would undoubtedly be greater than that shown at Akron, where the coal used is very poor and the cost exceptionally low. At Akron, local conditions made it necessary to return the gas from the smoke arch to the rear of the boiler where the chimney is located through a flue 40 inches square and 27 feet long. This is considered to be a disadvantage. I am informed by the superintendent of the works that the labor required to run this boiler is one-half of that which is ordinarily required with the usual setting.

The advantages which are claimed for this boiler-setting are: Economy of fuel and prevention of smoke, economy of labor, more even action of the boiler and its longer continuance in service, due to the small amount of deposits in the flues.

The system is particularly applicable in the setting of boilers where continuous service is required, where the cost of the fuel is great, where the space occupied by fuel is valuable, or where the production of smoke is objectionable.—*Manufacturer and Builder*.

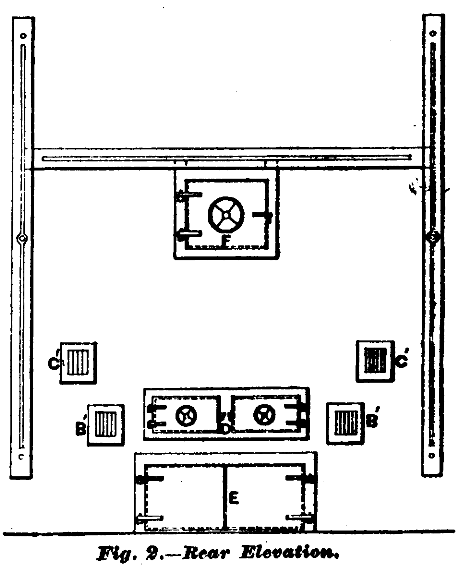


Fig. 2.—Rear Elevation.

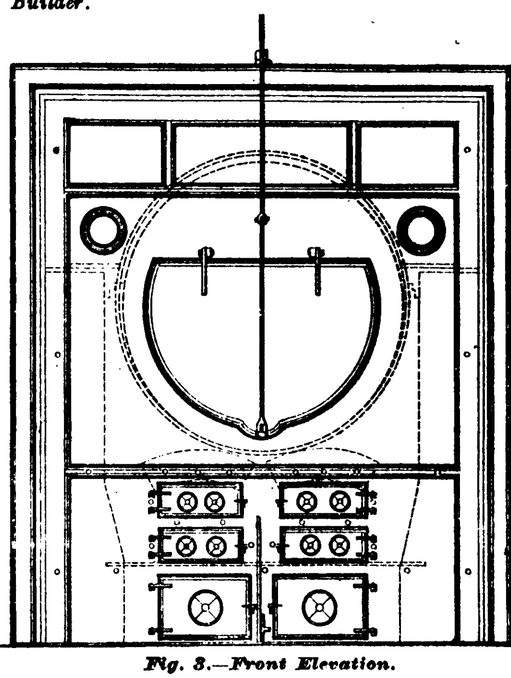


Fig. 3.—Front Elevation.

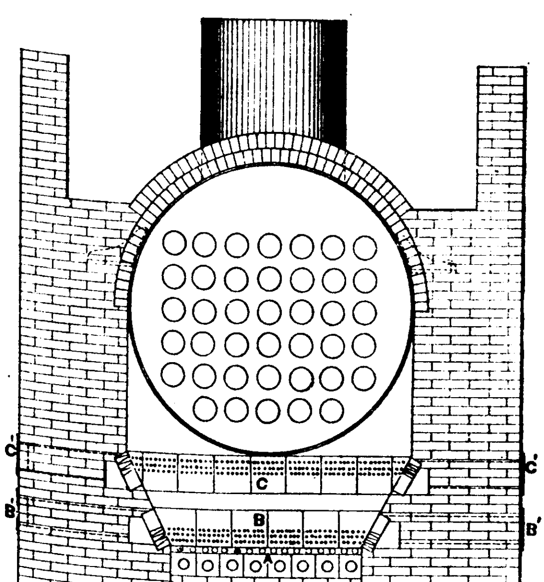


Fig. 4.—Cross Section, with Water Grate.

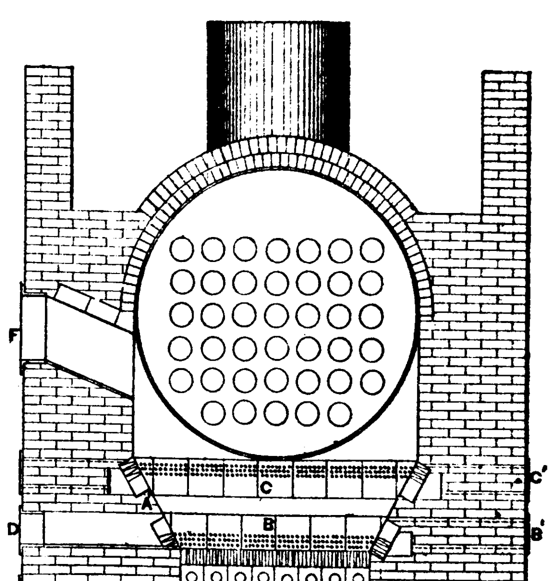


Fig. 5.—Cross Section, with Tile Grate Doors on the Side.

HEATER FOR RAILWAY CARS OR BUILDINGS.

B. V. Seevers, of Oskaloosa, Iowa, is the inventor of an improved heater designed for use in railway cars, but which may also be employed in offices, stores or dwelling houses.

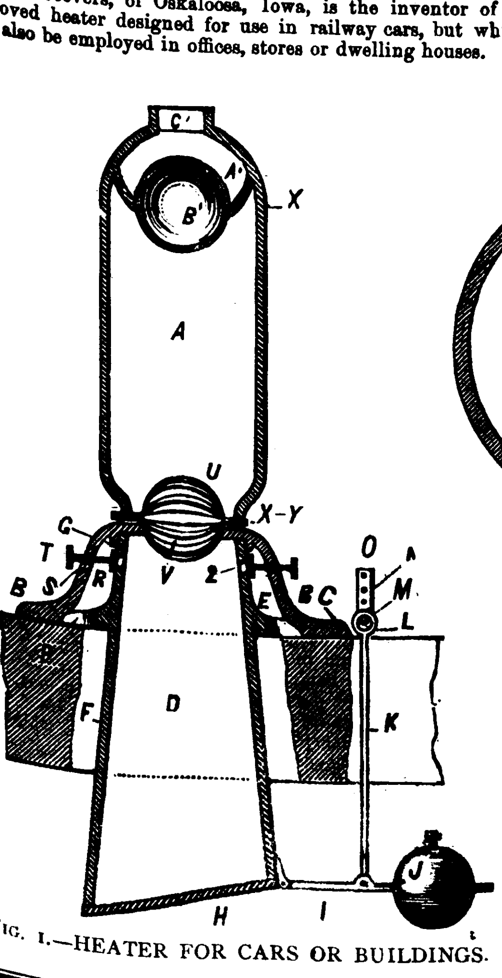


FIG. I.—HEATER FOR CARS OR BUILDINGS.

In the engravings, Fig. 1, is a vertical sectional view. Fig. 2 is an enlarged horizontal sectional view on the line *x x*, Fig. 1. Fig. 3 is an enlarged horizontal sectional view on the line *y y*, Fig. 1.

D is a downwardly projecting inverted hopper or chute, having an annular flange, E, by which it rests upon the floor through an opening, F, in which the body of the said chute extends. The upper end or rim of the chute fits within a rim

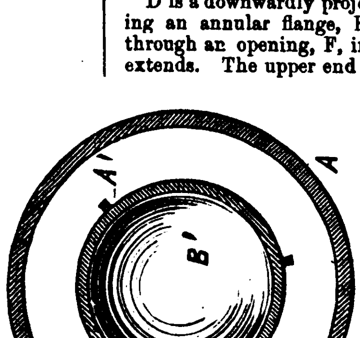


FIG. 2.

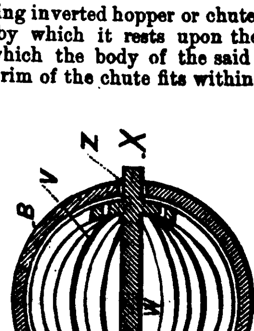


FIG. 3.

or flange, G, cast or formed upon the under side of the base, thus causing the several parts to be nicely joined together. The chute D is provided at its low end, which is inclined or beveled, as shown, with a hinged or pivoted cover H, having rigidly connected thereto an arm or lever I, projecting rearward of the hinge or pivot, and provided with a ball or weight, J, by which the cover is kept in a closed position.

The arm or lever is threaded to make the weight adjustable at any desired distance from the fulcrum.

The weight J is so adjusted upon its rod or arm I that it will overbalance the weight of the door H on the opposite side of the fulcrum, and thus, by causing the door to bear against the lower rim or opening of chute D, keep it closed; and the farther the weight J is removed from the fulcrum the greater, of course, will be the amount of ashes and cinders which the door will sustain before being titled open by their pressure overcoming the weight of the counterpoise J.

The flange E of the chute D is provided with notches P, directly above which are located draft openings, Q, capable of being partly or entirely closed, so as to regulate the draft.

find a camera which opens to a considerable length a great advantage.

The grate is globular or spherical in shape, mounted upon a central axis, W, and having projections, X, paralled to the axle. One end of said axis projects, as shown, so as to be readily operated by means of an ordinary key or wrench.

The body of the stove is provided upon its inside near its upper end with a series of projections, A^1, supporting a hollow ball, B^1, which is larger in diameter than the pipe opening C^1, which projects upward from the top of the stove in the usual manner.

The ashes will drop from the grate down into the chute, where they will remain until their weight overbalances that of the ball J, when the door or cover H will partly open, thus causing the lowermost ashes, which have had ample time to become cold and dead, to be shaken out by the motion of the cars, or, when the heater is used in a building, by their own gravity, the door being arranged at a sufficient incline for this purpose.

The advantages of the spherical grate will be readily understood. It can never be titled, like the ordinary grate, so as to cause the fire to drop out. The live coals always have a tendency to drop down toward the sides, where the heat is most effective. It also presents a much larger surface than the ordinary grate, different parts or sections of which are alternately exposed for use, thus preventing it from being readily burned out.

When this heater is used in a car, and the latter should by any accident be upset, the ball B_1 will roll down and close the pipe opening, thus preventing the coals from escaping and setting fire to the car.

In the yard, when the cars are run in to be cleaned, all that is necessary is to raise the rods. Thus opening the lid and the whole thing is cleaned. No dirt or dust is made in the car, and the time taken to empty it amounts to nothing. When an extra draft is needed the lid can be fastened open, or partly so, as desired, and any amount of draft secured. Any pattern of stove can be used with any desired arrangement of drafts, etc., above the floor. In private houses or business rooms with a cellar, a bin can be arranged below to receive the ashes. In the morning, the ashes can be shaken down, the lid set open and a better draft secured than in any other way, coming from the cellar, and thus affording needed ventilation below. When hot enough the lid can be closed at will.

In the spring, at house cleaning, the ashes can in a short time be carried and hauled away, thus avoiding the annoyance of carrying out hot ash pans several times a day, spilling coals on carpets, burning fingers, filling curtains and furniture with dust and the house with gas, etc., as is the case with any ordinary stove.—*American Inventor.*

WHERE BUTTONS COME FROM.

The button trade of New York is estimated at from $8,000,000 to $10,000,000 a year. Last year the importation of buttons exceeded $3,500,000, the aggregate for the last four years being nearly $13,000,000. At American rates of wages many of the imported buttons could not be put upon their cards for the price they sell for.

Glass buttons are made mostly in Bohemia, and children are largely employed at the work, which they can do as neatly and cheaply as adults. The children get ten cents a day, men from forty to 50 cents, and women a little less. Pearl buttons are imported from Vienna, where they are almost exclusively manufactured; and the all-important shirt buttons are received mostly from Birmingham, England, where the majority of metal buttons are likewise procured. The most extensive of all the button manufacturing, however, is that of the Parisian and Berlin novelties. In one manufacturing village near Paris, where there are from 5,000 to 6,000 inhabitants, all the working people are engaged in making the agate button, which, even with thirty per cent. duty added to the cost, sell, when imported into this country, at the extremely low figure of thirty-one cents per great gross. The material alone, it is reported, could not be procured here for double that amount.

While American manufacturers make no attempt, and probably have no desire to compete with European producers employing hand processes, they excel in making bone, composition, brass, ivory and gold buttons by machinery, and are able to export considerable quantities of these styles. In Providence, R. I., for example, sleeve buttons and jewelry buttons are largely manufactured expressly for exportation.

Scientific.

ELEMENTARY LESSONS ON DRY PLATE PHOTOGRAPHY.

SELECTION OF APPARATUS.

The first thing the beginner has to do, is to determine what size of "plate" he will work—that is to say, how large his pictures are to be. As a matter of course, he should begin work upon the smallest plates which he can buy, as the first few results are sure to be far from perfect, and the cheaper the plates spoiled the better. That does not, however, bind him to the smallest size. In considering size of plate to be worked, it must be borne in mind that the larger the plate the greater the weight to be carried into the field, the greater the difficulty of manipulation, and the heavier the expense at every turn. This being the case, we would suggest as a good size that known as "half plate"; that is a plate measuring 6½in. by 4¾in., which allows of pictures being taken of the popular size, and the apparatus necessary can very easily be manipulated in the field. Having decided the size, the next thing to consider is in what manner to purchase the apparatus; and here we must say emphatically that the only way in which to be sure of getting reliable photographic requisites is to go to a first-rate dealer, and to purchase them new from him. There is a general idea in the mind of the non-photographic public, probably gained from seeing numbers of old cameras and lenses exposed for sale in pawn-shops and such like, that great bargains are to be made in second-hand photographic apparatus, and that the beginner may "pick up" what he wants very cheaply by a little looking about. There can be no greater mistake. The experienced photographer may occasionally pick up an article very cheap; but the man without technical knowledge will be sure, if he attempts to do the like, to find on his hands goods which will be useless to him when he has somewhat advanced in his art. The "sets" made up by most of the chief photographic dealers are most excellent and complete; but the sum charged for them is greater than many are willing to lay out at once. They may buy at first only those articles which are absolutely necessary to begin with, and may add to their store from time to time, as they think fit. We give a list of the articles most necessary for working quarter-plates: a camera, a lens, a tripod stand, three flat dishes or trays of porcelain or other material, a graduated measure, holding a ½oz., a graduated measure holding 4oz., a dozen gelatine quarter plates, and a dark-room lamp.

A photographic camera is, as probably everyone knows, a sort of box at one end of which is held the sensitive plate, and at the other end of which is held the "lens"—which latter throws an inverted object in front of it on to the plate—and that there is a means of adjusting the distance between the distance between the lens and the plate, or of "focusing," the camera. Every camera has, besides this, a piece of sound glass, which can be put in the exact place to be afterwards occupied by the plate, and upon which the image can be seen so as to facilitate focusing. It is also fitted with a "dark-slide,"—a sort of case in which a sensitive plate may be fixed. After the camera has been focused, the dark-slide is placed in the position before occupied by the ground glass, which latter is removable. The "shutter" or sliding-door of the dark-slide is then removed, and on taking the cap off the lens, the image falls on the plate. As many dark-slides as are desired may accompany a camera, and thus a number of plates may be carried into the field. Slides are also constructed to hold two plates each, and are called "double dark-slides." These are by far the best and most convenient to use for dry plates. Three slides are a common number to accompany a camera. This enables half-a-dozen plates to be carried out. Each dark-slide should be fitted with a set of carriers. "These enable plates smaller than the largest size for which it is constructed to be placed in it."

All modern cameras for use in the field are made with bellows-bodies so that they can fold up into small compass for ease in carrying. In purchasing a camera, the photographer should get one which will open to a considerable distance—if possible as much as twice the length of the largest sized plate which it will work. In some part of his career the amateur is sure to aspire to the taking of portraits. His attempts in this direction are almost certain to be failures, and to cause great pain to his friends, but nothing is surer than that the portraiture fit will attack him. When it comes to this, he will

There are various adjustments attached to modern cameras which, although of little use in the hands of the beginner, will be found of great convenience to him when he is more advanced. These are chiefly a vertical and horizontal adjustment of the front on to which the lens is screwed, and what is called a "swing-back." This latter provides a means of varying to a certain extent the angle between the sensitive plate and the axis of the lens. A leather case into which the camera and the dark-slides fit, should be provided. A "single achromatic" lens of such a length of focus as to enable the largest plate which the camera will hold to be covered should be purchased. The lens should be bought direct from some reputed maker. The particular form of lens known as the "wide-angle landscape" is the best. The tripod stand calls for little special remark. The only requirements of the camera stand are that it should be light, should be easy to fit up and take down, and should be quite rigid when fixed up. The flat dishes or trays—or, as they are sometimes called, flat baths—are for use in the operations of developing, fixing, &c. Such dishes, made of so-called porcelain, can be had for a few pence each, and we should recommend that such be purchased for quarter-plate work. When the photographer advances to larger sizes, he may indulge in the more expensive and more convenient dishes made of ebonite and other light material.

NEW ACOUSTIC TELEPHONE.

We give an engraving of an improved telephone and telephone call signal, patented by Mr. John B. Bennett, of San Luis Obispo, Cal. This instrument may be placed in any desired position, and the line wire may extend in any required direction without making an angle at the instrument, and whichever way the instrument is turned the appearance will be the same. The great difficulty with other string telephones is that they are often incapable of being placed in the most convenient position. The curved speaking tube—which is also used for hearing—terminates flush with the front side of the case, and is so constructed that any sound-wave entering its mouth is focused directly on the centre of the diaphragm.

The instruments are furnished with a good and distinct automatic alarm, which is operated by turning a crank on the instrument, the operation being the same as that of operating a magneto bell. Turning the crank causes the hammer to strike rapidly and strongly against an eye in the diaphragm to which the line wire is attached, affording a loud and distinct alarm free from all the bother and expense of electricity. If wished for special purposes, a magneto call can be arranged within the case at slight expense in the place of the automatic call, and can be operated by the same crank.

These instruments are nicely finished, the mouth-piece, crank, and other parts being nickel-plated. This telephone for short distances less than a mile to a mile and a half, works clearly and satisfactorily. The inventor states that he has heard distinctly through a full mile and a half of line.

A new suspender has been devised by the same inventor by which the line is supported without interfering with its sound conducting qualities. It is also capable of turning angles in the line without material loss of sound.

This telephone has the advantages of great simplicity, and transmits speech naturally and loudly without the application of electricity and without the troubles attendant on its use.

For further information address the inventor as above.—*Scientific American.*

ELECTRIC MOTORS.

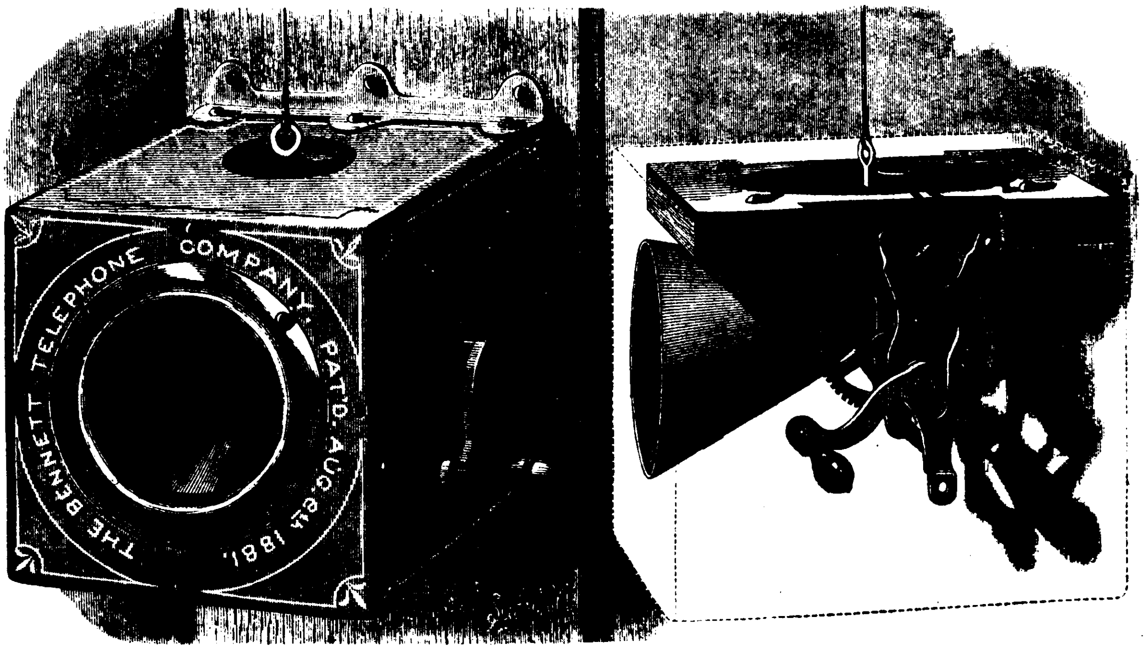
A writer in *Popular Science Monthly* has this to say regarding electric motors:

"The next and last branch of my subject is the transmission of motive power to a distance. I have shown you how currents of electricity are produced; also how they do work; how they produce electro-magnetism; how they generate heat; how they produce light; and now I want to show you that the whole thing is reversible. If, by the exertion of mechanical power, currents of electricity can be produced, those very same currents of electricity can, in their turn, produce mechanical power. If, instead of receiving currents of electricity from the dynamo machine, on the Thames embankment, we transmit currents of electricity to it, we should cause it to rotate, but in the reverse direction. I have here a small machine for the purpose of illustrating this to you; it is the invention of Mr. Griscom, who has supplied it to a large extent in America for turning sewing machines. The wires from the band dynamo machine are now attached to the Griscom motor, and when currents of electricity are generated by turning the handle of the dynamo, they are conveyed to the motor and cause it to revolve with the high rapidity you see. It is surprising that such a tremendous momentum should be produced by so small a strength of electric current. The wires connecting the two machines in this instance are short, but the effect would have been practically the same had the machine been miles apart. By changing the wires the direction in which the motor rotates is reversed, so that I not only get power transmitted, but can reverse its direction. In this case, as the electricity is generated by hand, its power is small; and, therefore, with my strength, (which is only about one-twelfth of a horse-power), I can stop the rotation of the motor; but, if steam power were employed to generate the electricity, the power transmitted would be beyond my control in that sense. This motive power was illustrated in many different forms at the Paris Exposition; for instance, from the commencement of the Champ-Elysees, to the Exposition Building, a tram car was propelled (sometimes at the rate of 25 miles an hour) upon rails laid down for the purpose, and during the time that the exposition was open, that car carried 75,000 to 80,000 people, who were conveyed to or from the building by motive power generated by steam in the exhibition and conveyed by wires to the further extremity of the track. An electric railway will form part of the Electric Exhibition at the Crystal Palace, and among the proposals to be laid before Parliament next session is a project for constructing an electric railway between Northumberland avenue and Waterloo Station. Again, at the Paris exhibition, an enterprising firm of agriculturists showed land plowing by electricity, and, in fact, the application of electricity to innumerable useful purposes was illustrated—rock boring, newspaper printing, driving sewing machines, embroidery, leather work, glass cutting, wood carving, lifts raised, ventilation assisted, etc."

PLOW FOR LAYING ELECTRIC CABLES.

Electrical communications are constantly multiplying, and this movement is seen every day increasing in rapidity. The invention of the telephone, and its more and more frequent applications, has necessitated the laying of very numerous conductors, and is constantly requiring a greater quantity of them. In such instances air lines will probably be in the majority, since they are economical, easily put up, and readily watched. But on another hand, they are exposed to the inclemency of the seasons and to being tampered with by malicious persons, and are subject to get out of order. It is certain, then, that in many cases subterranean lines will be employed. The principal drawback to these latter is particularly that of their greater cost. The cables need careful insulation, and putting them in place is quite a laborious operation. The latter offers particularly the inconvenience that, in addition to expense, it requires time. In certain cases, in war, for example, a great advantage would accrue from the use of subterranean lines, but it is rarely possible to lay them, since there is no time to do so.

Instruments adopted for facilitating and hastening the operation of laying underground cables have been invented, and these naturally present themselves under a form similar to that of a plow—the principal work being to open a sufficiently deep trench. This is the operation that is really onerous, and it is because of the cost of it that hitherto subterranean lines have been employed only in cases where several of them could be laid in the same trench. At the recent Electrical Exhibition there were shown two types of plows adopted for the purpose just indicated. One of these, in the German section, was light and incapable of reaching much depth. There is reason to believe that it was invented principally for military purposes, and that it was designed to quickly lay a temporary line. Such being the case, the utility of the instrument is not very great, for the chief object is to have an apparatus capable of laying a permanent line. And such is the object attained by the other plow that the Exhibition has shown us, and which is the invention of a French engineer, Mr. Jules Bourdin. We give a representation of the apparatus in the annexed figures. The manner in which it operates will be readily understood. A lenticular disk precedes the share, cuts the roots, and, in a word, opens the trench. The share is provided behind with a bent tube, and lays the cable at the very bottom of the ditch that the compressing roller in the rear afterwards closes. The machine carries a windlass frame designed for holding the coils of wire, and necessitates the attendance of but few men. The instrument is simple, strong, and well got up, and it ought to give good results. The inventor has taken care to reduce the



BENNETT'S ACOUSTIC TELEPHONE.

trench to a minimum in width, while at the same time giving it a depth which, it appears, is about a meter. The circumstances that led Mr. Bourdin to devise the apparatus under consideration are quite curious. A few years ago be had to locate a system of telegraph lines between the different factories and shops that lie scattered over the domains of a wealthy and active Russian property owner, General de Maltzoff. It seems that in that country it is very difficult to preserve aerial wires. The peasants have some respect for lines belonging to the government, as it would cost too dear to touch them ; but private lines are constantly being damaged by them, for they do not hesitate to take the wires at any time to mend a broken cart or for any other similar purpose. It becomes absolutely necessary, therefore, to have recourse to underground lines, and it is of the utmost importance to lay them by some means that shall prove as expeditious and as inexpensive as possible. This is why Mr. Bourdin sought to solve the latter problem by the use of his plow, and it was by the aid of this apparatus that he performed the work intrusted to him.

As regards the speed with which cables may be laid by this means, we are enabled to give some account of it from information furnished us by an agriculturist. An ordinary plow, drawn by three horses, and always moving in a straight line, can make, according to his estimate, four kilometers per hour at a maximum, the furrow opened being thirty centimeters in depth. This speed could not be much exceeded even in very mellow soil, since it represents the maximum speed of horses while walking ; and it is not possible to plow on a trot. However, by increasing the power of traction, the special arrangements of the wire-lying plow ought to permit the speed to be increased a little and to reach at least five kilometers per hour ; and such, in fact, is the speed reached by the inventor during the work done by him in Russia. The difficulty of plowing deep lies especially in the resistance of the subsoil ; and the depth of the superficial layer determines the maximum depth of the former. Very often this depth will not have to be very great ; but cases will occur in which the laying of subterranean cables will be greatly facilitated by the use of the plow that we have just described.—*La Lumière Electrique.*

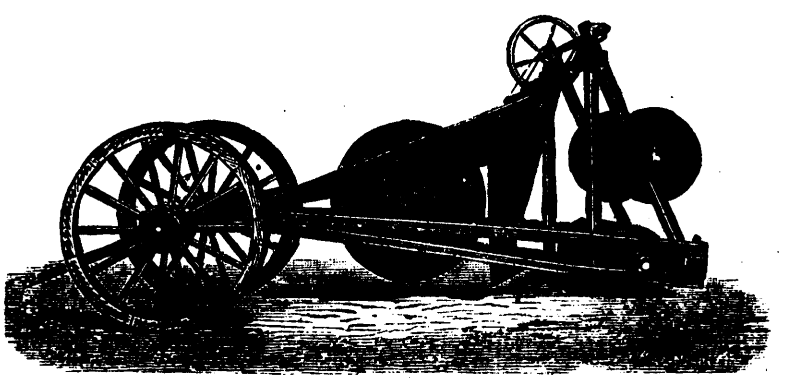


FIG. 1.—PLOW FOR LAYING ELECTRIC CABLES.

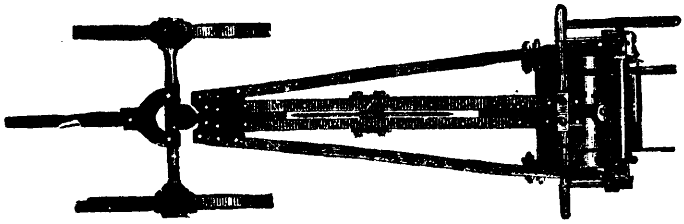


FIG. 2.

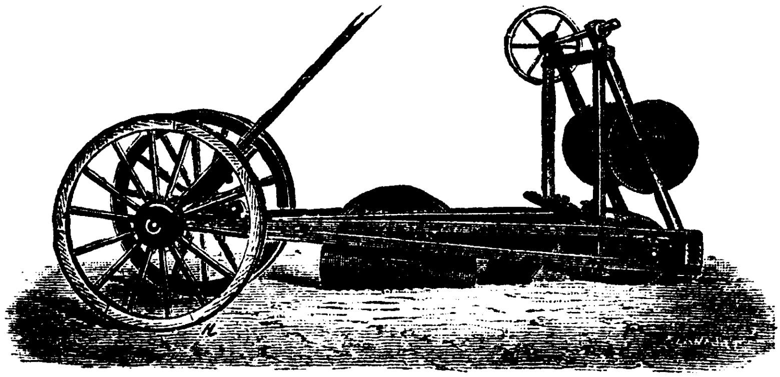
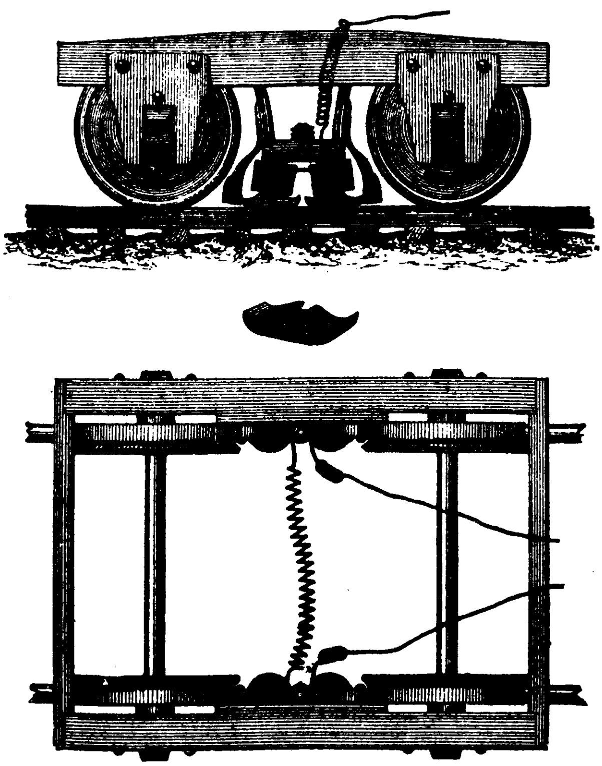


FIG. 3.



NEW ELECTRO-MAGNETIC BRAKE FOR TRAINS.

RAILWAY SIGNALLING APPLIANCES AT THE CRYSTAL PALACE ELECTRIC EXHIBITION.

Recent railway accidents which have exposed the defects of some of the existing methods of signalling have naturally made the appliances exhibited at the Palace Exhibition objects of much attention, and as nearly every really useful system is shown in working order (that is, when not disarranged by the carelessness of experimenters), the public have an opportunity, not often afforded, of becoming acquainted with the signalling arrangements commonly adopted on railways. Besides the standard systems, as they may be called, there are, however, several novelties which are more or less adapted to remedy defects which are inherent in or appertain to the well-known devices, and these we shall endeavour to describe as minutely as possible. The London, Brighton, and South Coast Railway Company exhibit the methods adopted on their line at various periods, including Saxby and Farmer's union of "lock" and "block," while the London and South-Western show Preece's system in working order for a block section, with three signal-repeaters to indicate to the signalman in the boxes the position of the semaphore arms. Mr. Spagnoletti's arrangements as employed on the Great Western are also shown, and as we have previously mentioned, Mr. C. V. Walker, the electrical engineer of the South Eastern, exhibits a unique and chronologically arranged collection of instruments used for signalling purposes. All of these are tolerably familiar to those interested in the subject, as they are fully described in text-books; but in the exhibit of W. R. Sykes, shown in very large scale model, we have perhaps the most advanced and most perfect combination of the electric lock and block. This system has been in use for some years on the London, Chatham, and Dover, and the Metropolitan District, and is probably as near perfection as it is possible to go. It is shown as working between three signalling points, and those who are sceptical can try for themselves how far it is possible to break it down, and set signals so as to cause an "accident." The system is based on the mechanical union between the lock and block, and every signal given requires the attention of at least two signalmen. Thus, suppose we designate two signal boxes as A and B, A cannot lower his semaphore until B releases his lever, and per contra, B cannot lower his semaphore for a train in the opposite direction until A has released the lever by electrically removing a pin from the stop in the lever. Suppose a train to be approaching A's box, and travelling towards B's, A sends the call to B, and receiving "line clear," sends another signal which releases the lever in B's box, and enables the latter to pull off his signal, which he can put on again, but "off" until he gives "line clear" a second time. Thus two trains cannot be in one block-section at the same time, except by consent of two signalmen. Similarly, by combinations of electrical and mechanical arrangements, it is impossible to pass trains by signal while a siding is open for shunting, as the fact that the points are open for the siding effectually locks the main-line signals. On the other hand, points for sidings cannot be opened if a "line clear" signal has been given to a main-line train, until that train has passed out of the section. Thus, unless two signalmen at different boxes make the same blunder, it is impossible for an accident to occur, provided the drivers of the trains pay attention to the signals. It will be readily understood that such a system would have prevented the Canonbury "accident," which may be taken as an extreme case of railway blundering that would have been simply impossible if the signalling arrangements had been on the plan just described.

All the systems we have mentioned are, however, thrown out of use by dense fogs, and by occasional defects, and attempts have been made by enthusiastic inventors to persuade the railway companies to employ what may be termed automatic systems, not that they are really automatic, dispensing with the services of signalmen, but as complementary signals appealing more directly to the driver than the semaphores, for which it may be said he has to look out. Even in the case of fog, however, the Sykes' system has been found to answer remarkably well, for the simple reason that a signalman cannot allow a train to leave until the signalman in advance has released the lever.

Still, fogs are not unknown in London, so dense that the driver cannot see even the post, let alone the semaphore, and in such cases fog-men are employed—introducing yet another element of human fallibility. To provide for such conditions as these, several devices in the shape of electric gongs working in connection with the signals have been invented, and one of the simplest of these is Sullivan's electric fog and night signal, shown in a working model in the Eastern Gallery at the Palace. This arrangement is simple, not likely to get out of order, and certainly more trustworthy than the average fogman. It consists simply of a small bar placed parallel with the rail, and projecting slightly above its surface when the signal-arm is "on," or at danger. The wheel of a passing engine depresses this bar, and rings a powerful gong in a box near the post; while, should the signal be "off," the bar is drawn below the level of the rail, and the gong is not sounded. The signal is entirely under the control of the signalman, and can be worked either electrically or mechanically in connection with or separate from the semaphore. It is, in fact, a type of a useful class of signals, which can be so arranged as to supplement the ordinary semaphores in clear weather, and to act as substitutes in the event of fog or derangement of the apparatus.

The British and Irish Telephone Co. exhibit a working model of Redcliffe's fog-signal, which differs so far from that just mentioned, that the "signal" itself is given on the engine. In this arrangement we have the usual magnet and armature, the latter carrying a projection, which rubs against a long lever carried alongside the engine, in about a line with the centres of the driving wheels. This lever actuates a small semaphore placed on a level with the driver's eyes, and also sounds the whistle,—a crude idea, which does not commend itself by the finish of the model. Several better devices have been described in our back volumes, and so long ago as Feb. 5, 1875, we gave an account of Sir D. Salomons' system, which was so far complete in details as not only to call the driver's attention, but actually to shut off steam and apply the brake for him. That system (See p. 516, Vol. XX.) necessitated a central insulated rail, which was so connected to the engine that on the latter entering a block section already occupied, a bell would be rung, or, as before explained, the steam might be automatically shut off. A practically identical system was patented last year by a Mr. Putman, of New York, and in the Concert-room Gallery, Messrs. Apps exhibit a nicely-finished working model of the system invented by Mr. T. T. Powell, of Harrogate. In this we have the insulated centre rail or wire in contact with the train by means of light wheels and rods, a couple of signal-boxes, and bells, &c. Levers at the side of the rails are depressed by the passage of the train and give notice in the signal-boxes, while tapper-keys on the engine and guard's-van enable either driver or guard to communicate with the signalmen, and the latter can, of course, communicate with them. The model is sufficient to show that a railway worked on this system would form an electric circuit, or combination of circuits, by which not only would signalmen be able to communicate with trains approaching their boxes, but the manager could, by means of an indicator, locate the position of any train at any given time; further, platelayers could inform signalmen promptly of any defect in the road, and passengers could communicate with the driver or guard. The difficulty is the centre insulated rail, which would cost something, and the insulation, we are afraid, would be a source of trouble. In some respects, Mr. Powel's system is more complete than that of Sir D. Salomon's, for the latter breaks his centre-insulated rail into "block sections"; but we do not think that either plan is likely to be adopted for some time.

A really useful invention is shown in the Eastern Gallery in the shape of King's patent electric railway signal, which is specially adapted for use on single lines in sparsely-populated countries, or where the amount of traffic will not allow of a competent and ample staff of signalmen. In the model we have a simple line with a branch to a siding and three posts, one of which contains a clock capable of indicating time up to 15 minutes, and a semaphore put "on" by mechanical means as the train passes over a lever treadle level with the rails. This semaphore is put to "off" by means of electricity when the train reaches the next post, where, at the same time, it puts the second signal at danger. The use of the clock is not quite apparent, for the inventor can scarcely expect his system to be adopted in crowded districts, but for certain purposes it will be employed in the following way:—The clock, say, is at post A: a driver approaching and finding the signal "off" will see by the clock how many minutes have elapsed since the previous train passed into that block section, and as his engine passes that post it will, as explained above, put the semaphore at danger and the clock-hand back to zero. When the engine passes post B, it again runs over a treadle, which puts the semaphore at B to danger and clears the block section in the rear by lowering the semaphore at A, where the clock-hand again indicates the number of minutes since the engine passed. Suppose post B guards the entrance to a siding, the engine which passes A and enters the block between A and B puts a special semaphore at danger at B by means of electricity, and thus gives warning that a train is approaching, and that the pointsman must be ready to clear or to pass into the siding, as the case may be,—a lever at B working a signal at C to indicate whether the branch or siding is clear. The arrangements are all under cover, and the treadles and other accessories are so arranged that the signals work at the same speed whether a fast or slow train passes; in fact, the details have been carefully worked out, and the system will not doubt find employment in America, Australia, and other places, as well as in large goods stations with long lengths of sidings. Another device worth notice is found in the Southern Gallery, where Dr. Garau shews a model of his method of communicating with the guard by making the electric connection through the buffers. On pulling the signal cord in any compartment, an arm is thrown out from the side of the carriage, and a bell rung in the guard's van. It is obvious, however, that this method is not to be compared with the others, as it depends for its efficiency on the fact of the buffers being in contact, and that is not always the case except, perhaps, on some of the metropolitan lines. Altogether it may be said that although some useful novelties are shown at the Exhibition, so far as railway signalling is concerned, the established methods are the best. —*English Mechanic.*

NEW ELECTRO-MAGNETIC BRAKES FOR RAILWAY TRAINS.

The great desideratum of a brake for railway trains which shall not only be prompt, effective and safe in application, but which shall avoid the wear upon the car-wheels incidental to the methods now employed, seems to have been at least fully met in the simple contrivance of recent invention, which we have caused to be illustrated in the accompanying cuts, and which is about to be put into practical operation through the agency of the New York Electro-Magnetic Brake Company, whose offices are in this city.

This invention involves two important and novel features, viz.: First, the application of a frictional surface to the rails independently of the car-wheels; and second, the use of magnetic attraction to produce the necessaary friction.

In the various forms of brakes now in use upon railway trains, a frictional surface is applied to each wheel to retard its revolution and to cause it consequently to slide upon the track. Evidently this sliding of the wheel under the heavy load superposed thereon rapidly grinds and wears away the surface of the wheel, producing an unevenness in its circumference which rapidly increases, not only from the repetition of the sliding, grinding process due to the application of the brakes, but to the pounding resulting from the irregularities of the rim as it is carried with great rapidity over the rails. Hence it is that wheels which would otherwise be sound and good for a series of years become, by reason of the application of brakes thereto, shortlived and have to be trued up or thrown aside in a few months. On the elevated railroads of New York, where the brakes are necessarily applied at short intervals, owing to the frequent stoppages, a car-wheel is thus rendered unfit for use in from nine to fifteen months.

The first step towards the invention of the present electro-magnetic brake was taken in the direction of relieving the wheels from this wear and tear foreign to their proper function, resulting from the application of the brakes directly to the rails. It was found, however, that the application of a frictional surface to the track by any system of leverage involving the use of the car as a fulcrum, and its weight as the force to produce friction, must operate to lessen the weight upon the wheels to a corresponding extent, and to that extent increase their liability to leave the rails and jump the track—a danger which the action of the levers would serve to facilitate rather than avoid.

The next step in the invention overcame all difficulty on this score, and the grip of the brakes upon the rails is made to tie and hold the train to the track. This is ingeniously accomplished by simply magnetizing the brake shoes, so that when excited they shall spring into contact with the rails, and cling thereto with a power and prehensile force proportionate to their length and to the force of the electric current employed in exciting them.

The new electro-magnetic brakes are constructed in very simple form, as shown in the cut, and consist of a pair of iron brake-shoes adapted to slide upon the rails, and which are suspended from an iron cross-bar upon two iron arms, each of which is encircled by a suitable magnetic coil. The two arms connected by the cross-bar and encircled by the coils are thus converted into the poles of a horse-shoe magnet, and they are supported in a stout iron frame or pedestal, fixed and braced between the wheels. The cross-bar is allowed a limited vertical play, which is taken up by a spring of sufficient force to uphold the brake-shoes clear of the rail when they are non-magnetized. The brake magnets on opposite sides of the track are placed in a common circuit by a transverse connecting wire, as shown in the plan view (Figure 3) of the accompanying illustration.

The wires are to be connected for use with a dynamo-machine, an electric battery, or an accumulator. So soon as the circuit is closed through the wires, the magnetized brake-shoes will be instantly attracted to the rails with a force due to the force of the current, and by their friction will arrest the train with as great efficiency as any of the brakes now in use, but with the great advantage of not interfering with the free rotation of the wheels and of operating to bind the train to the rails, so as to offer a positive safeguard against derailment.

To prevent the possibility of danger from a shoe breaking in two in the middle, so as to leave an irregular portion attached to the arm of the magnet, the shoes are not bolted to the arms, but are connected thereto by transverse dove-tail joints, as is shown in Figure 2, the detachment of the shoe being prevented by a set screw. If the shoe accidentally breaks in the line of the joint, both pieces will instantly drop away, and suitabl guards (seen next to the magnet on either side of it) will operate to sweep the pieces from the rails clear of the wheels.

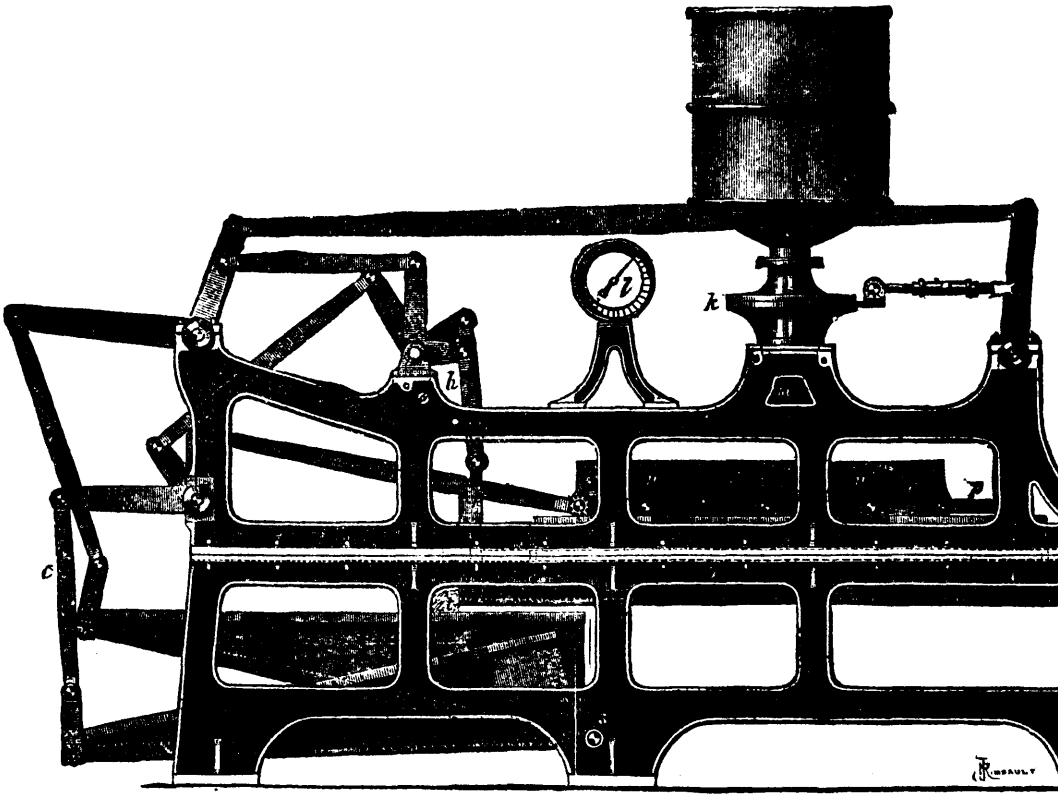
The cost of applying the new brake to a car scarcely exceeds that of the ordinary hand-brakes, while it seems to present at this low cost all of the advantages of the best forms of the continuous air or vacuum brakes now in use; and in view of its economy, simplicity and comparatively unlimited power, it is claimed that it is also entirely practicable for use upon freight trains, not only giving the engineer perfect control of his train, but, by acting upon each and every car at the same moment, avoiding the possibility of the telescoping or "chimbing" of the cars on the top of each other, as now sometimes occurs when the brakes are suddenly applied to a single car with the train in rapid motion. The complete command of the movements of the trains thus ensured will permit of the running of heavy freight trains with safety at a much greater speed than at present.

An important advantage not to be overlooked in connection with the relief of wheels from the wear and tear of brakes, is the fact that much larger wheels may in such case be used with great gain in the ease of movement in the trains. The increased life of the wheels will justify the increased cost which an enlarged diameter implies, but which the rapid wear of the wheels will justify, the increased cost which an enlarged diameter implies, but which the rapid wear of the wheels, under the old system, precludes, on the score of proper economy.

It is estimated that the use of these electro-magnetic brakes will reduce the expense account of a road in the item of wheels alone nearly seventy-five per cent, and it is claimed that they present the simplest and cheapest continuous brake system yet devised, and one which provides and permits the application of the utmost degree of power in arresting the movement of the train which its momentum will render safe, while at the same time it is more prompt and direct in action than either the air or vacuum brakes.

KENYON'S IMPROVED ADJUSTABLE RUBBER BUCKETS.

The accompanying illustrations show an improved form of Kenyon's rubber buckets for chain pumps. These are expanding buckets, with an adjusting screw and cone. In Fig. 1 A represents the link, B the collar by which the rubber E is held or lifted, F the top plate, nut or washer, and D the expanding cone. The new form of bucket is much shorter than the old style, and, as may be seen from Fig. 2, occupies very little space in the length of the chain. This is the full size of the 1½-inch bucket. For wells not more than 12 feet deep, three buckets are used, but for deeper wells they are used about 10 feet apart on the chain. Rubber buckets greatly improve the action of the chain pump and reduce the labor of working it. In winter, when it is desired to have the water "run back," the buckets can be easily loosened for this purpose. They can be readily tightened to take up wear, but this is necessary only at long intervals.



MACHINE FOR PURIFYING SEWAGE.

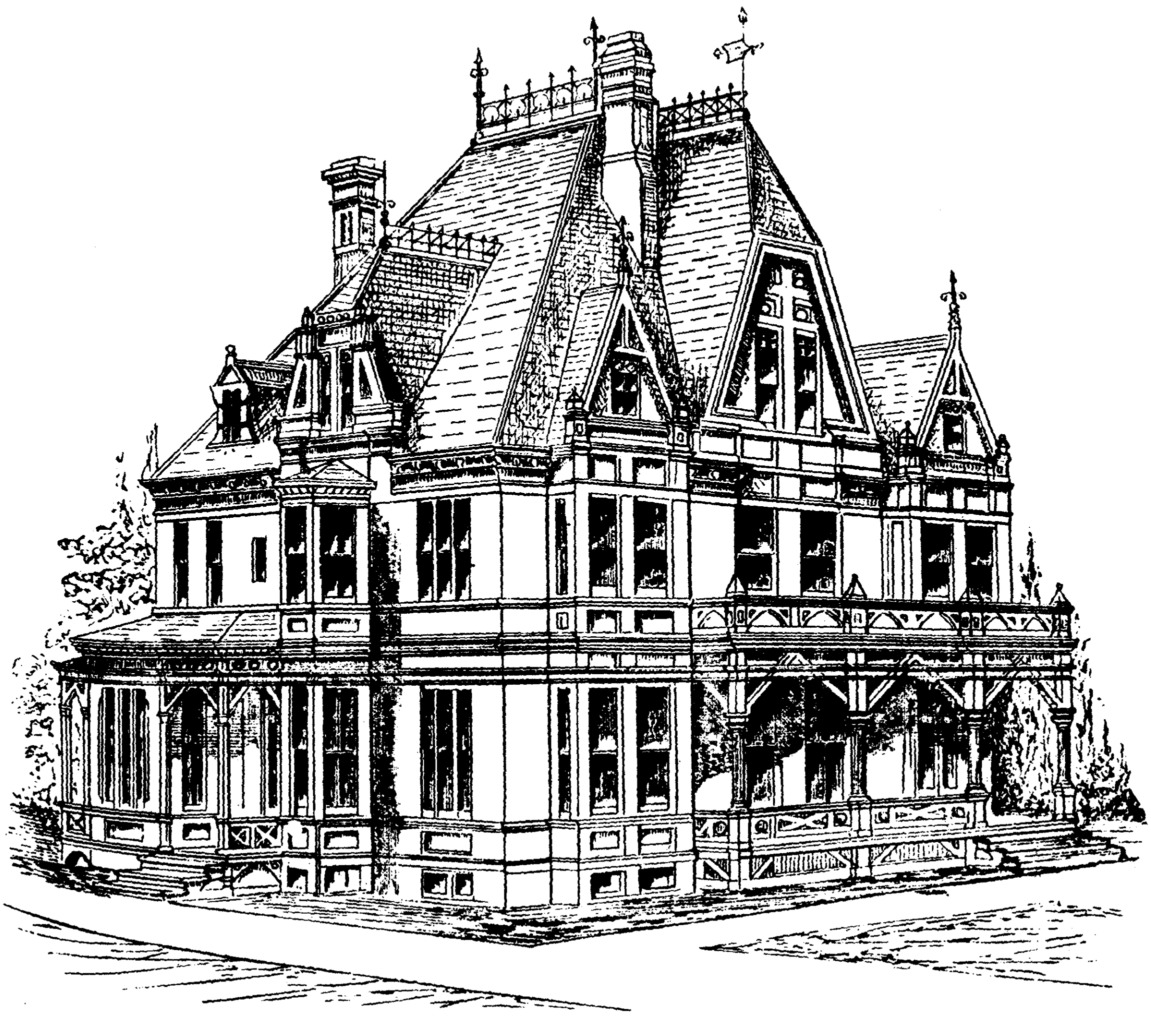
Sanitary and Plumbing.

SEWAGE MACHINE.

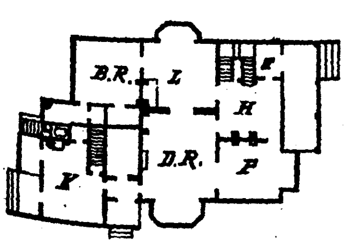
The question of the purification and disposal of sewage has been tackled by a large number of engineers, chemists and others with a greater or less degree of success—more frequently less than greater. Mr. John Hanson's treatment consists in the use of lime and black ash waste as purifiers, and his system has been in use at Tong, near Bradford, England, for about four years with every success. It is also in use at other places, notably at Golcar, near Huddersfield, where the works were designed by Mr. Hanson and were started near the close of last year. The objection to lime alone, as stated by Mr. Hanson, is that lime alone does not remove the germs of infection, whereas with the addition of black ash waste the water is so effectually purified that according to a report of the constable of the Tweed Commissioners, salmon fry and other delicate fish can live in the purified water. This black ash waste is a by-product from alkali works. According to Prof. Roscoe, for every ton of soda ash produced, from 1½ to 2 tons of waste are formed which accumulates in enormous quantities. This waste contains the whole of the sulphur burnt in the pyrites kiln, amounting to from 15 to twenty per cent of the weight of the waste. The purifying properties of black ash waste are as follows: Black ash waste as it comes out of the vat contains all the sulphur which was used in the making of the soda ash. It is then in the form of insoluble monosulphide of calcium. When the monosulphide of calcium is exposed to the action of the atmosphere it passes into a state of higher oxidation, then called disulphide of calcium. When this soluble disulphate of calcium is brought into contact with caustic lime, after both have been added to the sewage, then the disulphite of calcium contained in the black ash reacts upon the free caustic lime which is held in solution, and precipitates both in the form of monosulphide and sulphate, carrying down with them all the sewage impurities, thus discharging the effluent, neutral and pure, into the stream. By means of lime alone this is stated to be impossible. The two deodorizers are well stirred in the cistern by agitators, worked by a small gas engine. Into the lime, cistern water is introduced to produce the necessary paste, and into the other the sewage runs by gravitation, and thus the effluent of each is a dilated fluid which is conducted into mixing and settling tanks. The tanks are emptied occasionally, the residuum being removed for use as a manure.

The chief feature of the machine, says *Iron*, is that it is worked by the sewage which is to be subjected to treatment, thereby avoiding the expense of skilled labor and fuel. Assuming the main sewer to be arrested, as it were, by this machine, its contents flow into a reservoir provided with a set of rollers which convert the lime and black ash to form the precipitate into a pulp. This is discharged into two trough levers beneath, which form the motive power for setting the whole machine in motion. A sufficient quantity of sewage having gone into one or the other of these troughs, it goes down, discharges its contents charged with the precipitating material, and in the action turns all the machinery that has ground the black ash and lime, and even registers the number of gallons of sewage that have passed. The invention is very simple. Every crank and lever is set in motion by one fall of the troughs, and it has not a wheel in it. Mr. Hanson calculates that for £500 such a machine could be erected which would clear the sewage of a town of 10,000 inhabitants. Of course, the great idea of treating sewage is to introduce the precipitating elements, to make it, in fact, innocuous; but this hitherto has only been effected at a great expense. Mr. Hanson's machine promises to make this a very simple matter.

Our engraving represents a side elevation of the apparatus. *a* and *b* are the water levers; when one is full of sewage water the lever drops and the empty lever rises, giving motive power to *c* and *d*, which are rods connected with levers *e* and *f*, and to the whole of the machine. The rods *g* and *h*, are connected to sluices from which flow alternately the sewage water Nos. 1 and 2, *a* and *b*. There is a lever bar, *i*, working the back part of the machine. The hopper *j*, contains the black ash waste



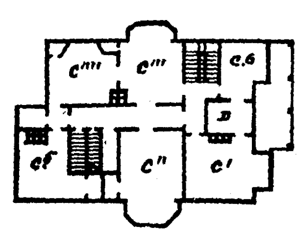
DESIGN FOR A COUNTRY HOUSE.



First-Floor Plan.

COST OF CONSTRUCTION,

$6,600.



Second-Floor Plan.

and lime or other chemicals for purifying purposes. A slide *k*, is regulated to supply from *j* the given quantity of chemicals required to purify the quantity of sewage water contained in *a* or *b*. An indicator, *l*. is for registering the number of gallons of sewage water that pass through the machine. The chemicals fall through the tube, *m*, among the grinding rollers, *n*, by which they are crushed. The rollers are pulled forward by a lever, *o*, and backward by the lever, *p*. A sewage pipe, *q*, conducts the foul water to the sluice valves *r*. The water levers, *a* and *b*, turn on a fulcrum rod, *s*. At *t* is seen the sewage water falling into the water levers.

It will, no doubt, occur to some that as the sewage is purer at night than during the day, the addition of the purifying material during the former period is so much waste. So thought Mr. Hanson, and he has devised an automatic arrangement whereby, as the sewage becomes purer, so the supply of purifying material is cut off until it ceases entirely. As the sewage becomes gradually foul in the morning the supply of the chemicals commences and continues. The mixture of sewage and chemicals will be led from the water levers into a series of settling tanks.—*Scientific American.*

THE DANGER OF BAD WATER.

In reply to the question, What has sanitation done? a gentlemen who has been engaged in superintending sanitary measures in one department of the British Government, says:

During the last 30 or 40 years, that is, since the organization of the sanitary department of the Privy Council, the rate of mortality throughout England has sensibly decreased, and the average of life has increased beyond all anticipation. Even in old London, saturated as its soil must be with the filth of ages, the judicious employment of sanitary measures has enabled its inhabitants to attain to a very respectable degree of healthfulness, and to escape in a very marked manner from the deadly effects of organic poisons which are constantly being generated in their midst. I shall refer to just two or three circumstances which have occurred in my own official experience. Some 20 years ago a terrible epidemic of cholera swept across the northwestern provinces of India and nearly decimated the population. Scarcely had the scourge ceased to afflict the land when an outbreak of typhoid fever began to thin out the remnant. Lord Lawrence, who was then Governor-General called in the aid of scientific experts, not with the object of mitigating the ravages of the prevailing disease, but to find out what had occasioned it, and to try if possible to prevent its recurrence. The writer of this letter, who had the honor of being appointed to superintend sanitary measures in the Punjaub, traced both these epidemics to polluted water. The sources from which the drinking water was drawn were contaminated with human excreta. The city of Zullunder, situated between the rivers Sutlej and Buas, was selected for my head quarters. The epidemic raged here with great vigor, both in the European military cantonments and among the native population in the civil station—death rate having been estimated at something above 70 in 1000. Within a year after the introduction of sanitary measures the mortality fell to 16.

In 1865 a very loathsome disease, which was epidemic in the city of Delhi, had broken out in the beginning of the year with exceptional severity. The Government desired that the question should be looked into without the least delay. A commission was accordingly appointed, consisting of three members, to investigate the cause of the disease, and to report to the Governor-General. The senior member, who was also the president of the committees was the head of the medical department. He was a great surgeon, and celebrated for his skill and dexterity as an operator. The second man was an Inspector General of Hospitals, who has since been deservedly raised to the honor of knighthood and to the position of honorary physician to the Queen, on account of his eminent abilities as a physician. The third member was, of course, the Sanitary Commissioner who was at the time only an assistant surgeon in army rank. The two distinguished seniors of the service talked a good deal of the "waves of the disease," speculated on the possible introduction into Delhi of the Aleppo boil by emigrants or visitors from Asia Minor, and drew out a lengthy and learned report full of plausible and ingenious theories. The sanitary officer, however, went straight to the water supplies of the city. He analysed the water of every well in the place, together with that of the river and the canal. The water of one well, next the Jumma Musjid, one of the most ancient of Mohammedan temples in Hindostan, was found to contain upward of 12 grains of decomposed organic matter to the gallon. It happened, too, that this well was situated in the very center of the district in which the disease prevailed. In his report, the sanitary commissioner had no hesitation in mentioning this as the source and origin of the loathsome disease, and in suggesting the closing the well, as the only measure necessary to stamp it out. The Mohammedans objected to any interference with their well, which they regarded with almost superstitious veneration, for it had been sunk at the time of Akbar the Great, when the mosque itself was built, and the feelings of race and religion were strongly associated with both these structures. Lord Lawrence, however, being a man of ample resources, thought of a plan which would at once conciliate the good will of the bigots and test the soundness of scientific conclusions. An order was issued to the effect that all the wells in the Mohammedan quarter of the city would be cleaned out at the public expense, and the writer receive dhis instructions in the following curt demi-official manner: "Have bottom of well dug up to about 15 feet. Examine the mud and see whence comes the filth. Then analyse fresh water from spring, and report it fit for use. All this was quite unnecessary, for after the well was drained and the bottom dug up 6 or 7 feet, an immense mass of human bones was found imbedded in the black mud, and looking as black as the mud itself. After this discovery, there was no difficulty in persuading the Mohammedans to close up the well. In the course of the year the famous Delhi sore, in spite of the "waves of disease," and in spite of the visitors from Asia Minor, vanished from Delhi, and has never since reappeared.—*Metal Worker.*

Architecture and Building.

DESIGN FOR A COUNTRY HOUSE.

BY D. T. ATWOOD, ARCHITECT.

In calling attention to the country house represented on the opposite page which was erected recently at Joliet, Ill., the architect takes pleasure in the opportunity afforded to express his appreciation of the intelligent aid rendered him by his client, J. H. Winterbotham and family, in the arrangement of the interior and the selection of tints for painting.

It is quite a comfort, as well as a satisfaction to an architect, called upon to design and detail for the erection of a building he cannot personally superintend, to feel that the thoroughness and sympathy of his client can be trusted, and not mar the effect and usefulness of a design by hasty and ill-advised changes. The tact which is always at hand to supply a proper suggestion, lending, as it were, sight and sense to the distant workman, is not so commonly exercised, as it might be, for mutual aid and benefit.

The arrangement of the first and second floors for family use and comfort is, apparent, upon referring to the plans. The hall is a large reception room, in itself, with an open fire, and with the dining-room, parlor and library can be opened—"en suite"—at pleasure.

The bed room on the first floor is conveniently arranged for communication with the front and rear portions of the house, and has ample closet accommodation, and a well arranged and fitted bath room.

The kitchen with northeasterly exposure, is large, and properly ventilated, with two additional flues in the chimney stack. There is a hood over the range to control the current of air and vapor. Double pantries are accessory conveniences—and a china and plate closet, with extra fittings, is reached from both the kitchen and dining room, besides minor closets.

The second story furnishes six spacious bed rooms, besides dressing-room and closets; and the third story, two rooms for servants and three for general purposes. Nearly all are provided with flues for ventilation which, in connection with the heating apparatus can be made to perform efficient and healthful service.

The basement is devoted to laundry, furnace and storage uses. The interior finish is substantial and tasteful without being costly. The exterior is painted with dark rich colors, carefully selected, and applied in a manner to give a subdued play of light and shade upon the surfaces, and harmonize the angles and projections of the façades and roof with the general outline of the building. The estimated cost of this house is $6,600.

The laying of a telegraph-cable through the St. Gothard Tunnel has been completed. The cable is about 1·4 in. thick, and consists of seven independent lines.

Cabinet Making.

CABINET MAKERS PAST AND PRESENT.

Cabinet work that has come down to us from the fifteenth, sixteenth and early part of the seventeenth centuries was made by the carpenters and joiners employed on the construction of the building for which the cabinet work was designed. The cabinet maker, as such was unknown until about the first quarter of the seventeeth century. The making of furniture was the province of the man who made sashes, planed the door frames and carved the corbels—that is, the better class workmen that were employed on the woodwork of a new building were generally retained after the building was finished to make most of the furniture required to furnish the house. Many times, too, these workmen were left to their own resources for the design of the work they executed. Sometimes, perhaps, they were assisted in working out an artistic problem by the fair "ladye" of the "manor" but it more often fell to themselves to both design and execute. It must not be thought, however, that all workmen were good, even in those days, for it is on record that many men were dismissed and fined for executing inferior work, and thereby spoiling stuff. It seems to have been a rule, particularly towards the latter part of the sixteenth century, to imprison a workman if he had engaged as a first-class workman of a certain standard, and then failed, when tried, to come up to that standard. He was also obliged to pay for all materials spoiled. How many botch carpenters would be breaking stones in jail to-day if such a rule obtained now? On the whole, however, we prefer our present way of doing business, for, after all, it does not take long for a good sharp foreman to discover the man who "knows all" but never accomplishes anything. Men, nowadays, soon find their level in the workshop, and if the accomplished workman receives no other benefit for his superior skill and assiduity than the appreciation of his employers, and the respect of his fellow-workmen, he has gained something worth striving for. We know of no reason whatever that should prevent a good joiner from working hardwood as skillully and as speedily as a trained cabinet maker. As a rule, a good joiner can make superior cabinet work—work that will stand more wear and tear than that usually turned out by furniture men; but the trouble lies in the fact that good joiners are very scarce. The cabinet maker must possess a certain amount of skill in the use of tools and finishing, or he will prove very unprofitable to his employer, a state of things not permissible nowadays; this skill may not be much; but much or little, it must be there. On the other hand, there is a certain rough work that can be done about a building by any one having brains enough to dig a post hole, and the rougher the work and coarser the operative the more profitable to the employer. Again, the wages paid the more skillful joiner is so little above the amount paid the coarser workman that it is scarcely worth striving for, more particularly so, when we take into consideration the fact that the higher the class of work the more expensive are the tools required to do it.—*Builder and Woodworker.*

A beautiful golden-yellow dye is now prepared from the young wood of various poplars. The young branches and shoots are cut off, crushed and brayed, and then boiled in alum water in the proportions of ten pounds of wood and one pound of powdered alum to three gallons of water. The liquor is boiled from twenty minutes to half an hour and then filtered. In cooling, it thickens and clears, throwing down a greenish-yellow deposit of resinous matter. When sufficiently clear the liquid is again filtered, then left exposed to the air for three or more days, according to the weather and the atmosphere. It quickly oxodizes under the action of light and air, and assumes a rich golden tint, and in this state can be used for dyeing fabrics of all descriptions. For yellow and orange-yellow shades it is used alone; mixed with Prussian blue it gives green; with oak bark, brown and tan; with cochineal, etc., orange and scarlet shades. The coloring thus produced is said to be of a superior quality.

The Academy of Meteorological Aërostation is to hold an exhibition of appliances used in the "aërial arts" in Paris during the summer of 1883. The exhibition will form the "centenary" of the Brothers Montgolfier, and commemorate their invention of balloons in 1783. The "aerial arts" include a great variety of materials, from gas to ropes, and barometers to pocket-knives.

Mechanics.

THE FIRST METAL-TURNING LATHE.

Joseph Moxon, an Englishman who was hydrographer to King Charles II. gives the first known intelligible description of a metal-turning lathe, in a small book entitled "Mechanick Exercises," which was brought out in monthly parts, commencing in 1677. In this, the art of turning occupies a large proportion of the space. It will be interesting to quote the quaint language used in this book. The description accompanies an illustration of a turn-bench held in a bench-vise. The work is rotated by means of a drill-bow, and a sphere is shown being turned. The chapter reads as follow:

"Of turning small work of brass or other mettal. Small work in mettal is turned in an Iron lathe called a turn-lathe called a turn-bench. The figure of it is described in plate 16 at C. When they use they screw in the chops of a vice, and having fitted their work upon a small iron axis, with a drill barrel fitted upon a square shank at the end of the axis next the left hand, they with a Drill-bow and Drill string carry it about as shewn in smithing, with this difference, that when a hole is drilled in a piece of Mettal they hold their Drill-bow in their Right Hand: but when they Turn small work they hold the Drill-bow in their left Hand, and with their Right Hand grasp the Tool, which is commonly a Graver, or sometimes a sculpter, fit to such Moldings as are to be made on the Mettal. They begin to work first with the sharp point of a Graver, laying the Blade of it firm upon the Rest, and directing the point to the Work, and lay Circles upon it close to one another, till they have wrought it pretty true. Then with one of the broad edges of the Graver they smooth down what the point left, and afterward with Sculpters, Round or Flat, or great or small, they work their intended Moldings. The circumstances and considerations in the choice of a Drill-bow and Drill string for Turnery are the same with what you find in Smithing and Drilling."

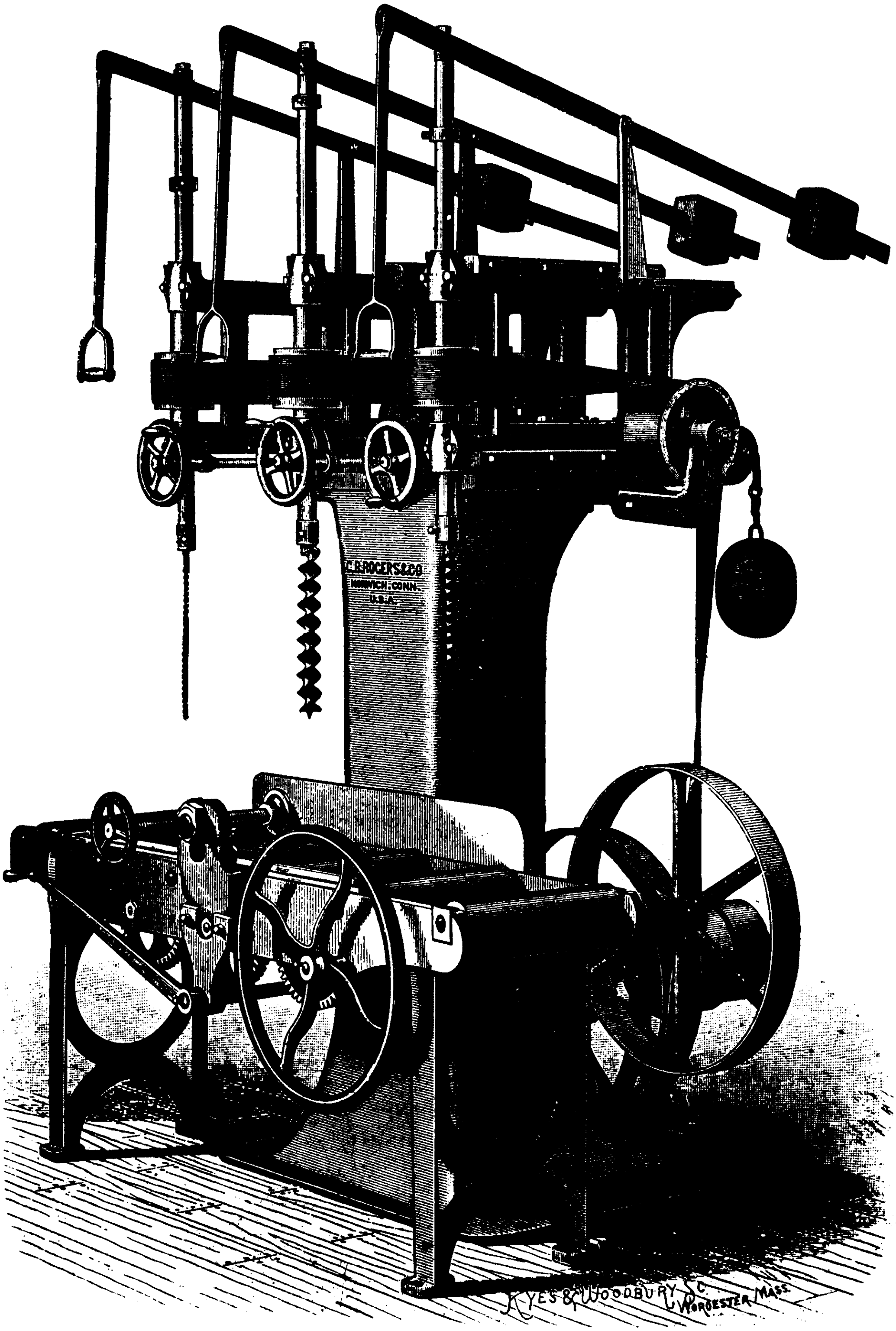
That the art comprehended the fashioning of metal at a remote period, evidence exists. Metal vessels, exhumed from the ruins of Thebes, bear unmistakable marks of the tool applied when the object was rotating. The machinery then in use probably lacked the stability necessary for turning metal successfully. Various forms of fly-wheels are shown in books published about the beginning of the nineteenth century, proving that the continuous rotary motion was then used. The pole, was, however, evidently preferred, and now soft-wood turners use it. The alternating motion allows them some advantages which we need not here discuss.

VERTICAL CAR-BORING MACHINE.

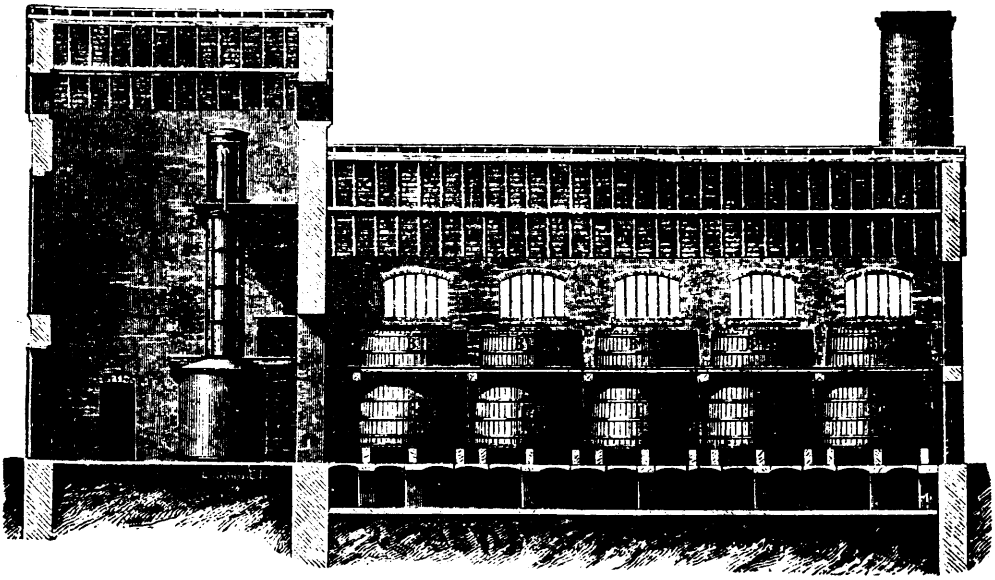
From the numerous products of the extensive wood-working machinery establishment of C. B. Rogers & Co., of Norwich, Conn., we select for description their vertical three-spindle borer which possesses certain practical features of construction which will interest our mechanical readers.

The machine referred to, and which is represented by the accompanying engraving, has been recently constructed from new patterns, and is designed for boring heavy timber with different sizes of holes without the delay and trouble of adjusting the spindle or changing the bits, necessary in single-spindle machines. This machine has three spindles, operated by the handles connected with the weighted levers at the top, and driven by one belt from a counter-shaft at the back of the machine. By a heavy weight, in connection with adjusting friction pulleys, the belt remains at the same tension whatever the position of the bits. The middle spindle has a larger pulley than the other two, for slower speed to work the larger bits. Seventeen bits are furnished, varying from ⅜ to 2 inches —all above 1⅜ inches to work in the middle spindle. The bits have a horizontal adjustment of 15 inches, and vertical throw of 16 inches.

The bed upon which the timber rests is furnished with four rollers which can be operated by the hand-wheel, or by the lever which operates the friction power feed attachment from the counter shaft. The machine is built wholly of first quality iron and steel, and in the most substantial manner, thus making a useful and durable tool for all kinds of timber boring. The counter is attached to the base of the column, and is furnished with tight and loose pulleys, 10-inch diameter and 5-inch face, which should be speeded to 275 revolutions per minute.—*Manufacturer and builder.*



VERTICAL CAR-BORING MACHINE, WITH THREE SPINDLES.



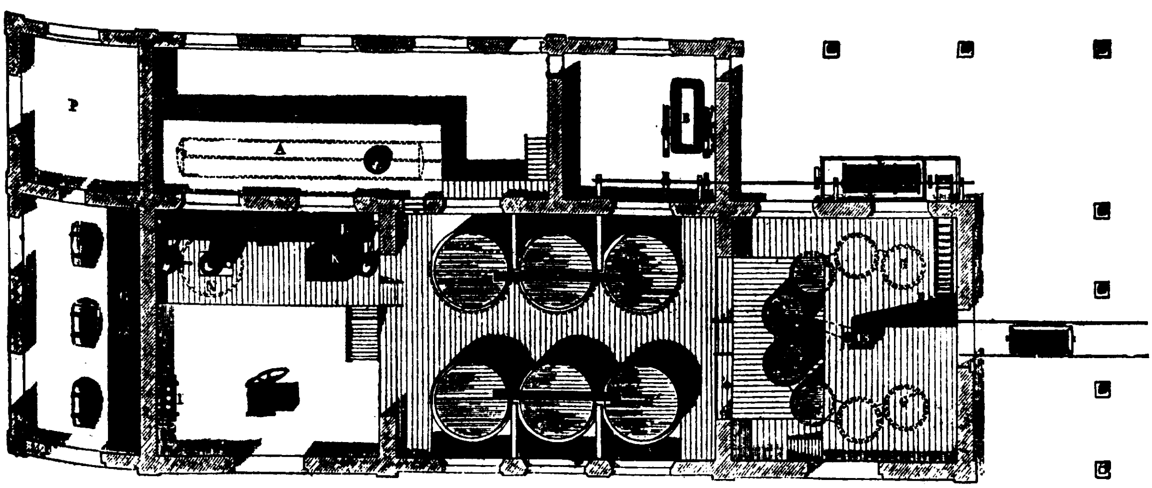
SECTION OF BEET MOLASSES DISTILLERY.

Trade Industries.

BEET-SUGAR MAKING IN COATICOOK.

Coaticook is a picturesque town of about 3,000 inhabitants, situated some 100 feet below the track of the Grand Trunk Railroad. The beet-sugar factory there existing was organized at Montreal, in the winter of 1880. Through the efforts of Mr. G. Lomer the final plans were matured in March, 1881. The capital stock then thought necessary was $150,000, but was found to be inadequate for the requirements; with an increase of $125,000 it is contended they will be able to work 250 tons per twenty-four hours. The plans of the factory were made only after an engineer came from Germany to examine the locality and the buildings there existing that were to be made use of. Positive orders were given for the machinery in January, 1881. The first deliveries were made in March, 1881. The total cost of the foreign machinery was to be $50,000, and of that made in America about $40,000 (for boilers, pipes, etc.). These figures represent the actual outlay, which is very much greater than was at first intended. The boxing of the machinery cost $900, and the freight was at an extremely low rate. Some few men came over from Germany to do the mounting; and it has been concluded that, in such cases, it would be better to send over an entire gang, as in this manner considerable time would be saved.

The total number of farmers contracting for beets was 2,107, but it has been decided not to deal directly with so many, but to make the contracts with, say four agents who will be directly responsible for the same. Those farmers contracting for small areas of one-quarter of an acre, as they did last year, cannot grow beets with the same profit as others who have special agricultural appliances. To overcome this difficulty, to each agent will be furnished a five-row drill, a five-row hoe, a spiral harrow, and a beet harvester. These will be imported from Germany, while those implements used last year were of American manufacture. It is thought that without counting the hundreds of acres that were destroyed by the frost, the average yield has been 15 tons to the acre, while the maximum yield is 22 tons. The greatest distance the roots were grown from Coaticook was one hundred and twenty miles, at St. Anne. The total number of arpents contracted for 1,850. The largest area under contract was 100 arpents. The roots were carried to the receiving department of the factory in carts or cars. By



PLAN OF BEET MOLASSES DISTILLERY.

special arrangement with the railroad, the freight by cars was $1.20 per ton. The roots have their necks left on, when gatherered on the field, and are silotted in the same condition, as it is argued that this is the only way that beets can be kept in a perfect condition. The second growth that is likely to take place under the circumstances, or the loss of sugar therefrom, is very much less than results from bad slicing or the increased danger of rot. The entire silotting is in charge of a gentleman of many years' experience, in Russia; he claims that he has never lost a ton, when the work was properly attended to. He is not an advocate of ventilating the silos upon the field, and contends that it is the cause of considerable trouble. The manner of building the silo consists in digging a trench about one foot deep around the outside of where the silo is to be built. Then the beets are piled on the interior surface of the ground (in a manner we have frequently described, about three or four feet in height, in the shape of a pyramid having a triangular section), a small quantity of earth is then thrown over them; here they remain for a variable time, during which the water, from evaporation, escapes. Their exact condition is determined by placing the hand in the interior; when no sensation of heat is felt, and the temperature of the air is about 34° F., more earth is piled on. This is again increased after several days, until the total thickness is some two or three feet. The length of these silos may be variable. No separation is required to prevent any trouble from spreading.

These silos were to be seen on top of the hill by the factory. They were built on undulating ground, and there was no fear from the water from the ravine below, with which the roots come in contact. By the factory is placed a root-house, where some 1,500 tons of beets are in reserve. In it may be found a good ventilator, etc. This root-house may be filled from the top by a suspended wire rope bearing baskets. The other end of the rope, on top of adjoining hills, is in proximity to the beet-receiving station. The latter communicates, by small tracks and cars, with the various parts of the field where the roots are silotted. This method we consider excellent, and under the conditions that the Coaticook beet-sugar factory is placed, works splendidly.

(*Contract of Farmer with Company.*)

I hereby agree to and with the

PIONEER BEET-ROOT SUGAR COMPANY [Limited]

that I will continuously, during the next years, raise acres of Sugar Beets annually from seed furnished by them, and to sell and deliver to said Company all the beets from said acres at the price of *five Dollars per ton of 2240 lbs.* clean Beets, free from earth and stone, with leaves cut off. Beets to be delivered at the Company's Factory in Coaticook, or on board cars at Railway Station, First Planting 1881.

In case of my decease or sale of Farm this contract to cease.

....188

Contract of Company with Farmer was as follows:

PIONEER BEET-SUGAR COMPANY [Limited.

COATICOOK, 188

The Pioneer Beet-Sugar Company (Limited) hereby agree to buy of during years, all the Sugar Beets raised on acres from seed furnished by this Company, and to pay cash on delivery, at the rate of five Dollars per ton of 2240 lbs. clean Beets, free from earth and stone, with leaves cut off.

Beets to be delivered at Company's Factory, Coaticook, or on board of cars at nearest railway station.

.... *Vice-President.*

.... *Treasurer.*

As regards the farmers, it is said that very few of them know a good beet from a bad one, for sugar manufacture. Very few of them have had any experience, before last year, in growing beets. The contracts were made with them through four agents. The fertilizer prescribed was superphosphates and ashes.

The soil upon which the roots were grown was of various kinds, but was principally sandy. These latter gave the best results. Efforts were made to have strict adherents to German methods of cultivation; but as the farmers cannot see the importance of this, their neglect, for the present, was overlooked, but it is hoped that, little by little, the correct principles will be realized by them. The seed used was of german origin, and gave entire satisfaction; more of the same kind will be employed the coming season. The Company advocates 16 pounds to the acre, but the farmers would not use more than 11 pounds.

It is hoped, however, that with time these prejudices also will be overcome. The farmers plowed only 8 to 10 inches, but efforts will be made to encourage 14 inches in depth. The time the sowing took place was generally in May; but one farmer, whose crop failed, waited until the middle of July, and, notwithstanding, he made money off his land. The thinning out was done in the usual manner. The early frosts were not calculated to increase the chances for a good crop. The rolling of the land, before sowing, was in all cases strongly insisted upon. The Company advocates the planting of beets two consecutive years upon the same land, and then not for three years. The farmers in the vicinity of Coaticook have for principal occupation that of raising cattle. The beets grown by them were in many cases employed for stock fodder, and with good results.

The only supposed trouble that was contended was an insect closely allied to the *Altica*; but it said that the harm done by them was nothing of any importance, for when the young roots were examined no evidence of their ravages could be found. In no cases was transplanting resorted to. The consequence was that those roots that did not come up, from being at too great a depth, or from other causes, were not replaced. The company grew only 50 acres, but this area will be increased the coming season, and efforts will be made to have perfect harmony prevail among the farmers; they are invited to take stock in the company, payable in beets, or in whatever they see fit. We are glad to find the Coaticook Beet-Sugar Company has been so fortunate in their sale of pulp. Any number of tons are ordered at $2, and an offer for the entire lot at $6 a ton, delivered on cars at Boston; thus showing that not only farmers, but cattle-breeders, are realizing the immense value of this food. Mr. Lomer tells us that upon dairy farms where it has been experimented with, the flow of milk, the quality of the butter, etc., has been increased. For cows, it is recommended to give them daily one-tenth of their weight of pulp and chopped straw; for oxen one-fifth of their weight. A large amount of the pulp is being silotted in a natural rock cave; in this manner a higher price, it is thought, can be obtained for it, when the proper times arrives. The total amount of pulp they expect to obtain will be about 3,000 tons. If this should be sold at $6 a ton it would represent a revenue of $18,000—an item worthy of consideration. As for the other refuse, nothing has as yet been decided upon, but it is thought that the molasses may be easily sold at twenty cents a gallon. For the coming year a distillery is talked of.

The main difficulty that has been contended with was the piping. Under present conditions, the prospects for the future are most favorable. In conclusion, we wish to call our readers' attention to an excellent principle that has been adopted for the paying of the roots, which consists in a graduated scale, varing with the time of delivery, it having for its object the encouraging of the keeping of the beets by the farmers until wanted at the factory. While, for example, beets of 12 per cent. of sugar would be worth $4.00 a ton in October, the end of November they would be valued at $4.75. In this manner, all concerned are benefited.—*Sugar Beet.*

CANALS ON THE PLANET MARS.

A curious discovery, made by Signor Schiaparelli, Director of the Royal Observatory at Milan, seems to start again that old and unanswerable question, "Are the planets inhabited?" This Italian astronomer is one of the most assiduous watchers of the planet Mars. It was he who, in 1877-8, first detected the many dusky bands which traverse and subdivide the ruddy portions of the martial orb. Again, in 1879-80, when the position of the planet was favorable, he reidentified these strange lines; but during last January and February he has been able to observe and map out in more than twenty instances duplications of the dark streaks "covering the equatorial region of Mars with a mysterious network, to which there is nothing remotely analogous on the earth." The Italian astronomer has styled them "canals," for they bear the appearance of long seaways, dug through the Martial continents, as if a mania for short cuts had seized the inhabitants of the planet, and everybody residing there had become an active M. de Lesseps.—*London Telegraph.*

Miscellaneous.

TEA.

One of the most valuable and exhaustive contributions to tea literature which we remember to have seen, says the London *Grocer*. is that just published in the form of a cyclopedia, by Messrs. W. B. Whittingham, Gracechurch street, E. C. It consists mainly of compilations from the *Indian Tea Gazette*, a publication in Calcutta that has for a number of years been exclusively devoted to the consideration and discussion of all questions relating to tea in India, from the time of its earliest introduction there down to the latest period of its importation here. The cultivation of the plant in the different districts and provinces, the selection of soils and manures, and buildings for its manufacture, etc., are all ably treated in this work; and as it deals thoroughly with the scientific, statistical, and domestic branches of the subject, it is a manual of information and instruction well deserving the attention of the tea planter, importer, dealer, and consumer.

In the ten years ending 1876 the imports and consumption of Indian tea in the United Kingdom increased from about 3,000,000 pounds to 28,000,000 pounds, and within the last five years the supply and demand have kept close pace together, till they have reached between 45,000,000 and 46,000,000 pounds! Imagine how this prodigious growth of the tea trade must have benefited the native Indian race and the county to which they belong. Our author says: "Hundreds of thousands of acres of land have been taken out of jungle and planted with tea. Districts hitherto deadly are fast becoming salubrious; coolies are in fair health, instead of dying off like sheep; and the tea industry, which was once looked upon as the last refuge for the destitute, is now viewed as a profession of the highest social rank."

According to the cyclopedia: "We say that a green tea has a fine flavor, also that a congou has a fine flavor, but they are totally unlike." The volatile oil it contains gives to tea its flavor. The effect of this oil is to produce wakefulness; but, on the other hand, the best authorities declare that "theine," another property in tea, does *not* create sleeplessness, being of a nature to soothe and compose. Theine also supplies to the human system what it loses by fatigue. This property in coffee is called caffeine, and the drinking of it is attended with similar results; but at the same time it is well known that "green tea will produce effects on persons that black teas will not," and that there is a greater fermentation in black tea than in green. Tannin, which is a powerful astringent, is another ingredient in tea; when chewed it "puckers up the mouth," but it is thought by some that it aids digestion. "Tasting tea upon an empty stomach is injurious, producing a sense of weakness, as if one had fasted a long while;" and "tea experts," who are at it all day, "are made exceedingly nervous." Some assert that there is nourisment in tea; others say that there is none, and that tea consumes food; while the book we quote from informs us that tea, like liquors and drugs, when taken moderately, will have one effect, but if consumed largely it will produce just the opposite.

With regard to the names of different sorts of teas and their meanings, we may state that "Pekoe" is a term from the "Pai-hao"—White Down or Hair, because made from young spring leaf buds, while they are still covered with down. "Souchong" is from "Seao-chung," which means Little Sprouts. "Congou" is a corruption of "Kung-fou," or labor; and "Hyson," or He-Chun, signifies Fair Spring; while the meaning of "Young Hyson" (Yu-chien) is, Before the Rains. The instruments for "making tea" are likewise very useful, and cannot be too widely known; and retail grocers might render a service to their consumers by giving them seasonable directions. In the first place, "tea should not be boiled, as the volatile oil will escape with the steam, and a much larger proportion of the tannic acid is extracted, leaving the infusion bitter." The best way to make tea is to have an earthenware teapot, which should be quite hot when the dry tea is put into it. A few minutes after pour in the boiling water upon the tea, which, after "drawing" from seven to ten minutes, "is at the best point for drinking."

A sufficient quantity that is wanted for use directly should be made at the first drawing. The habit of filling the teapot a second or third time is not right, because the theine, which is quickly soluble in scalding water, will have escaped, so that those drinkers who are supplied from the second drawing will lose the most beneficial part of the tea, and will have instead "a decoction composed briefly of tannin." Churned tea, properly prepared with milk, is a beverage highly prized in Cashmere in entertaining visitors; and we are told that "the ladies there no doubt vent their grievances to sympathetic ears, discuss their bonnets and their babies, and talk scandal over this cup in much the same way as their English sisters do over 'five o'clock tea.'"

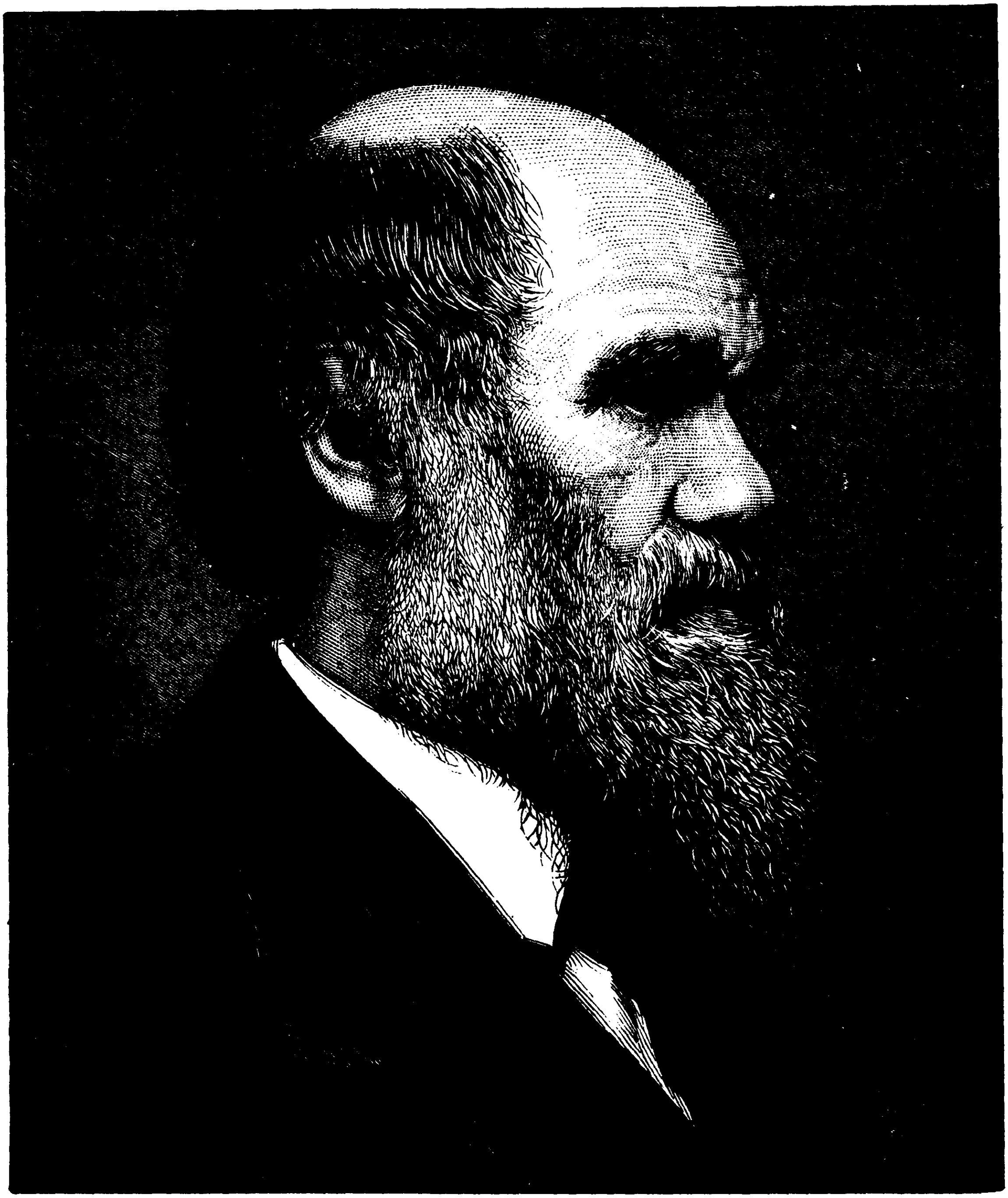
THE TEMPERATURE OF TUNNELS.

Observations in shafts, mines and borings shows that at a certain depth below the surface the temperature is constant all the year round. The exact law as to the increase of temperature beyond this depth is not known, it being assumed, however, that it rises from .03 to .033 C. for each additional meter (2.28 feet) of depth, and consequently increases by 1° for every 98 or 100 feet. Special circumstances, such as the influx of warm water, decomposition of gravel and feldspar, slow combustion of coal, &c., may, naturally, involve changes in certain places. Thus, in the celebrated Comstock Mines, Nevada, a temperature of 40 to 50° C. prevails at a depth of from 2000 to 2600 feet. The depth reached by mines is, however, by no means so great as the height of the mountains superincumbent upon the tunnels which pass under the Alps, or are to be made through them, and it is consequently fortunate that the above increase of temperature is not experienced in tunnels, but stands in relation to observations in plains or on mountains of medium height. The Mount Cenis Tunnel, for example, is about 4428 feet above the sea level at the middle, and the highest part of the mountain chain below which it runs is some 5248 feet higher. The prevailing temperature there is for the air—6° C.; for the mountains—1° C.; the temperature observed in the tunnel shortly after its completion was 29½° C., making a difference from the summit to to the tunnel center of 30½° C. Thus, the increase of temperature would be 1° C. to about 170 feet of depth under the mountain chain. With regard to the St. Gothard Tunnel, it may be said that the outer temperature is felt for a distance of only 6000 or 9000 feet, the temperature at greater distances depending upon the mass of the overlying rock. In the middle of the tunnel, some 3785 feet above the level of the sea, the temperature is 30½° C., and on the summit of the mountain, about 5500 feet higher, it is—1° C. M. Dubois-Raymond, who assisted in making observations in the St. Gothard Tunnel, came to the conclusion that work may be carried on just as easily in a dry atmosphere of 50° C. as in a moist atmosphere of 40° C.; those two figures forming the limits within which man is able to work for any length of time.

IMITATION OIL PAINTING.

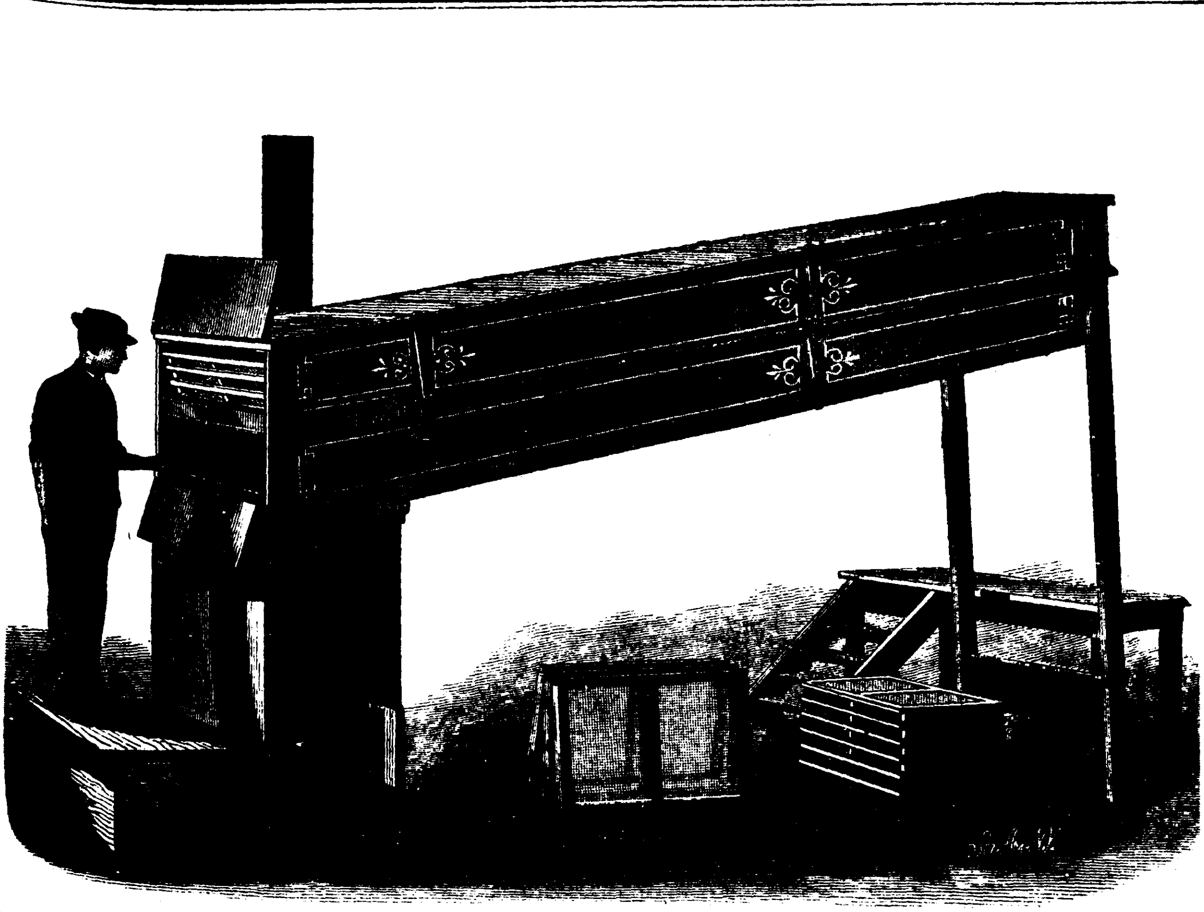
An improvement or extension of chromo-lithograghy, imitating the roughness of oil painting, is described as follows:

After the colors are transferred to the prepared paper from the color electrotypes, as in the old process, the picture resembles an ordinary chromo-lithograph, and is perfectly flat and smooth in appearance. In order to secure the roughness of surface and other individual marks which are the peculiar characteristics in the original oil-painting, the latter is covered with gelatine, which accurately secures an impression of all the individual surface marks of the painting. From this gelatine mould there is prepared another impressson in India-rubber or other elastic substance which permits of stretching, so that the coyy of the original may in the printed copy be either enlarged or reduced as desired. This india-rubber impression is afterward used to obtain a copper stereotype plate, and this in turn serves in the preparation of a negative or depressed copy plate. This plate presents an exact reproduction, in mould, of the surface of the original painting, and the depressions are filled in with pigment colors corresponding with the surface elevations of the painting. When thus arranged the prepared chromo-paper is laid upon the copper plate, and under the pressure and heat of a transfer press the pigments adhere to the prepared paper and produce all the surface effects in the original painting. Varnish is next applied, and the result is a painted color copy which is an exact color counterpart of the oil-painting, and which may subsequently be transferred from the prepared paper to either canvas, wood or metal, at the option of the printer, to be used in preparing any number of copies. The merit of the new process is this peculiar fidelity of reproduction which renders the printed copy so like the original that it is difficult to detect the difference.



THE LATE CHARLES ROBERT, DARWIN, L.L.D , F.R.S.

(SEE EDITORIAL.)



IMPROVED FRUIT EVAPORATOR.

IMPROVED FRUIT EVAPORATOR.

In properly evaporated fruit there is no loss of pleasant or valuable properties, but an actual increase of fruit sugar, from the fact that evaporation is essentially a ripening process, the development of sugar ranging from ten to twenty-five per cent in different fruits, as determined by chemical analysis. By the process of evaporation, properly conducted, in a few hours the juices are quickly matured and the maximum development of sugar secured, and water pure and simple evaporated, the change being analogous to the transition of the grape to the sweeter raisin, or the acid green apple to ripeness, with corresponding delicacy. The cell structure remains unbroken, and the articles, when placed in the rejuvenating bath of fresh water return to their original form, color, and consistency.

In evaporating cut fruits, such as apples, pears and peaches, the correct method is to subject them to currents of dry heated air, so as to dry the cut surfaces, quickly, preventing discoloration, forming an artificial skin or covering, and hermetically sealing the cells containing the acid and starch, which yield glucose, or fruit sugar. This principle is demonstrated in nature's laboratory, in the curing of the raisin, fig, and date, which are dried in their natural skins—a process not applicable to cut fruits—in a tropical climate, during the rainless season, by natural, dry, hot air in the sun ; through a crude and slow process, the development of glucose or grape sugar is almost perfect.

The annexed engraving shows a practical, economical, and inexpensive fruit drier made by the American Manufacturing Company. In this evaporator separate currents of dry, heated air automatically created, pass underneath and diagonally through the trays and then off and over them, carrying the moisture out of the evaporator without coming in contact with the trays of fruit previously entered, and already in an advanced stage of completion. The greatest heat is concentrated upon each tray or group when it first enters the machine, and each tray or group subseuuently entered removes or shoves the previous one forward into a lower temperature. This operation is continued throughout, being rendered perfectly practicable by the inclined, divided evaporating trunk. No steaming, cooking, or retrograde process becomes possible.

We are informed that, so perfect is the active circulation of dry, hot air over, under, and through each line of trays, any tray taken from any portion of the trunk at any time, after being in the evaporator ten minutes will be found to contain fruit that is perfectly dry on the outside, to sight or touch, although the process of complete evaporation may be put one-quarter or one-half finished.

By this construction a maximum evaporating capacity per square foot of tray surface is secured, and the full benefit of fuel consumed is realized, and there is entire freedom from burning or scorching. A bright characteristic color in the product is, in every way, perfect and capable of commanding the highest market price.

These evaporators are made in various sizes, adapted to home use or to the more extensive requirements of the fruit-evaporating establishment.

As the quality of evaporated fruit has been improved by the introduction of more perfect apparatus and methods, the market has increased and better prices are commanded.

The evaporation of fruits has become a profitable business even to those employing the more costly and extensive apparatus. The improved evaporator shown in the engraving has all the advantages of the more complicated and costly apparatus with none of its disadvantages, being portable and perfectly adapted to its work.

For further information address the American Manufacturing Company, Waynesboro, Pa.

Chemistry, Physics, Technology.

SOUND.

Sound as a substance is nothing ; that is, you cannot see it. Sound is produced or generated by causing some substance to vibrate in the air either by shock or similar action. Without air no sound can possibly be produced. Air is as necessary to sound as it is to combustion. If we drop a solid substance into water we find that the water yields at the point at which it was first subjected to a shock. This swelling we call a wave. When the first wave has made way for the substance creating the disturbances, it causes the water next to it to form another wave, not so great as the one first made, and so on until the power expends its strength when at last all action ceases. If the body of water is not sufficiently large to allow of this succession of swells to exhaust themselves it is reflected back to the original point. If the water be confined in a square vessel the waves in meeting the sides are broken, resulting in confusion. As it is with water so it is with air. No matter how rapidly air may m ve, unless it comes in contact with some substance no sound is produced.

In a clear, dry air sound can be heard at a greater distance than when the air is damp or otherwise defective in its sound-bearing capacity.

Sound is due very materially to the atmosphere in which it is generated, and where the effects are to be heard. It has been an old theory, that if we take a sea-shell and hold it to our ear, we will hear the swell of its native ocean. It is true that if we hold the shell as mentioned, we do get the sound like the rushing of air. The same effect may be had by holding an earthen inkstand to the ear. In this case we might naturally suppose the sound emitted to be that of the wave breaking over the clay that was used in making the ink vessel.

In musical instruments the cylindrical form is important. Where this form is not preserved various modifications of it are employed. The violin, for example, is composed of two outer walls. Then comes the finger board. Again we have the button at the lower end ; then we have the sounding-post placed in the inner side, and immediately under this is plaeed the bridge, over which the strings are drawn and held in position. The outer partition presents a line of swells and and sweeps. The strings are adjusted to harmonize. To the bow we apply a resinous substance to produce friction. We draw the bow over the strings, which produces a vibratory sound. If the body of the instrument were made of thicker material, or without sweeps or curves, unpleasant sounds would be the result.

In the piano we produce musical sounds by hammering on wires when in proper tension. This hammering causes them to vibrate, to send off their sound to the sounding-board. which is then reflected to the outer air. Another example which it is well to refer to, is the snare drum. We stretch across each head a piece of sheepskin. Across the lower head the snares are placed. An air-hole is made in the body. When the upper head is struck, the air in the cylinder hammers against the lower head, causing it in turn to hammer against the snares, while the sound reaches the outer air by means of the hole in the body. When the drum is muffled a dull sound is the result. The xylophone is a good example of the sound-producing capacity of wood. A small hammer striking the pieces of wood, of which the instrument is composed, causes them to vibrate, sending off their wavelets of sound.

To produce sound we require, in connection with air, substances that have density, elasticity and vibratory power. If we suspend a common brick and strike it with any substance, say a piece of iron, a very dull sound is the result. The brick has a certain amount of solidity about it, but no elasticity or vibratory powers, and consequently yields no sound at the moment. If we take a stone of the hardest species we get better results than with a brick, because of its density. Steel has density, elasticity and vibratory powers, and produces sound. If we form the steel into a circle, leaving the ends in contact, we get an increased amount of sound. So long as steel vibrates so long will sound be amitted.

A bell has density, elasticity and vibratory powers, and is capable of containing air in a condensed form. If the bell is formed so as to consist of angles, as, for instance, the cow bell, we get the same confusion of sound as mentioned in describing the action of waves in water, that is, of water placed in a square vessel. If the bell be fractured there is no continuation of the sound, vibration becomes suspended by reason of the fracture. A barrel, perfectly tight, with the bung inserted, if struck gives a hollow sound much subdued If the barrel were loosely constructed, the sound would be similar to that ofthe fractured bell. If we strike a square box, the sound is momentary. Its many angles cause a confusion of the sound waves. It is an old theory, that a clear frosty air allows of a greater amount of sound than a clear, warm air. This is incorrect. No matter where sound is generated, it will ever travel in search of the higher, purer and more expansive atmosphere.—*Blacksmith and Wheelwright.*

HOW A SCIENTIFIC MAN DETECTS ARSENIC.

Recently during the trial of the Malley brothers for murder, at New Haven, Conn., Prof. R. H. Chittenden, a young man, instructer in physiological chemistry, Yale College, testified as follows :

"I made a chemical examination in a room in the college to which no one had access but myself. The doors were doubly locked, and, in my absence, sealed. On the 16th of August I opened the jar labeled 'Stomach and œsophagus.' I poured the contents into a clear porcelain dish. They weighed 603 grammes, or 1 pound 5 ounces and 118 19-100 grains avoirdupois. The fluid contents had the odor of alcohol, and were distinctly acid in reaction. The stomach had already been opened. Nothing abnormal was observed in its lining. I then sampled the mixture preparatory to analysis. I cut the stomach into small shreds, transferred them to a mortar and ground them into a liquid mass. I next weighed off from this mixture 266 grammes, equal to 9 ounces and 167 2-5 grains. I subjected this to evaporation or distillation at a gentle heat. In the distillate I could detect only alcohol. I examined the residue for organic or alkaloid poisons. All the residue retained failed to give any reaction to chemical reagents, or when given to animals. I found no trace of organic or alkaloid poisons. Sometimes they can be obtained by physiological tests when chemical tests fail. Eighty-eight grammes or 3 ounces 45½ grains, of this stomach mixture were weighed out, and tests were applied for mineral poisons. They revealed traces of a substance bearing a resemblence to arsenic. It was got in the form of a dark metallic body."

The Professor stooped down and raised a mahogany case filled with little glass vials, all numbered. It was similar to the one used in the Hayden trial. He laid it on the Judge's bench. It was afterward transferred to the table in front of the jurors. Glass bulbs and tubes, a Marsh apparatus, an alcohol lamp, a porcelain bowl, vials filled with acids, and other chemical paraphernalia were placed on the District Attorney's table. A white rubber tube connected it with the gas bracket over the witness box.

"In addition to the substance bearing a re emblance to arsenic, I got seven milligrammes of oxide of iron," he said. "I calculate that the stomach and contents contained 729-1,000ths of a grain of this oxide. I dissolved it in hydrochloric acid, making it chloride of iron. It is the fifth exhibit (pointing to a vial in a Mahogany case). I next identified the arsenic, and ascertained the amount. I weighed out another 100 grammes of the stomach mixture, 3 ounces 23C 3-5 grains. I weighed it in a porcelain bowl. 223 centimeters of nitric acid were added to the mixture. I placed the bowl in an air bath, heated at 150 degrees, nearly 380° Fahrenheit. In this way all the tissue was dissolved and converted into liquid. The arsenic present was converted into arsenic acid. This heating on the air bath was continued for nearly two hours. The liquid then took on an orange color. I am particular in detailing this operation because in this work I have repeated it nearly sixty times. When the orange color appears, three cubic centimiters of pure sulphuric acid is added to the mixture. This produces a very violent oxidation or combustion.

"The organic matter of the tissue is converted into carbonization like charcoal. The arsenic acid still remains. While still heated, eight cubic centimeters of pure concentrated nitric acid were drop by drop added to the mixture. The mass was then heated fifteen or twenty minutes longer. The destruction of the organic matter was then complete. A dish containing the carbonaceous matter was then filled with distilled water. It was allowed to soak twenty-four hours. In this way the arsenic, as arsenic acid, is dissolved out of the water, and the carbonaceous matter left undissolved. The clear solution containing arsenic, with a little coloring matter, is then evaporated to dryness, being heated by steam. The residue contains all the arsenic originally in the tissue. The residue is then dissolved in very dilute sulphuric acid. This solution is then gradually introduced into the Marsh apparatus. In this apparatus (holding up a bulbular glass instrument), thirty grammes of pure zinc, alloyed with a little platinum, is placed. Then a small quantity of sulphuric acid is poured in, which, acting on the zinc, generates hydrogen gas. This gas issues from a tube like this, (attaching a glass tube like the spout of a pump to the Marsh apparatus). It then passes through this tube (exhibiting another tube), called the chloride of calcium tube. This dries the gas, and frees it from moisture. The gas then passes through a longer and smaller glass tube (showing it), and finally issues in a jet, which when lighted gives a colourless flame. When the apparatus is filled with hydrogen gas, the substance under examination for arsenic is poured into the upper bulb of the Marsh machine (showing the bulb). A glass stop cock (illustrating) is then turned, and the fluid flows, drop by drop, into this lower bulb, into which the hydrogen is being constantly evolved. In this manner the solution containing the arsenic is brought into contact with the hydrogen. The arsenic combines with the hydrogen, forming a gaseous compound, called arseniureted hydrogen. The arseniureted hydrogen ultimately passes through the narrow glass tube (showing tube). This tube is placed over a small glass furnace (exhibiting a furnace). By the action of these three lights (showing lights in furnace) six inches of the tube are heated to a red heat. As the arseniureted hydrogen passes through this six inches of tube, it is decomposed into metallic arsenic and free hydrogen. The hydrogen passes off, and the metallic arsenic is deposited at the cold end of the tube. The apparatus is allowed to run until the zinc is completely dissolved. This usually takes in from three to four hours. It depends upon the rapidity with which the gas is evolved. As the first portion of the acid flows into the bulb a second portion of stronger sulphuric acid is added, and allowed to flow under the zinc. Lastly, a third portion of still stronger sulphuric acid is added. These serve to completely change the arsenic into arseniureted hydrogen, and the entire amount of metallic arsenic is deposited on the inner surface of the glass tube. The apparatus is then taken apart, and the portion of the tube containing the metal is cut out with a file. (The Professor illustrated by cutting a tube with a file). Thus a piece of glass is secured which contains all the metallic arsenic. The tube, plus the arsenic, is then carefully weighed. Then the incrustation of arsenic is dissolved by nitric acid. The tube is rinsed with water, and finally dried. It is weighed. The difference between the first and second weighing is the weight of the metallic arsenic. My hundred gramme sample of the stomach mixture, treated in this manner, gave a metallic deposit, which weighed 1 3-10 milligrammes.

"I calculate from my analysis of the 100 grammes of stomach mixture," Professor Chittenden continued, "that the whole 603 grammes contained 79-500ths of a grain of arsenic. I next verified the result already obtained. I dissolved the metallic acid in nitric acid, and evaporated the solution to a dryness. It left a white residue. This residue dissolved completely in a drop of water. I then added a little solution of nitrate of silver, soluble in ammonia and soluble in nitric acid. I identified the substance as the white oxide of arsenic beyond the shadow of a doubt. It is the same as that sold at stores under the name of arsenic.

The Professor said that he next weighed out 106 grammes, or 3 ounces 323¼ grains of the sample stomach mixture, and treated it in the same manner as he had treated the preceding portion. He got from it 1 7-25 of a milligramme of metallic arsenic. This demonstration proved to his mind that the arsenic was evenly distributed. There still remained 43 grammes of this sample stomach mixture. He oxidized this in the same manner, and obtained from it metallic arsenic. He proved it by a different process from the first. He used various processes in proving its demonstrations, with the same result. The arsenic was always there. The liver, kidney, heart, lungs and spleen, brain, trachea, diaphragm, and intestines were similarly examined. The total amount of arsenic obtained from these organs was 1 grain and 847,5000ths of a grain.—*Scientific American.*

DR. LAMBERT says it is a common error that the joints of animals have always a synovial fluid which is in the nature of a lubricant. The elephant with his relatively moderate motions and great weight, has admirable cartilages but absolutely no lubrication therefor.

TO TAKE OUT MILK AND COFFEE STAINS.

These stains are very difficult to remove, especially from light colored and finely finished goods. From woolen and mixed fabrics they are taken out by moistening them with a mixture of one part glycerine, nine parts water, and one-half part aqua ammonia. This mixture is applied to the goods by means of a brush, and allowed to remain for twelve hours (occasionally renewing the moistening). After this time, the stained pieces are pressed between cloth, and then rubbed with a clean rag. Drying, and if possible a little steaming, is generally sufficient to thoroughly remove the stains. Stains on silk garments which are dyed with delicate colors, or finely finished, are more difficult to remove. In this case five parts glycerine are mixed with five parts water, and one-quarter part of ammonia added. Before using this mixture it should be tried on some part of the garments where it cannot be noticed, in order to see if the mixture will change color. If such is the case no ammonia should be added. If, on the contrary, no change takes place, or if, after drying, the original color is restored, the above mixture is applied with a soft brush, allowing it to remain on the stains for six or eight hours, and is then rubbed with a clean cloth. The remaining dry substance is then carefully taken off by means of a knife. The injured places are now brushed over with clean water, pressed between cloths and dried. If the stain is not then removed, a rubbing with dry bread will easily take it off. To restore the finish, a thin solution of gum arabic, or in many cases beer is preferred. is brushed on, then dried and carefully ironed. By careful manipulation the stains will be succesfully removed.

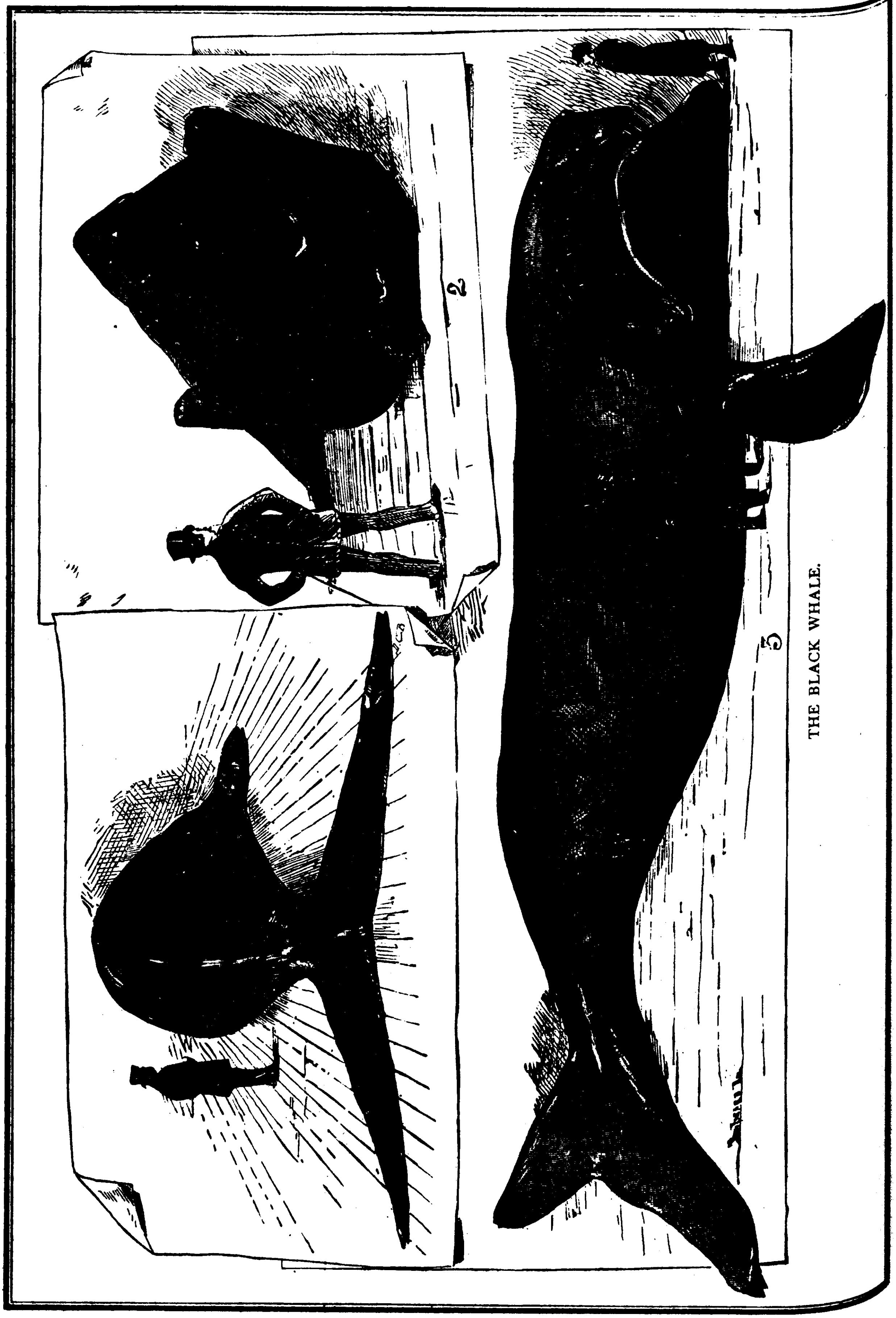
OLD GERMAN NEWSPAPERS.

At the end of last year there were in circulation in Germany 4,413 newspapers. Of these 98 were older than the present century. Among them the *Frankfürter Journal*, 261 years old; the *Magdeburg Zeitung*, 253 years old; the *Leipziger Zeitung*, 221 years old; the *Jenaische Zeitung*, 207 years; the *Augsburger Postzeitung*, 195 years; the *Gotaische Zeitung*, 190 years; the *Vosetsche Zeitung*, 159 years; the *Berlin Intelligenzblatt*, 128 years; the *Kolnische Zeitung*, 84 years. There are 200 newspapers averaging from 80 to 50 years; 1,127 averaging from 50 to 21 years; 1,542 between 20 and 6 years; and 1,380 between 5 years and 3 months old. Altogether there are 1,491 German newspapers more than 20 years old. That a newspaper's existence in Germany is often a very ephemeral one may be inferred from the fact that 20 per cent of the newspapers which circulated through the German post office in 1880 came first into existence within the same year, and the average existence of those newspapers was not more than six months. Some have been more hardy, and have survived into the present year.

EFFECTS OF HEAT ON ELECTRICAL CONDUCTION.

Prof F. Guthrie, F.R.S., recently read a paper on the discharge of electricity by heat. He showed by means of a gold leaf electroscope that a red hot iron ball, when highly heateda would neither discharge the positive prime conductor of g glass electrical machine nor the negative one, but on coolind the ball a temperature was found at which the ball dischargen the negative conductor, but not the positive one. Lastly, on cooling the ball still further—but not below a glowing temperature—it was found to discharge both positive and negative electricity. A platinum wire rendered red hot by the current also discharged a negatively-charged electroscope more readily than a positively-charged one. When placed between two electroscopes, one havifig a + and the other a — charge, it discharged neither. When the + one was withdrawn the—was discharged; but when the—was withdrawn the + was not discharged. There therefore seemed a tendency in a hot body to throw out + rather than —electricity. These are interesting experiments, and open a litte room for discussion *versus* positive and negative electricity.

THE EYE OF THE HOUSE FLY.—Prof. Fairfield thinks there are reasons to believe that the common house fly with its numerous lenses, capable, as has lately been proved, of change of focus, like the human eye, by a circular muscle, overlooked by early entomologists, can avoid the serious difficulties we meet with in higher powers, and could distinctly recognize objects only a twenty-millionth of an inch in diameter.



THE BLACK WHALE.

THE INDIAN BELOSTOMA.—(Natural Size.)

Natural History.

THE TILE FISH.

BY DANIEL C. BEARD.

How little is really known, even by our most learned scientists, of that wonderful country that lies hidden beneath the waves! What we know of its geography, aside from the summits of the mountains and highlands that are high enough to rear their heads into our world of air, is barely sufficient to mark out safe routes for vessels from point to point. Of the the creatures that dwell in this unknown region our knowledge is limited to such specimens as accident may cast up, or the fisher's net gather along its outer edge, or the dredge of the scientific explorer capture in its depths.

We can scarcely imagine creatures more hideously monstrous or more wonderfully beautiful than some of the known denizens of this immense world of the sea. For aught we know to the contrary the great sea-serpent may yet prove to be a living reality, for has there not been within the last few years discovered, captured, classified, measured, and publicly exhibited a sea monster as horribly strange and terrible as the fiery dragon of fairy tale? What was once called the fabulous devil-fish is now known to every school boy as the giant squid.

The discovery of a new and strange food fish need, then, be no surprising matter. Some three years since a Yankee fisherman caught a number of fish whose odd triangular crest, or adipose fin on the nape of their neck, at once marked them as strangers, and created a stir among *savants* and naturalists; but if they were surprised at this sudden appearance of a new fish, they were more surprised and puzzled last month when the commanders of two vessels brought in reports of sailing through miles of dead carcasses of this newly discovered fish, the *Lopholatilus chamæleonticeps*, or tile fish. Whence these mysterious strangers came, or what caused their wholesale slaughter, are questions we know not how to answer, but of the facts we have sufficient proof.

A specimen of the tile fish that was sent to the U. S. National Museum measured thirty-three inches in length; the illustration accompanying this article was drawn from the Washington specimen.

We first hear of the "tile fish" from the report of Capt. William H. Kirby, of Gloucester, Mass., who took five hundred pounds of a remarkable fish, new to both fishermen and scientists, and forming a type of new genus and species. These fish were caught on a codfish trawl eighty miles S. by E. of Noman's Land lat. 40° N., long. 70° W in eighty-four fathoms of water. According to Capt. Kirby the largest fish weighed fifty pounds.

We next learn of this fish from Capt. Wm. Dempsey also of Gloucester, Mass., who, in July, 1879, caught some with menhaden bait at a point fifty miles S. by E. of Noman's Land, in seventy-five fathoms of water, bottom hard clay; two miles inside there is nothing but a "green ooze in which no fish will live." Capt. Dempsey gives the following particulars of this *lopholatilus*: "Liver small, somewhat like that of a mackerel, and contains no oil. Flesh oily, and soon rusts after splitting and drying. The stomach and intestines are small, the latter resembling those of an eel. The swim bladder is similar to that of the cod, and he adds that "the fish were very abundant and bit freely." The largest fish caught by Capt. Dempsey had a bifid nucleal crest.

Some of the first tile fish that were brought into Gloucester were sent by Prof. Baird to Fish Commissioner Blackford, of Fulton Market. These fish were cooked and served at the Windsor, and their qualities as a food-fish tested by Mr. Phillips, Secretary Fish Culturist Society, Mr. John Foord, President of the Ichthyophagous Club, and Mr. Blackford. We next hear of this mysterious denizen of the deep from several of the daily papers. In their issue of the 23rd of March, there appeared accounts of immense numbers of dead fish that were seen by people aboard vessels that passed the southern end of St. George's Bank, Newfoundland. On the 3rd of last month Capt. Henry Lawrence, of the bark Plymouth, from Antwerp, and Capt. George Coalfleet, of the bark Dunkirk, witnessed this phenomenon.

When a drawing of the *lopholatilus* was shown by Mr. Blackford to several of the sailors of the above named vessels they at once declared it to be a drawing of the same fish whose dead bodies had so astonished them off "The Banks." These sailors had cooked and eaten some of the dead fish. The meat was fresh and hard, and according to their account very good eating.

The followiug technical discription of this fish is from Washington:

Radial Formula.—B. VI.; D. VII. 15; A. III., 13; C. 18; P. II., 15; VI., 5; L. Lat. 93 L Trans. 8+30.

Color.—"The operculum, preoperculum, upper surface of head, and major portion of body have numerous greenish yellow spots, the largest of which are about one third as large as the eye. Upon the caudal rays are about eight stripes of the same color, some of them connected by cross blotches. The upper part of the body has a violaceous tint, and the lower parts are whitish, with some areas of yellow. The anal and ventral fins are whitish; the pectorals have the tint of the upper surface of the body, with some yellow upon their posterior surfaces; the soft dorsal has an upper broad band of violaceous and a narrow basal portion of whitish. Many of the rays have upon them a yellow stripe; there are some spots of the same color, especially upon the anterior portion of the fin.

"The species appears to be generically distinct from the already described species of the family Latilidæ, Gill. It is related by its few rayed vertical fins and other characters to the genus Latilus, as restricted by Gill, but is distiuguished by the presence of a large adipose appendage upon the nape resembling the adipose fin of the Salmonidæ, and by a fleshy prolongation upon each side of the labial fold extending backward beyond the angle of the mouth. For this genus we propose the name *Lophotilus*." (G. Brown Goode and Tarleton H. Bean, "Proceeding of U. S. National Museum.")

A REDISCOVERY.—"THE BLACK WHALE."

BY DR. J. B. HOLDER, CURATOR OF ZOOLOGY, AMERICAN MUSEUM NATURAL HISTORY, CENTRAL PARK.

The recent occurrence of the capture of an adult baleen whale off our shores offered excellent facilities for familiar examination of the wonderful features characteristic of such great sea beasts. But an unusual interest attaches to this specimen from its being what naturalists are wont to term a rediscovery.

In brief, the history of this species is as follows: It is the black whale, so called in the early days of the settlement of this country, and is the one that for many years was so numerous south of Cape Cod, and along the shores southward to the Delaware River. William Penn, in the year 1683, mentions the capture of eleven off that river. For many years it gave employment to a large number of whalers in Nantucket and New Bedford. The creatures were chased in boats, not far from shore, and small vessels were fitted out for the business from various points along the coast of Long Island and near the Capes of Delaware. This whale fishing became so vigorous and was pushed to such extremes that ere long the creatures were either all captured or the few that may have escaped possibly sought other waters. The species then so numerous was lost sight of, and as in those early days little attention was given to important details referring to systematic descriptions of such animals, it was lost to science until, in the year 1868, Professor Cope noticed that this whale was occasionally making visits to the waters near its old feeding grounds—its range formerly being from the Gulf of St. Lawrence to the Carolinas. The circumstance of its habitat being away from the Arctic regions, the favorite home of the two great Right whales of commerce, suggested to Professor Cope the specific name, *Cisarctica*; its generic affinities being the same as of the two larger species just mentioned, *Balæna*.

The Right whale of the North Atlantic, formerly chased by the Basque whalers, according to Eschricht, is the species *B. biscayensis* which has also some affinity with the Right whale of the Southern Hemisphere, the *B. Australis*. After closer investigation, it is found that in all probability the first mentioned is one and the same with the present, now called *B. Cisarctica*, though Gray, of the British Museum, stoutly maintains the contrary.

The immense size of these creatures and the few opportunities offered for examination, and also the difficulties attending a proper measurement of parts, render the task of the cetologist, one of considerable uncertainty. This is seen in the glaring errors extant in all works on this subject. Though this species must have been examined many times since its reappearance, yet no account is on record that gives the characteristic external features. The anatomical differences are very marked. The American Museum of Natural History, Central Park, has a skeleton of this species of adult size. Now that we have a fine example of the whole animal at hand, we have taken the opportunity to make the most thorough and careful measurements and drawings of parts, with reference to completing its identity.

Reference to authors on the history of cetology shows many very curious as well as absurd conceptions. The works of Belou and Rondelet exhibit among the first accurate and scientific delineations and text, but they knew very little of the whale. Belou, 1553, figures several dolphins accurately enough, but one especially bulky he denominates Balæna. For a long period so little was known of the animals of this order that they were generally regarded and described as fishes.

The great Greenland whale (*Balæna mystecetus*)—called the Right whale—is the most familiar of the baleen species; yet a glance at the list of synonyms shows that the few other forms now known as distinct were confounded in one. The great bowhead and the Seibold whale of the northwest coast are of this genus, but are seen to have distinct specific characters. One of the most prominent external distinctions between the present *Cisarctica* and the two latter is the proportionate length of head; that of the latter is as 1 to 3 5-6, while the others are as 1 to 2.

It is surprising that so much uncertainty should exist through so long a period concerning the identity of this species. A most noticeable feature seems never to have been mentioned in descriptions, and no figure is extant. The beautiful dolphin-like snout is so well marked that it is very surprising it has not been mentioned. A feature so handsome and well defined should have sufficed to render this species recognizable at once.

A glance at the literature of this subject is sufficient to see that the material at hand is very meager, most measurements and descriptions relating to the baleen, the carbones, and to the skeleton generally. The proportions of the present specie are very striking as compared with those of others. We have seen that the head is a little more than one-fifth of the body in length; that of the Greenland whale being one-third.

The tail in this example measures, from tip to tip of flukes, 16 feet, and each fluke is 10 feet in length by 4 feet in width at the median line. This proportion of width of tail to the length of body greatly varies from that of the above cited species. The great size of the tail in the present species and the more slender body and smaller head altogether must credit it with greater activity. The body at the junction of the tail is but 80 inches in circumference, and a most graceful form is seen in the gradual enlargement towards the deepest point, near the head.

The whole length is about 46 feet. The length of head in an axial line from the angle of mouth to the symphysis of the lower jaws is 11½ feet.

The pectoral fins measure at their base 3 feet, in a line leading from the anterior to posterior edge over the superior surface, being, probably, about one-half the circumference. Their length is 7 feet and breadth 3 feet 10 inches.

The spiracles are situated somewhat below and behind the more prominent portion of the cranium and directly above the eyes. They are 16 inches apart at the posterior portions; 2 inches in greatest width, and a line running directly between the two terminations of the sulcus measures 12 inches, the spiracles being crescent shaped—*dos à dos*.

The space between the inner canthus of the eye and the upper lip measures 3½ inches; from the outer canthus to the nearest point of the axilla, 29 inches; from the lower eyelid to the angle of mouth, 26 inches.

The relative positions of external ear and eye are: A line drawn 6 inches in length, perpendicularly upwards from the centre of the eye, subtends one sixteen inches in length which terminates in the ear.

The beak or snout is 2 feet in width at the point where the rounded process rises above it. The latter is 16 inches across its thickest portion, and maintains a uniform bulk until it is lost in the form of the head; its height at the front is 20 inches, where it is bold and handsome in proportions. The baleen plates at the deepest portion of the mouth measure between 6 and 7 feet in length and 7 inches in breadth.

The palate and tongue are of a delicate pinkish color; more deep in tone in the former. The anterior aspect of palate measures at its geatest width 16 inches, arching in Gothic figures forward to the outline of the mandible, and suddenly contracting posteriorly to a space of 3 or 4 inches. A deep sulcus extends along the median line.

The baleen plates lie about one inch apart. According to Gray, who established the genus *Eubalæna*, to which this species is referred, the baleen is "thick, not polished, with thin enamel coat on each side, and a coarse, thick fringe," these being his sub-family characters, as in part distinguishing the present from the Greenland whale. The baleen of the latter is twice the length of that of the present species, which accounts for the great depth of the under jaw and bowed upper, which latter features give rise to the trivial name *bowhead*.

A marked difference is noticeable in the anatomical characters of the various species. The number of vertebræ vary; in this there are, according to Gray, "fifty to fifty-nine." The cervical are united at their bases. This feature is common to most whales. They are, also, reduced to such thinness that the whole number thus coalesced does not occupy more room than one average cervical would naturally be supposed to.

Though this species is the true cisarctica whale, and therefore a denizen in the more temperate latitudes of the Atlantic, yet its great rarity, from causes here mentioned, renders it unfamiliar, and it is not probably often met with by vessels crossing to Europe. The whale that is so often seen by passing vessels is a fin-back, a baleen whale having much smaller and shorter plates and a fish-like fin on the after third of the back. The profile of the whale is strikingly different from those we have considered, as the baleen being so short, the head is not proportionately large and deep. The fin-back is a very comely animal, yet fish-like in form, saving always the radical difference in tail, the whale having one of horizontal form, which is suggestive of the hinder limbs, as seen in walrus, seals, etc.

The tongue of the baleen whale is a curious mass, containing considerable oil. It is not susceptible of movement externally. The gullet is small, scarcely large enough to take in a small herring. Their food, however, is of another character, being largely the masses of jelly fishes and minute ocean forms that realize with a slight variation the words of Macbeth's soliloquy, for they do "the multitudinous seas incarnadine, making the green one red." This is true in respect of the salps, and certain lower organisms, but the Arctic seas are tinged an olive green by the extended masses of various medusæ.

The uses of the baleen will now be apparent. When we consider that masses of minute jelly-like objects are taken into the enormous open mouth of the whales and the water unavoidably closed within the mouth must be forced out, we see the frayed edges of the baleen acting as a sieve, and the water passing out between the plates.

The eyes are remarkable for comparative dimensions, the largest being about the size of a large orange. They are beautiful organs, being possessed of all the prominent features of the typical eye of mammals, having lids and lashes; and they are said to have acuteness of visions equal to any other animal. The eye is so placed that it commands a view from every point.

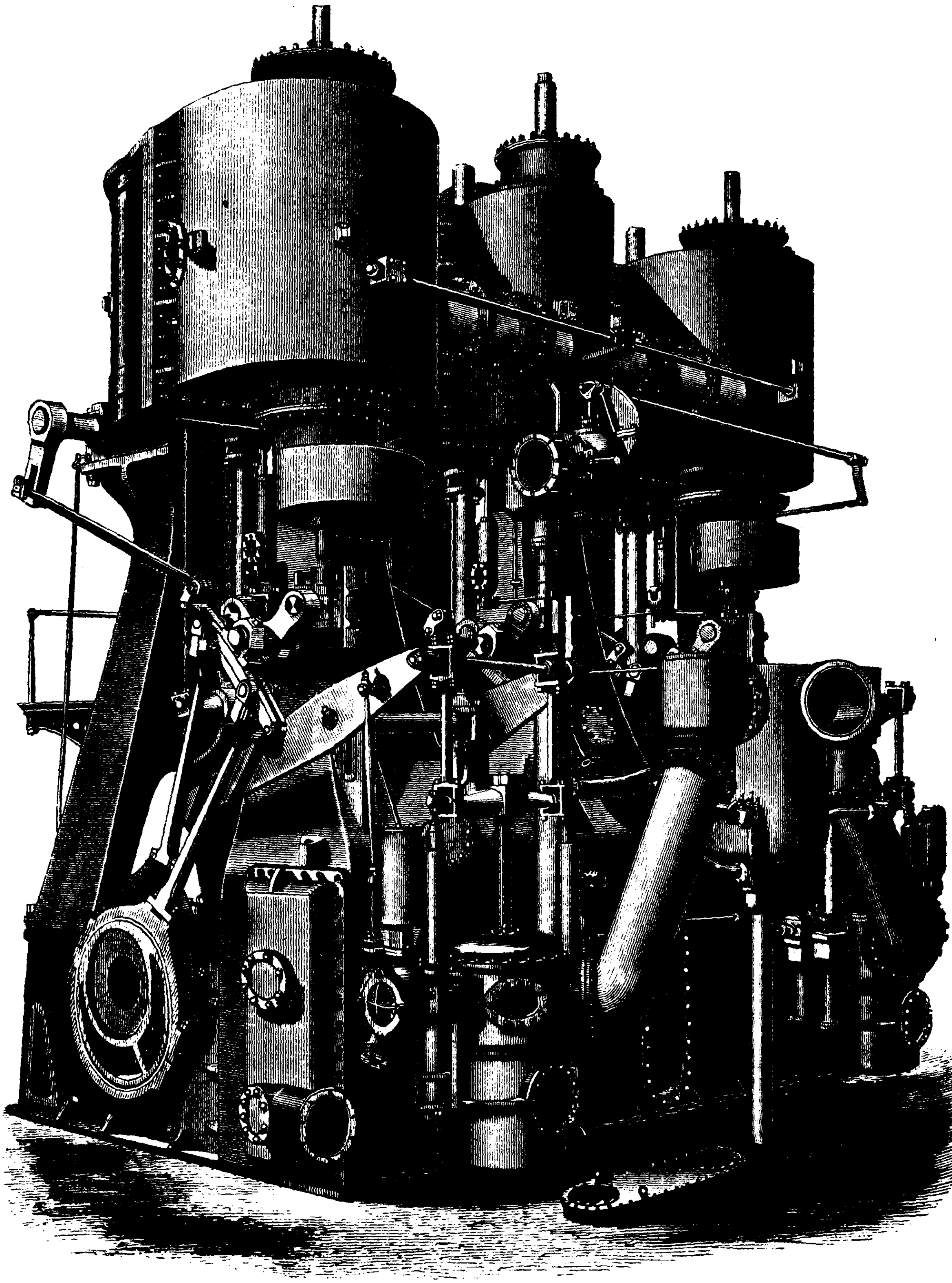
The internal ear is like that of other mammals, but the external part is reduced to a mere orifice, just large enough to take in a pen-holder. The sense of hearing is, however, acute.

These whales are regarded as silent as to voice, though a roaring sound is heard when the creature is hard pushed, which is thought to proceed from the blowing hastily repeated.

They have but one cub at a birth, though, as in the case in other mammals, twins sometimes appear. The teats are situated on the abdomen, about two feet apart. They are not prominent, the glands being concealed internally. The young at birth are said to be nearly one-fourth the size of the mother. The milk is remarkably rich.

The baleen of commerce is denominated whale fin. At various periods this portion has been no inconsiderable part of the profitable results of the whale hunting. The baleen of the present example is said to be worth over one thousand dollars.

With regard to the past year's history of the Paris Academy of Sciences, we note that three members have died—viz: M. Delesse, and M. Sainte-Claire Deville (both in the section of mineralogy), and M. Bouillaud (in medicine); also two correspondents, viz: M. Kuhlmann, of Lille, and M. Pierre of Caen (both in rural economy). MM. Jordan and Fouqué have been elected new members, and Mr. Gould, of Cordoba, a correspondent. M. Blanchard has been elected vice-president for 1882. The *Annuaire du Bureau des Longitudes* for 1882 contains an account of all comets observed during the last decade, important data in thermo-chemistry, a resumé of what is known about intra-Mercurial planets, a *fac-simile* of M. Janssen's photograph of the comet of last summer, &c.



THE ENGINES OF THE SS. *PARISIAN.*—FRONT VIEW.—(SEE EDITORIAL.)