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NOTE AND COMMENT.

TWO men who should be well known to most of our readers have died since our last issue. Of the one Mr. Street the English architect, we publish a portrait and life in another volume. Of the other, an American by adoption, whose portrait will be found on page 37, a more direct editorial notice seems fitting.

Dr. J. W. Draper was born near Liverpool, England, May 5, 1811. His taste for scientific investigation was developed early, chemistry being his favourite study. After studying some time at the University of London, he followed his family to this country in 1833, and completed his academic studies at the University of Pennsylvania, graduating with honor in 1836. Some of his scientific investigations having attracted attention, he was called to a professorship in Hampden-Sydney College, Virginia, where he stayed two years teaching chemistry, physiology, and natural philosophy. In 1839 he was called to the chair of chemistry and physiology in the University of New York, with which institution he has since been identified.

When the medical department of the University was organized Dr. Draper was chosen secretary, and in 1850, on the death of the first president, Dr. Valentine Mott, he succeeded to the presidency, filling that office until 1873, when he retired to give his attention to his literary work and his academic classes in science.

Notwithstanding the severe draught upon his time and strength demanded by his presidential and professional duties, Dr. Draper found time to pursue the scientific investigations which have gained him a place among the great leaders of intellectual progress in all ages. His earlier studies in vegetable physiology were many years in advance of those of the rest of the scientific world. He led the way by twenty years into that marvelous field of research opened up by spectrum analysis. In his conception of the essential unity of radiant energy he was a full generation ahead of the physical investigators of Europe. As a philosophical historian, tracing the influence of material progress, as sociation and environment upon the natural development of nations and races toward civilization and rational thought, he was not less a leader and a worthy representative of the type of man toward which scientific civilization is making. Though in no respect what is known as a popular writer, Dr. Draper probably reached a wider range of active minds among all civilized peoples than any other modern writer, his principal treatises having been translated into most if not all of the leading languages of the world, some of them having been adopted as text books in the colleges of all nations, notably his "Physiology" and "The Intellectual Development of Europe.

Mr. Peterson has presented his report on the subject of the new bridge over the St. Lawrence for the Atlantic and North Western Railway. Three different routes were reported on ; those crossing respectively, at Nun's Island, Heron Island and opposite Lachine. In spite of the slight advantages possessed by the easy connections with existing roads offered by the first of these, and the good foundation which the rock bottom opposite Heron's Island affords, both these routes, Mr. Peterson considers, will have to be abandoned in favor of the third on the score of economy. The line opposite Lachine is not only the shortest but it also provides a more direct route to New York by ten miles than by the Victoria Bridge ; it is also a shorter route for through traffic from the West to New York, St. Johns, etc. Another advantage it possesses is that on one side there is a high bank which does away with the necessity of constructing an approach. It also has the shortest waterway, the length being 3,418 feet. Mr. Peterson proposes to bridge the river with ten spans of 300 feet, and one over the channel of 330 feet. The borings have all displayed a solid rock foundation, and in no place is there more than two feet of gravel over the rock. The greatest depth of water is forty feet and the greatest current seven miles an hour. The spans are made unusually large on account of the ice from Lake St. Louis, and also with a view of interfering as little as possible with the water way of the river. The estimated cost is only $1,407,373, as against $2,946,186 and $2,176,435 for the Nun's Island and Heron Island routes respectively. Another advantage attending this site is the close proximity to the Caughnawaga quarries, where stone can be obtained for the piers and the embankments. All the spans will be deck spans except the middle or channel span, which will be thorough one. The proposed bridge will be a double track one, and constructed in the form of a double intersection truss bridge.

THE ACADEMY OF LETTERS.

Several weeks ago the readers of the daily press were somewhat astonished by the announcement that an Academy of Letters "had been formed under the patronage of the Governor-General." Particulars were not wanting as to the officials of the new institution. Dr. DAWSON was the President, and various other most worthy gentlemen occupied posts of honor at the heads of the departments into which the new Academy was divided. The names, too, of a number of the members of this learned body, some of them well known, some who had hitherto concealed their literary light under the journalistic bushel, were published with all the dignity which should properly belong to such an announcement.

It was somewhat of a relief to those amongst us who viewed with a little suspicion such a very mushroom growth as this would seem to be, to find that either the inventive genius of the reporter who was responsible for the paragraph had led him into error, or that the enthusiasm of the promoters of the scheme had carried them away. The foundation of an Academy will, we presume, require some overt act of the powers that be. Whether Parliament is to be called upon to pass a Bill for its creation, or whether the exercise of the prerogative of the Governor-General will suffice to call it into being, it may be safely assumed that something more than an informal meeting of a few self-chosen *littérateurs* will be needed to bring the scheme to that maturity, which according to the papers it has already attained.

The real facts of the case, so far as they can be ascertained, are briefly these: The Marquis of Lorne, it was known, before his departure, had interested himself in the scheme of which these are the fruits. At his suggestion, a meeting of several persons interested in the proposed Academy was to be called during his absence, to discuss the feasibility of the plan, suggest the persons best fitted in their opinion to form the new body, and submit for his satisfaction on his return, the information acquired on these and kindred branches of the subject. This, then, has been done; this is, in fact, all that could be done and it is the steps which the Government, we presume we may say which the Marquis will take, that alone have any interest for us now.

It would be waste of time to enter now upon the discussion of the *pros* and *cons* of the Academy that is to be. For that it is to be is as certain as the most reliable of Mr. VENNOR's prophesies, to say the least of it. Captious and disagreeable persons will point to the complete failure of the Academy of Arts to fulfil the bright promises with which it started. Still more disagreeable persons—who have been left out of the list—will be quite confident that the affair cannot succeed without them; while—tell it not in Gath—there are those who even doubt the ability of our great Dominion to furnish twenty names fit to inscribe upon the Roll of Fame. The majority, however, will wisely reflect that the Rubicon is past, and that as the thing must be, it is well to make the best of it.

But one thing there is to do, and which it is imperative upon the press to do thoroughly. The Governor-General has—with all due respect—but a limited knowledge of the literary talent of this country. He will not unnaturally be inclined to accept the report tendered him, the substance of which we have already, and without more ado to adopt it in default of any outside suggestions. It is the more incumbent upon us then to point out that the list of proposed members, as we have it from the daily press, contains some very serious omissions, which, if not corrected, will bid fair to make the whole scheme ridiculous in the eyes of the *cognoscenti*.

It were too invidious a task to criticize the names that do appear individually. There are several which, no doubt, are entitled to a place upon the roll of any literary institution that may be given to the country. Others may perhaps have talents of which we have never heard, but which may be developed in the hot-bed of Academy distinction. But so far as we can see, it is only those who can speak for themselves who have been heard hitherto, and a word should be said in favour of those retiring spirits who seek no distinction for themselves, but who are doubly worthy of it on that account.

Where, for example, is GEORGE MURRAY's name? A graceful writer, an able historian, withal a poet of no little force and originality, he is a head and shoulders above the little men who crowd in before him. Where again is the Abbé VERREAU? Buried at home in the books he loves and knows so well, he asks, it is true, but to be left alone with them. He seeks no distinction; but his name would do more honour to the Academy than his title of Academician could bring to him. If the new body is to be in any sense representative, it is such men as these who must grace its muster roll.

One other name has been left to the last, because its omission seems so extraordinary as to require special comment. What are we to say of a meeting, which, in selecting the literary talent of Canada, has forgotten the name of CHAUVEAU? Historian, novelist, poet, the most notable man of letters probably that Canada has produced—in a word, the *doyen* of French literature. It is not too much to say that to constitute an Academy of Letters and omit his name, will be to make the whole affair ridiculous in the eyes of the world, or at least of the literary portion of it.

There may be other names that should be mentioned, but we forbear to press our opinions further. Fortunately, the selection of the Academicians will not be with us. It will be an invidious task at best, and one which we do not envy the Governor-General, upon whose shoulders probably whatever there may be of blame will rest. That the task will be performed conscientiously on his part we do not for an instant doubt. We would only ask him not to be guided blindfold by the recommendations of any meeting, but to endeavour, if the Academy really is to be an honour to him and to the country, to make it really a representative of whatever of literary genius the country does possess.

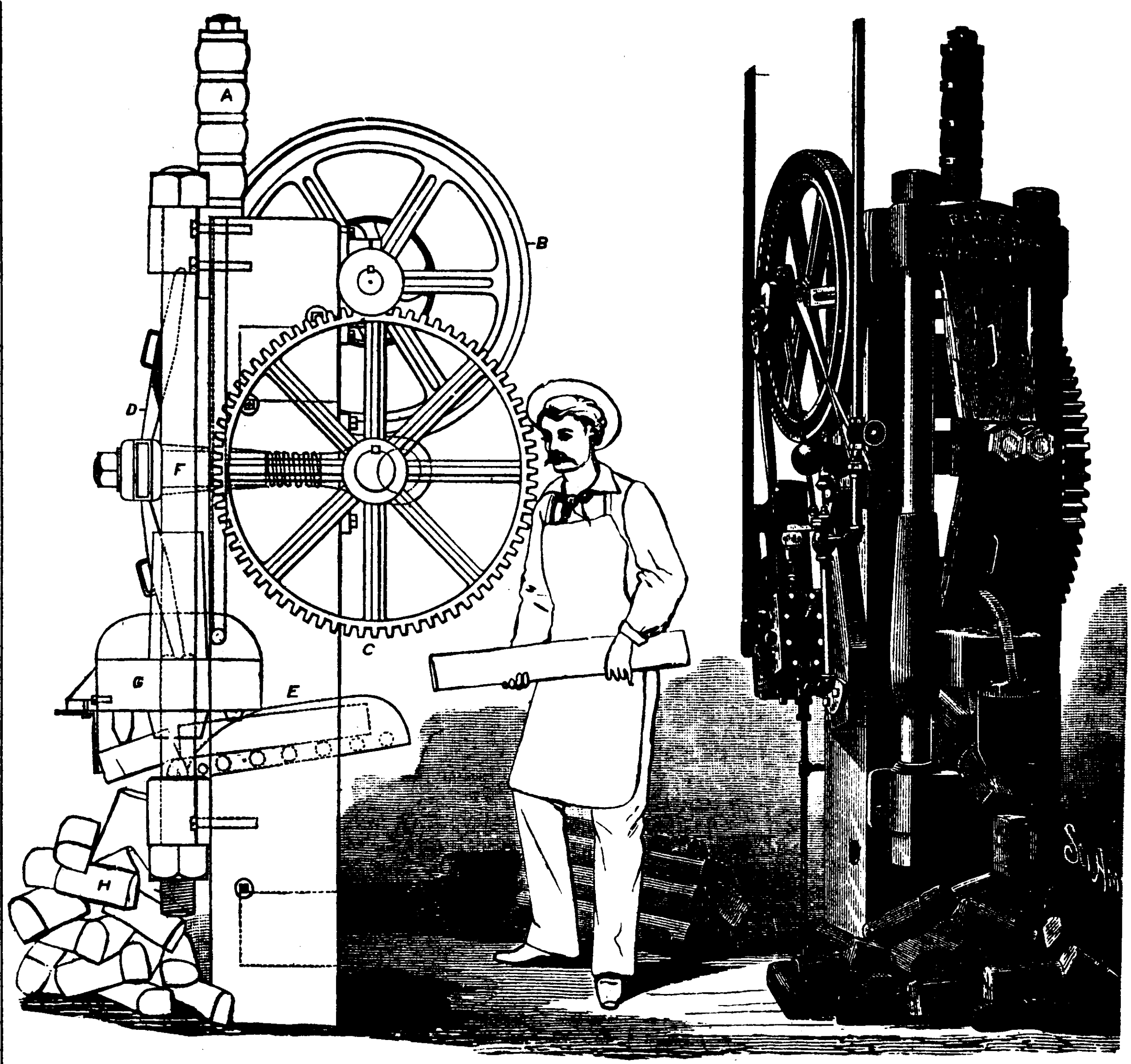
THE MOST ECONOMICAL STEAM-ENGINE.

A notable trial of a remarkable steam-engine has been made recently by Mr. E. A. Cowper, the President of the Institution of Mechanical Engineers, and, as really trustworthy records of engine trials are scarce, it is worth while paying special attention to the results obtained in the case in question, more particularly so because they show an economy which has rarely, if ever, been equalled in a properly conducted trial. As every one who has looked into the question knows, there is a very large margin for possible improvement, if we compare the actual efficiency of a steam-engine (which, in that case, includes boiler) with the absolute value of the fuel in heat-units ; for the best Cornish engines rarely utilize more than 14 or 15 per cent. of the potential power of the coal, and it is clearly seen that, under any circumstances, so long as we employ heat to convert water into steam, there must, of necessity, be a loss of by far the larger portion of the energy latent in the fuel. The loss is, in fact, so great that it is tacitly ignored, and we compare steam-engines by calculating the number of pounds of coal consumed for each indicated horse-power. Not many years ago, and where coal is cheap it is still the case, as many as seven pounds were consumed to obtain one horse-power from the engine, and it is no uncommon thing—indeed it is too common—to find engines that, nowadays, consume five and more pounds for each indicated horse-power. When the pumping-engines in Cornwall were regularly tested, and it was shown what the "duty" might be made, a filip was given to the pursuit of economy ; but the era of steamships undoubtedly gave the greatest stimulus to engineers, for owners speedily discovered that if a vessel had to carry more coals than were absolutely necessary, there were not only the loss of the wasted fuel, but a more serious loss on the contracted cargo space. With the introduction of higher pressures, compounding, and the other improvements which have been employed during the last thirty years, the consumption of coal has been steadily reduced, until it now stands on the average of good examples of marine engines at about two pounds per horse power. Cases are indeed on record where one pound and a half has sufficed, but the statements made have not the weight of those we are about to give, which have clearly established the fact that for pumping purposes the consumption of coal need not be much more than a pound and a half for each indicated horse-power. The trial in question was made with a couple of compound pumping engines, erected at Ditton for the Lambeth Waterworks Company, by Messrs. Simpson, of Pimlico, the well-known makers of engines adapted for the purposes of water companies. They are of the rotative type, with beams and fly-wheels, the cylinder having a stroke of 5 feet 6 inches, and the pumps worked by rods attached to the beams, a stroke of 4 feet. Each pair of cylinders drives cranks placed at right angles on the ends of the fly-wheel shaft, and each cylinder stands under its own beam, but the special feature is the use of a receiver, consisting of a thin annular space through which the steam passes from the high to the low-pressure cylinder. This annular space is surrounded on both sides with steam at boiler pressure, and the engines being placed at a higher elevation than the boilers, all water drains back direct. The receiver is in fact what is known as Cowper's "hot pot," and is a simple and efficient method of carrying out the well-known principle that it is cheaper to allow steam to condense in jackets or heaters than in the cylinders ; or in other words, that loss in the boiler is of no moment compared to loss in the cylinder. The engines in question have each a high-pressure cylinder 21 in. diameter, and a low pressure of 36in., both steam-jacketed ; and at the time of the trial they were worked by steam at an average pressure of 60 lbs., supplied by three boilers 5ft. 6in. diameter, 27 ft. long and having single flues of 3ft. in diameter, without tubes of any kind. The grate surface is 17½ sq. ft. in each boiler, so that there is nothing specially remarkable in the boilers themselves, which are perhaps not of a type best adopted to give a very high evaporative duty. Further, the engines being used only for pumping water to flow on to the filterbeds, the height of lift is small—only about 35 ft.—so that in two important points the conditions are antagonistic to any very high duty being obtained. In spite of these conditions, however, the difference between the pump horse-power and the indicated power is a little more than 27 per cent., which includes the work of the cold water and the air and feed pumps. The slip of the pumps was carefully ascertained, and the quantity of water delivered, was found to be about 94 per cent. of the theoretical capacity of the pumps ; but not to make a long story, we may assume every precaution was taken to insure a correct return, the coal and feed-water being carefully weighed and measured to avoid all suspicion of "cooking." The indicators used were two Richards and two Darkes, and diagrams were at first taken every quarter of an hour ; but as little or no variation could be detected, they were subsequently taken at intervals of half an hour. Injection condensers are used, and the vacuum during the trial with a barometer averaging 30·26in. was so good as to leave a back pressure of 1¾lb. only in the low-pressure cylinders. With the engines running steadily at 22 revolutions per minute, their usual rate, the total indicated horse-power was 240, the coal used, including ashes, 1·6 lb. per I.H.P., and the total duty of 112 lb., 100,539,103 foot-pounds. Higher duties than that have been recorded ; but, considering the accuracy of the trial of the Ditton engines, the result must be considered more trustworthy in their case than in that of some of the Cornish pumping-engines. The water fed into boilers per indicated horse-power amounted to only 13.4lb. per hour ; but as the jacket drains were in connection with the boiler, whatever heat was used up in the receiver and the jackets was not measured as feed-water. The quantity of water discharged from the jacket and receiver drains was, however, measured during some other trials, and found to be about 2lb. per horse-power per hour, so that these engines may be assumed to require only 15½lb. of feed-water for each indicated horse-power. The temperature of the feed was 81° Fahr., and the water evaporated per pound of coal was 8.347 gallons, a remarkable result from simple Cornish boilers without the assistance of Galloway tubes. The state of the fires was carefully gauged at the beginning and end of the 24 hours' trial, and the water in the boilers was left a little higher than at starting. Mr. Cowper says that the furnace bars were not so good as they might have been, though it is doubtful whether they could much improve the result above given if they were of the most excellent kind. In a trial of about 8 hours' duration, made by the Company's engineer, 4 boilers were used, and a slightly higher duty was obtained than that given above, so that Mr. Cowper's results may be taken as representing the amount of work the engines can do, in the ordinary way, when carefully tended. The question will naturally be asked, "To what are these results to be attributed ?"—and the simple answer must be, "To the manner in which the steam driving the pistons is followed throughout its journey by steam from the boilers, for nearly every surface with which it can come into contact is kept hot by steam at the temperature due to the highest pressure in the cycle of operations. The steam in passing through the high and low-pressure cylinders is expanded fifteen times and necessarily undergoes a good deal of condensation ; being repeated in the receiver, it is delivered dry to the low-pressure cylinder, and there probably helps to produce the remarkable results we have recorded above. It is not unlikely that in this direction of reheating the steam on its passage from one cylinder to another further advances towards greater economy may be effected, for it is certain that without the "hot-pot" steam cannot be expanded fifteen times with advantage, It remains to say that the results obtained with the Ditton engines are little more than might have been expected from their makers, who have constructed many sets of pumping-engines with somewhat similar results, but with not quite so high a degree of economy, and so undisputable a record. Indeed the fact that Mr. Cowper made the trial and returned such figures as he has done, renders the experiment a notable one in the history of the steam-engine.

BLAKE PIG IRON BREAKER.

No person who, during the last dozen years, has attended our great industrial fairs can have failed to see, from time to time, a Blake stone crusher in operation, and no one who has seen them could fail to be struck with the enormous power of even the smallest sizes. The quantity of work which they are capable of breaking seems only limited by the amount of stone of a proper size which can be fed into the jaws.

Recently the company who manufacture them has undertaken to adapt the machine to an altogether novel use, namely, the breaking up of pig iron into pieces suitable for fitting into cupolas. Heretofore the breaking of pig iron has been done either with a sledge hammer, the drop, or by throwing the pig down upon a V-shaped anvil. In the case of the tougher varieties of iron, this work is very severe and of necessity slow. Some kinds of iron, indeed, are so tough that recourse must be had to the use of the drop. Our engravings represent the new pig-iron breaker, manufactured by the Blake Crusher Co., of New Haven, Conn. It is intended to break up pigs into lengths of from 7 to 8 inches. In its form the machine is

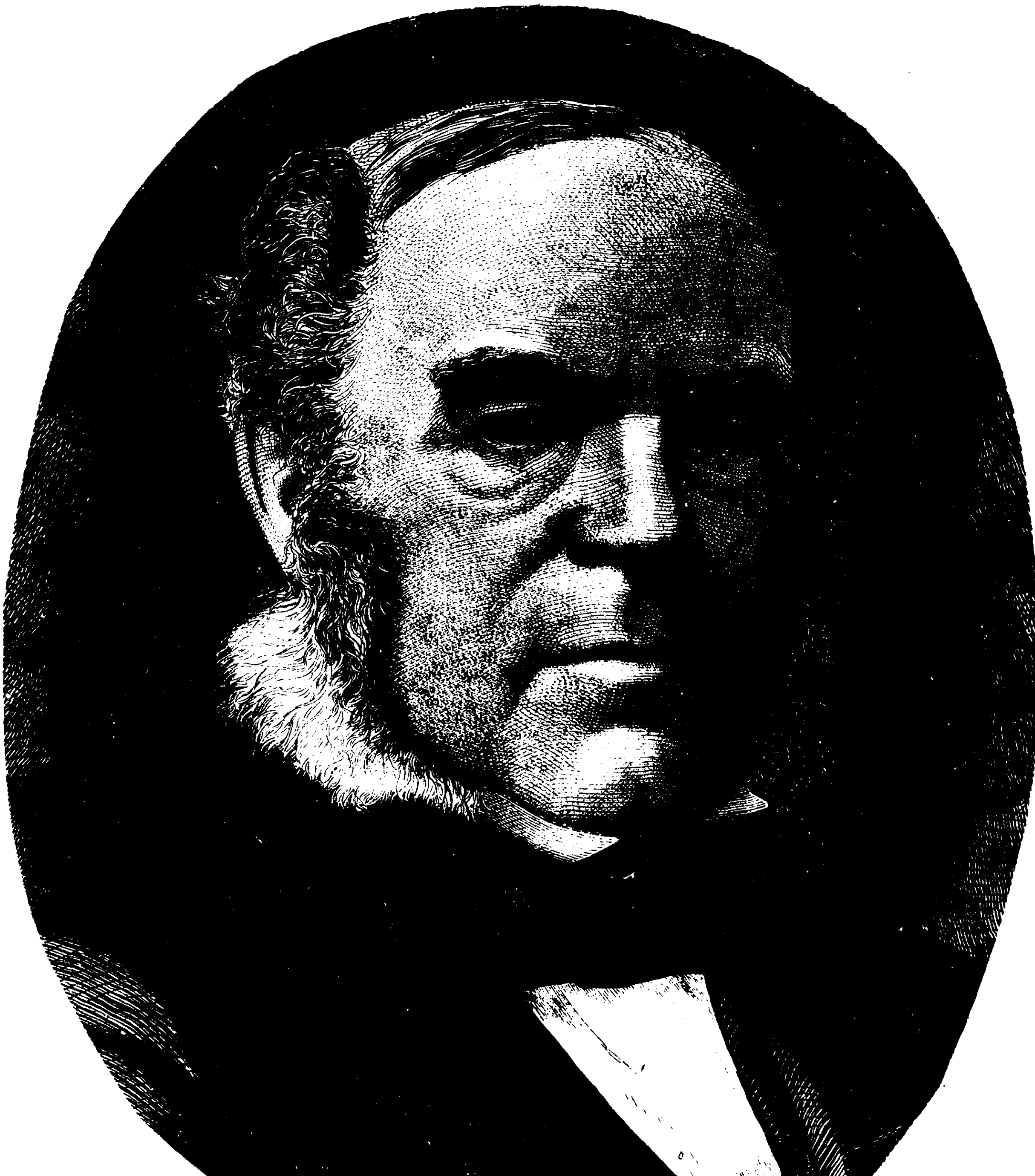


A—Rubber spring for raising the jaws or knives.
B—Fly-wheel. C—Gear-wheel. D—Toggle.
E—Trough containing pig to be broken.
F—Connecting rod for moving toggle.
G—Sliding head.
H—Iron broken to size.

PIG IRON BREAKER.

similar in many respects to an ordinary rock breaker standing upon one end. The pig is fed on an incline or yielding drive, furnished with rollers. It passes over a V-shaped knife to an adjustable stop on the end of the sliding-head G. This head is provided with two knives, equi-distant from the center knife on which the pig is supported. As the head G descends, the piece of pig extending from the center bearing, or knife, out to the stop is broken off. As it ascends the pig is thrust forward, and another piece is broken from it by the subsequent motion. The strain of the work is taken upon the two heavy vertical rods seen in both the shaded and outline view of the machine. The toggle-joint arrangement, precisely like that upon the ordinary stone-breakers, is capable of exerting enormous power. The product of the machine is really limited only to the rapidity with which the pig can be fed into it. Usually the machine can be run by a belt upon the band wheel, shown behind the fly-wheel B. Two or three horse-power only is required for the purpose. When necessary, a small steam engine can be attached, as shown in the right-hand drawing. One of these machines is being set up for the Albany and Rensselaer Iron and Steel Co. At the present time the pigs are broken into two pieces. Better results can be obtained, in both cupolas and steel works, by breaking the pigs into smaller pieces, and thus securing a more intimate mixture of the fuel, the fluxes and the iron.

All pig iron has more or less sand upon it, and beneath the sand there is a hard scale, which strongly resists the action of the heat and prevents melting. The clean ends of a broken pig melt first, and it is well-known that pieces of pig dropped through the cupola only partly melted, show that the melting began on the ends where clean iron was exposed to the heat. Sometimes, indeed, pieces will be found that have melted out for an inch or more, leaving the scale standing. On this account it is always best to have the pig broken into as many pieces as possible. Mr. Kirk even recommends that it be broken into four pieces, but, owing to the difficulty of breaking, melters very frequently are satisfied with breaking it once. The machine which is described, by enabling the pig to be broken into a great number of pieces, will facilitate melting, by exposing more clean surface to the action of heat, and will greatly improve the quality and quantity of the product. These points should be carefully considered by foundrymen, among whom we anticipate this machine will have a large sale.—*Metal Worker*.



JOHN WILLIAM DRAPER.—(SEE EDITORIAL.)

Engineering, Civil & Mechanical.

THE EARLY DAYS OF BESSEMER STEEL.

Under this title, the London *Engineering* of a recent date gives a concise history of Sir Henry Bessemer's struggles, which resulted, as the world now well knows, in the production of malleable iron in a fluid state, which was cast into molds and rolled into bars. It is the old story over again, and ever interesting. When Mr. Bessemer, by the advice of Mr. G. Rennie, the President of the Mechanical Section of the British Association, read, on the 13th of August, 1856, his paper on "The Manufacture of Malleable Iron without Fuel," practical men were prepared to treat the whole affair as a joke, and eminent manufacturers of iron came to enjoy the fun and to ridicule the author of the "absurd" proposition. But it was a case of coming to scoff and remaining to pray. One iron master offered to place his works at Mr. Bessemer's disposal for experiments. Mr. James Nasmyth, who was present, in his appreciative enthusiasm, held up at arm's length one of Mr. Bessemer's samples, exclaiming: "Here's a true British nugget!" This identical bar of iron," says our contemporary, "is now before us; it was rolled, cut, piled and re-rolled at Woolwich Arsenal, and fully proves the soundness of the principle on which the invention is based." The London *Times* reprinted the paper the morning after it had been read, and three days later a formal offer of $250,000 was made for the English patent, which was declined. A month after the appearance of the paper in the *Times*, $140,000 had been received for licenses to use the invention in Great Britain alone.

Then came a reaction, trials hastily made at various works having ended in a fiasco. "A brilliant meteor has flitted across the metallurgical horizon, dazzling all beholders for a moment, only to die out and leave no trace behind." Although this might be the general opinion, as voiced by one journal, it was not quite that of Mr. Bessemer, who at once set to work. At the end of three years, "steel of excellent quality was made from molten pig iron in fifteen minutes, wholly without the employment of skilled labor, or manipulation of any kind, and without the employment of fuel."

Another illustration of the irony of life is found in the fact that when Mr. Bessemer, having thus finally triumphed over every difficulty, read his second paper on "Iron and Steel" before the Institute of Civil Engineers, on May 24th, 1869, with the evidence of practical success before all in various and beautiful specimens, the merits of the invention were stoutly denied, and the process was ridiculed by members present. Hostile critics were Mr. Bramwell, Mr. T. Brown, Mr. T. M. Gladstone and Mr. Riley. The Sheffield steel-makers would not give the process a trial; and it was not until Mr. Bessemer determined to erect steel works at Sheffield and undersell the steel maker in his own market, that the Bessemer process was introduced. In Great Britain alone, the quantity of steel produced in 1880 was a little over twenty times the entire production of steel in that country prior to the invention. A remarkable fact, which will undoubtedly be mentally commented on by all thoughtful readers without any suggestions from us, will be found in the final statement of our authority, that for twenty-five years, owing to the clamor of interested or ignorant partisans, the original paper has been excluded from the Transactions of the British Association.—*Manufacturer and Builder.*

BOILER EXPLOSIONS IN 1881.

The number of boiler explosions in 1881 that have been of sufficient importance to attract the attention of local press reporters is not as great by about half a dozen as was reported in 1880. But the number is quite sufficient, being 160 explosions, by which 250 persons were killed or fatally injured and died soon after from the effects of their injuries, while over 300 more were seriously but not fatally injured.

Of these explosions almost exactly thirty per centum were in mills that use light and quick burning fuel, sawmills standing far ahead of any of the class in number and disastrous results. The class includes besides sawmills, all such as use the refuse timber and shavings from wood cutting machinery, and should also include such thrashing engine boilers as are fired with straw. But it is not practicable to separate such for the purpose of classification from others that use coal for fuel. It is probable that one-third of all the steam boilers that explode with destructive violence are such as use flashy, quick burning fuel. The furnace doors of such boilers must be often opened, and in the case of green sawdust the draught must be strong, so that when the furnace doors are opened a sudden chill of the furnace plates is caused by the inrushing cold air. The effect of the sudden cooling of parts of the boiler is to unduly contract and strain them, the contraction being resisted by those parts that are not so suddenly cooled. In long cylinder flue boilers, externally fired with flashy fuel, the contraction of the bottom of the shell is resisted by the rigid internal flues. Then the strain causes slight bending of the head flanges, if they have pliable wrought iron heads; or if heavy unyielding cast iron heads, then the strain caused by the contraction of the lower side of the shell is concentrated at the transverse seams, the weakest of which will yield and begin to leak, or it will pull in two between the rivet holes, perhaps one-third the way round the boiler before exploding.

The strains on the flanges of wrought iron heads from contraction of the bottom of the shell of this type of boiler, which contraction is resisted by the rigid internal flues, causes bending at the angle of the flange, and the strained and yielding line near the angle of the flange is at once attacked by the boiler water. The slight imperceptible motion is sufficient to crack off any lime scale that may have been deposited from the water and lay bare the disturbed molecules of the iron, and they are acted on over a larger area than when undisturbed, and with only a small area, that which lies in the general surface of the plate, exposed to chemical action of the water.

The weak line becomes weaker with every recurrence of the motion, and if the weak line is sufficiently long it may give way suddenly on the whole weak line, when an explosion may occur immediately on the escape of the free steam which presses on the highly heated water.

Weaknesses caused from this or any one of the many causes of deterioration of boilers, are, however not necessary conditions for an explosion, In fact it has been often remarked, and with propriety, "the stronger the boiler the greater the destruction." But it is plain that the force must be greater than the resistance to it when the boiler breaks open. It is only necessary to prevent the escape of the heat by radiation from the exterior surface of a boiler and through all steam outlets, and to continue the fire in the furnace at a temperature higher than that of the boiler water in order to effect a continued gradual increase of heat and of pressure in the boiler. This may be done sufficiently to accomplish the destructive explosion of the strongest boiler by fastening down the safety valve, closing the steam stop valves, and keeping up a moderate fire in the furnace. It is by the accidental arrangement of these conditions that many, perhaps most, explosions of strong boilers that occur are brought about.

It is fair to conclude that farmers and lumbermen who undertake to run their own steam boilers are more likely to make the fatal mistake than almost any other class of steam users. Therefore we need not wonder that so large a proportion as 33 per cent of boiler explosions are in saw and lumber mills.

Next in order of their numbers and effects come the explosions in iron works of various kinds. Something less than 11 per per centum of the exploded boilers were in this class of manufactories. The most notable explosions have been in rolling mills and furnaces, but for convenience in classification, boiler shops, machine shops, and foundries are included in this class.

The most important, however, and the most numerous explosions in this class are iron manufactories proper, and it is these that give this class its right to have this second place in the order of classification, and to these the reader's attenion is invited.

Most of the boilers used in iron works in this country are externally fired, although there are a few of the English Rastrick and a few upright flue boilers still in use.

Of the externally fired varieties there are the plain cylinder, the cylinder flue, the cylinder tubular, and the French double cylinder boilers. In iron furnaces it is a common practice to heat the boilers by means of the waste gases from the furnace, and for this purpose the furnace top is closed with a cast iron cover, and a large pipe is let into the side near the top, which conducts the gases to the chamber beneath the boilers, when sufficient air is sometimes admitted to complete the combustion of the gases and heat the boilers.

The sulphurous vapours from the contents of the furnaces are condensed by contact with the cool parts of the boilers, and corrosion sometimes goes on very rapidly, especially near the feed water inlet. Leaks occur, and the moisture from them increases the activity of the corrosive agents, and if not repaired the plates are soon reduced to such a weak condition that they give way. Now, if the break is of considerable extent, giving way suddenly, an explosion may be the result. It is a common saying among engineers that a weak boiler will not explode, but will simply blow out at the weak place, and relieve itself without breaking into fragments. It is true that weak places of smallish area, and surrounded by rigid stays or parts of full strength, often do blow out in this manner, causing damage only to such objects or persons as happen to be in range of the escaping stream of water at the moment; but it is also true that if the weak place happens to be of such extent and so located as to break with a snap and make a large opening through which the free steam instantly escapes, the explosion of the highly-heated water may break the boiler into fragments more or less completely, according to the relative quantity of water, its temperature, the form and location of the initial opening, and the direction in which the escaping water acts on the unsupported plates. But the conditions are so various that it is the veriest quackery to predict a specific set of results in any given case.

Puddling and reheating furnace boilers are often placed so that the gas from the burning coal is driven first through the reverb rating chamber, where the ore, the bloom, or the iron pile, as the case may be, is placed to be heated; thence urged by a blast fan, it enters the chamber beneath the boiler, or in case of the upright flue boiler, it enters the flue or flues which pass upward to the stack.

If the intensely heated gases impinge directly on a limited area of the boiler shell or flues in a concentrated blowpipe stream, it is sometimes impossible for the iron to transmit the heat to the water as rapidly as it is delivered by the blast on the small area of the iron plate. The iron may thus become weakened by being crystallized, and especially if a seam is thus exposed; because there the lap not only doubles the thickness of the metal between the hot gases and the water, but also there is less rapid transmission on account of imperfect contact of the plates, and of the rivet heads with the plates.

Sudden cooling of long externally heated boilers that are insufficiently or improperly supported causes very severe strains on the shells of iron works boilers. They are sometimes as much as twenty diameters in length, and when such boilers have three or more supports the distortion caused by the unequal heating sometimes throws the entire weight upon the middle and end supports alternately as the boilers are heated and cooled.

Overpressure, generally accidental, has, no doubt, contributed a full quota to disastrous explosions of iron works indicating to the unpractised or thoughtless attendants that they are ready to take care of the steam in case the demand for it is stopped by the sudden shutting down of the works, are not always capable o opening sufficiently to discharge the full volume that may be produced by an active fire. One such safety valve is often expected to relieve three, four, or half a dozen large boilers with steam outlets closed and heavy fires burning. Then, if one of the lot has a sufficiently extensive weakness, no one who knows and thinks about the conditions would be astonished if the weak boiler should blow up and break its nearest neighbor, which in turn might break the next one if no sufficient masonry was there to prevent it.

In one case, eight boilers in a lot of ten, in a sawmill, are reported to have been blown to pieces in the past year. And a few years ago nine boilers likewise exploded in an iron making establishment in Ohio.

There is a prevailing idea among attendants of steam boilers, more especially those in iron works, that no boiler will explode while there is sufficient water in it to prevent overheating of the fire surfaces, and the idea is entertained by many intelligent iron masters, which is unfortunate, because they naturally take less precautions in keeping a full supply of water, perhaps the colder when pumped in the better.

Railroad locomotives usually stand near the head of the list, generally in the third place, but this year only about seven per centum of the explosions have been locomotives; thirteen only have been reported, and the same number stand against steamers.

Portable engine boilers, hoisters, pile drivers, and thrashing machines stand third in this year's classification, which is not surprising in view of the extended introduction of agricultural and thrashing engines.

In distilleries, breweries, soap and candle works, and the like, there have been eleven boiler explosions.

In steam heating and drying and in dwellings there have been seven cases of disaster.

In bleacheries, dyeing, digesting, and other works where steam and water are used in vessels remote from the generator, there have been six cases of destructive explosions. There have been during the past ten years as many as thirty-five or forty of this class of explosions. This fact, if known and understood by those who believe in explosions from low water alone, ought to shake their faith in their own creed since there can be no such thing as overheating of plates about a steam chamber remote from the generator and heated only through a small steam pipe. These cases are in all respects similar to those of steam generators. They burst and fly in a similar way, the destruction usually corresponding to the amount of the contained water and its temperature, the same as in a generating vessel that is exposed to the fire. It is not probable, however, that so great a percentage of this class go to pieces as is found among generators, because they are not exposed to so many deteriorating influences as regular steam boilers are. There have been enough, however, to fully establish the fact that it not necessary that a boiler should be empty or partly so in order to produce a destructive explosion.

In the ninth item in this classification, viz., paper mills, flour mills, grist mills, and grain elevators, there have been *five* explosions.

In the tenth—cotton, woolen, and knitting mills—*four*; in mines, oil wells, etc., *three*; while there have been nineteen explosions in other mills and works not characterized in the press reports.

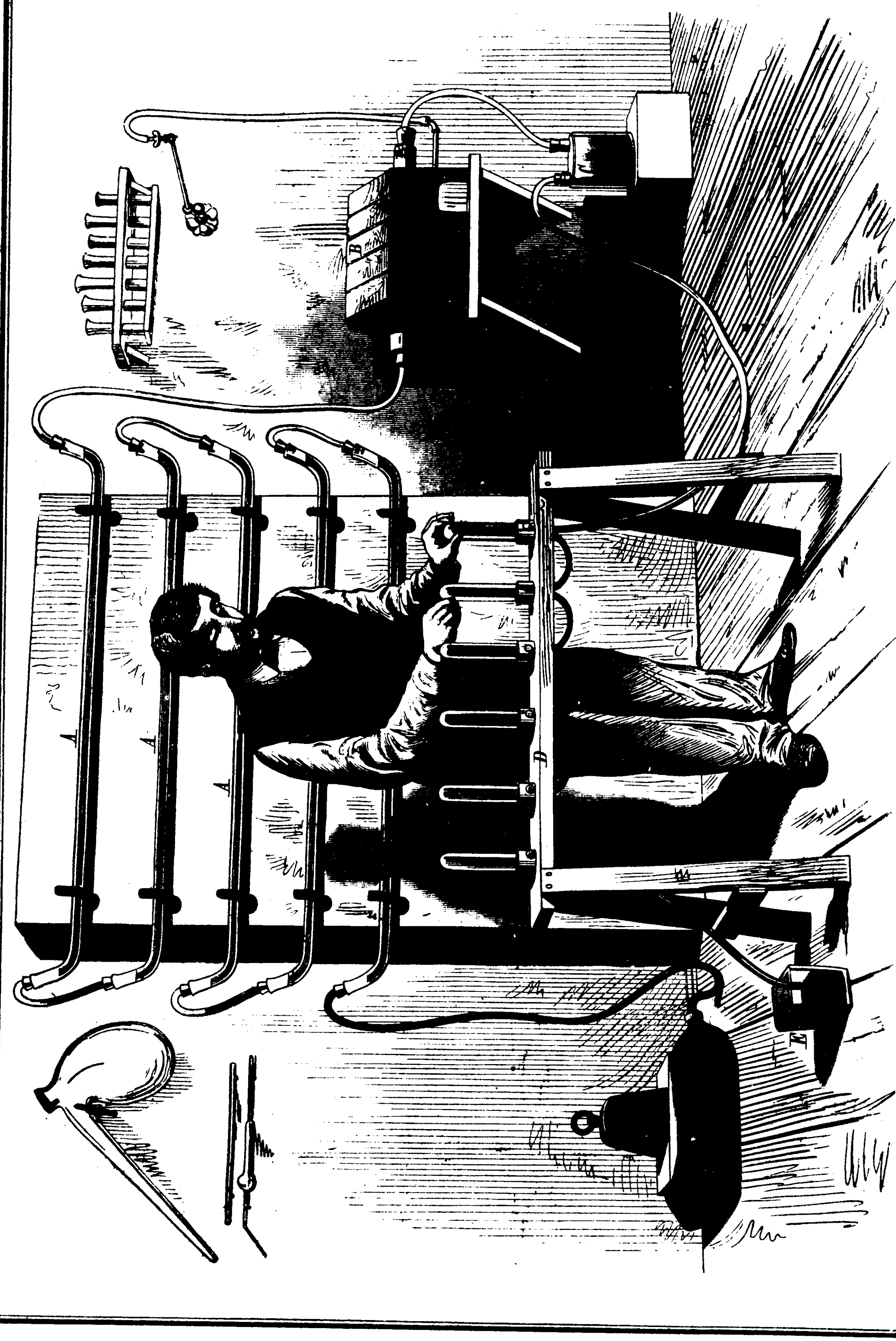
RECAPITULATION.

	Explosions in 1881.
(1) Sawing, planing, and woodworking mills	48
(2) Iron works	17
(3) Portables, thrashers, hoisters, etc	15
(4) Steamers, tugboats, etc	13
(5) Locomotives	13
(6) Distilleries, breweries, soap works	11
(7) Dwelling, steam heating and drying	7
(8) Bleaching, boiling, digesting and dyeing	6
(9) Grist, flour, and paper mill, and grain elevators	5
(10) Cotton, woolen, and knitting mills and factories	4
(11) Mines, oil wells, and works	3
(12) Mill and works not classified and those not characterized	18
	160
Number of persons killed	250
Number of persons injured	328

LEFT-HANDED GENEROSITY.

A year or two ago a Scotch firm of shipbuilders established what was widely noticed at the time as a "generous" scheme of awards to workmen in their employ who should invent or introduce any new machine or hand tool, or improve any existing tool, or make any other change of means or methods calculated to improve or cheapen the work of their shipyard. The policy was good, though, if our memory serves, it was characterized by shrewdness rather than generosity, since the granting of the award was conditioned upon the surrender by the inventor to the company of the right to use the new invention without further charge. The plan seems to have worked well for the company, who "have been encouraged to amend the scheme" in two important particulars. They now announce that should an invention or improvement be worthy of a greater reward than the sum ($50) originally fixed, the firm will either grant a higher sum, or, should the invention be considered worthy of being protected by patent, pay the inventor $50 and assist him pecuniarily in disposing of his patent or in completing it, at the same time reserving to the firm the right of using such invention themselves free from the payment of any royalty for patent rights.

These offers still keep well within the bounds of prudence, and indicate a sharp outlook for the main chance. The firm enjoy in consequence the pleasures of being generally lauded for generosity. We shall not be surprised if they discover in time that it will pay them to still further encourage the inventive faculty and habit among their workmen, if not by assisting them to take out patents for their inventions, at least without reserving any right of use without payment of royalty. Assistance so rendered might fairly be accredited to generosity; and yet, from a strictly selfish point of view, the generosity would pay handsomely, for the habit of constantly seeking better and more economical methods of working could not fail to make any workman more valuable to his employer, even if it did not lead him to invent anything worth patenting.

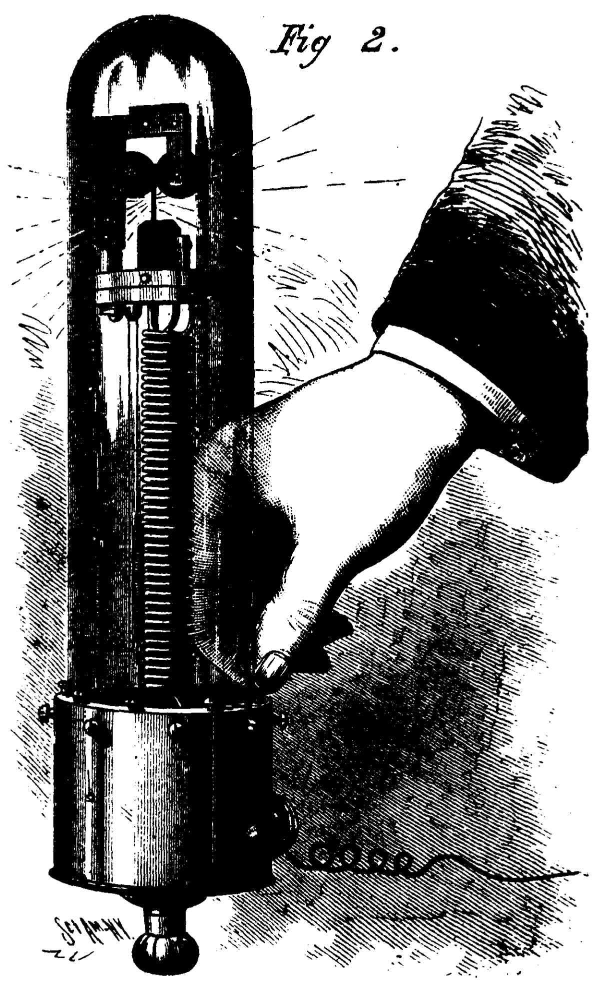


FILLING THE SAWYER LAMPS WITH NITROGEN.

Fig. 3

EXHIBITION OF THE SAWYER ELECTRIC LIGHT.

Fig 2.



THE NEW SAWYER LAMP.

Scientific.

THE SAWYER ELECTRIC LIGHT.

The practical working of the Sawyer system of electric lighting was recently exhibited to a few gentlemen in an ordinary up-town residence on West 54th street, in this city. Seven lamps were distributed at convenient points—one in the rear of the hall, one upon the center-table as a drop light in the front parlor, two upon a double arm gas fixture of the ordinary pattern in the front parlor, and three in the rear. It is stated that the seven lamps are operated upon one electrical circuit, supplied by a single generator transferring four horse power. The current travels about 1,600 feet through conductors having a diameter of a quarter of an inch.

The lamp, based upon the incandescence of a pencil of carbon immersed in nitrogen gas, is in no way different in principle from the Bouliguine or the old Sawyer-Mann lamp exhibited some years ago. The pencil is contained within a globe two inches in diameter and ten inches high, sealed at the bottom by means of a cement, which, while adhering perfectly to the glass and metal, is sufficiently elastic to compensate for the unequal expansion of the two. It softens only at a temperature of 500° Fah. The globes are charged by the process invented some time ago by Thomas B. Stillman, which is so simple in its details and so rapidly operated that a single workman can prepare fifty lamps per hour at a cost of about thirty cents, in such a manner that, according to Stillman's calculation, the amount of atmospheric air remaining is only an infinitely small fraction of the normal quantity.

The large engraving on this page illustrates the manner of filling the lamps with nitrogen gas. Several lamps are placed upon a stand and connected one with the other, so that the gas that fills the last lamp in the series must pass through all of the others. In this manner the gas is made to do double duty. The nitrogen gas is generated by a process which is not made public. It is stored in gas bags, and when required for use it is forced through the purifying and drying tubes, A, sodium, B, and bottle, C, whence it is conducted by a flexible tube to the series of lamps on the table, D. The last lamp in the series is provided with a flexible tube dipping in water in the jar, E, to prevent the re-entrance of air to the lamps when the flow of nitrogen is shut off.

The sodium furnace, B, contains a wrought iron tube partly filled with melted sodium, through which the nitrogen is forced to remove traces of oxygen. The bottle, C, is simply filled with fiber to prevent small particles of sodium oxide from reaching the lamps. The cost of the nitrogen is stated at eight-tenths of one cent, and that of its purification as one and one-fifth cents; the total cost of recharging a lamp, when the nitrogen is exhausted or becomes mixed with air, being, inclusive of the wages of the workman, two and three-fifths cents, against a cost of seventy cents for the process usually employed. The carbon pencil, seven inches in length and about three thirty-seconds of an inch in diameter, is fed upward as fast as disintegration takes place at the point of contact, by means of a regulator, which will be substituted by an automatic feeder as soon as the arrangement can be perfected. Mr. Sawyer says that one of these pencils, used for five hours a day, will last at a minimum calculation from his experiments, not less than ninety days, and, at a maximum, for two years. The cost of the pencil is a trifle less than two cents, and the cost of replacing and recharging with nitrogen nine and three-fifths cents. The bag of sodium and the large spiral conductors at the base of the carbon, which were distinguishing features of the Sawyer-Mann lamp exhibited about a year ago at No. 94 Walker street, have been discarded. Two small steel rods take the place of the latter. The globe, which is not unlike the chimney of an ordinary kerosene lamp in general appearance, is embedded in a nickel plated base, which may be highly ornamented or not according to the taste or means of the user.

Photometric tests, it is said, have been made with a Sugg photometer, such as is used by the gas companies for the same purpose, and each light was registered as equal to twenty seven and five-tenths standard candles, or a little more than twice the value of a five-foot gas burner, which usually registers from ten to twelve standard candles.

Mr. Sawyer claims that his system of distribution is entirely novel and original, but declines for the present to give a description of it, his patents not having been as yet secured. The regulator, we are told, is based upon the plan used by the old Berlin house of Siemens Brothers, by which only such a volume of current is supplied as is necessary to overcome the resistance. The light is readily toned down to a glimmer by turning a button in the wall. In its optical properties this light is much like gas. It is yellow, steady, and soft, and consequently not irritating to the eye. It has none of the blue rays incident to the voltaic arc arrangement, and the shadow cast by intervening objects is softened and mellowed at the margin. For practical purposes it is intended that the power of each lamp shall not exceed that of two ordinary gas jets.

The relative economy of this system of lightiug we are unable to learn. "Approximate estimates" of cost make it much cheaper than gas ; bnt in the absence of specific data for exact calculation, such estimates do not go far to satisfy the popular mind.—*Scientific American.*

EFFECTS OF ATMOSPHERIC ELECTRICITY ON THE TELEPHONE.

Of late several European observers appe r to have been studying the effects of certain meteorological phenomena on the telephone, the latter being connected with a wire stretched, for instance, between the roofs of two houses, and in connection with the water or gas pipes. On the occurence of lightning, more especially, sounds are heard, and at the same instant (according to M. Rene Thury, of Geneva) as the flash is seen, whatever the distance of the latter. Even when no thunder was heard, and the discharge must have been at least 35 km. off, M. Thury observed those induction effects. He says the sound is like that of a Swedish match rubbed on the box. The telephone affords an easy method of studying the velocity of transmission and other features of this electrical influence. M Lalagade, who has experimented similarly for some time past, thought to amplify the sounds, and did so by placing two microphones on the plate of the receiving telephone. The arrangement is set up in a quiet room, where all foreign vibrations are guarded against, and the author is able to hear the least sound at a distance of one meter or more from the second telephone.

Again, M. Landerer, at Tortosa, finds currents produced in his telephone-circuit by atmospheric electricity in three different ways. First, the condensation of aqueous vapor results in a sound recalling the cry of tin. A sensitive galvanometer in the circuit is not, or hardly, affected. These sounds are strongest at night. Next, there are the sounds which occur during lightning (and the currents producing which affect a galvanometer considerably). Thirdly the wind generates currents which do not act on the telephone, but act on the galvanometer strongly. At Tortosa, the very dry west winds produce the greatest oscillations. Telluric or earth currents, act both on the galvanometer and on the telephone : they are distinguished from atmospheric currents by the regularity and continuity of their action during pretty long intervals.

THE attention of the Berlin Chemical Society has been called by Herron Loew and Bokorny to the discovery made by them that living organic cells easily reduce dilute solutions of silver, whereas dead cells produce no change. It is stated that in whatever way the cells of algœ were killed the reaction on the silver salts ceased with the life of the cells.

THE MATERIALS OF PALEONTOLOGY.

Although paleontology is a comparatively youthful scientific specialty, the mass of materials with which it has to deal is already prodigious. In the last fifty years the number of known fossil remains of invertebrated animals has been trebled or quadrupled. The work of interpretation of vertebrate fossils, the foundations of which were so solidly laid by Cuvier, was carried on with wonderful vigor and success by Agassiz in Switzerland, by Von Meyer in Germany, and last, but not least, by Owen in this country, while, in later years, a multitude of workers have labored in the same field. In many groups of the animal kingdom the number of fossil forms already known is as great as that of the existing species. In some cases it is much greater ; and there are entire orders of animals of which we should know nothing except for the evidence afforded by fossil remains. With all this it may be safely assumed that, at the present moment, we are not acquainted with a tithe of the fossils which will sooner or later be discovered. If we may judge by the profusion yielded within the last few years by the Tertiary formations of North America, there seems to be no limit to the multitude of mammalian remains to be expected from that continent, and analogy leads us to expect similar riches in Eastern Asia whenever the Tertiary formations of that region are as carefully explored. Again, we have as yet almost everything to learn respecting the terrestrial population of the Mesozoic epoch—and it seems as if the Western Territories of the United States were about to prove as instructive in regard to this point as they have in respect of Tertiary life. My friend Prof. Marsh informs me, that, within two years, remains of more than 160 distinct individuals of mammals, belonging to twenty species and nine genera, have been found in a space not larger than the floor of a good-sized room ; while beds of the same age have yielded 300 reptiles, varying in size from a length of 60 or 80 ft. to the dimensions of a rabbit.

The task which I have set myself to-night is to endeavor to lay before you, as briefly as possible, a sketch of the successive steps by which our present knowledge of the facts of paleontology and of those conclusions from them which are indisputable has been attained ; and I beg leave to remind you at the outset that, in attempting to sketch the progress of a branch of knowledge to which innumerable labors have contributed, my business is rather with generalizations than with details. It is my object to mark the epochs of paleontology, not to recount all the events of its history.—PROF. T. H. HUXLEY, in *Popular Science Monthly.*

AMALGAMS.

Opinion is still divided with regard to the nature of amalgams, same considering them to be isomorphous mechanical mixtures, others, true chemical compounds. The former view derives support from those cases in which amalgamation is associated with an absorption of heat, as in the solution of a salt or in dilution of a solution ; the latter is supported by the fact that many amalgams are formed with a strong development of heat. A contribution to the subject has been lately made by Herren Merz and Weith, in the Berlin Chemical Society. These chemists have investigated whether, with regular heating, amalgams part with their mercury continuously or in distinct gradations.

The experiments consisted in placing the amalgam in a porcelain dish within a glass tube, contracted below, and enclosed in a second tube, having a bulb at its lower end. This bulb of the outer tube contained the substance of the vapour bath (sulphur, mercury, or diphenylamine.) To guatd the amalgam from air, a lively current of an indifferent gas was passed through the interior tube while the experiment lasted. The amalgams used, which were always directly produced by known methods, contained on an average, 60 to 80 percent. of mercury. This heating was continued, wherever possible, until after several hours no decrease of weight (or hardly any) was perceptible. There were examined gold, silver, copper, lead, tin, bismuth, zinc, cadmium, sodium and potassium amalgams. The results for the first eight are very briefly communicated, those for the last two, whose easy oxidability required special precautions, more fully. In the case of these alkali amalgams, the authors also sought to determine the melting points, but, for certain reasons, very accurate results were not reached. In general, the melting points of the amalgams rise at first very quickly with the proportion of alkali-metal, then gradually fall. It was thus observed, that when mercury is heated under paraffin to 250°, and then some sodium is added in portions, the whole mass solidifies with 4 to 5 per cent. of sodium ; but with further addition of some percentages the mass fuses completely.

The results of their investigation are summed up by the authors as follows :—A survey of the results described shyows for a series of amalgams, that even with moderate heating they do not furnish determinate compounds.

The amalgams of gold, silver, copper, bismuth, lead, tin, zinc, and cadmium lose their mercury entirely, or nearly so, even at or under the boiling temperature of mercury. Where no mercury remained, the cause is to be sought rather in a mechanical exclusion, than in a chemical action. But, on the other hand, the easy decomposability of these amalgams evidently offers no proof that there are no chemical compounds in them.

For the rest, if we consider the great variability of amalgams, together with the fact that, in squeezing the so-called mercury solutions of metals, these latter do not remain behind, but certain mercury compounds, the view acquires the greatest probability, that at least very many amalgams may be, indeed, molecular combinations, but in fixed relations.

Most pronounced does chemism appear to be in the amalgams of potassium and sodium. They lose their mercury extremely slowly, even at the boiling-point of sulphur, as also in a gas current, and so in circumstances highly favourable to removal of mere mixed substances. The remarkable relations, too, as regards the melting-point, seem to speak for the presence of true chemical compounds. Probably these amalgams, at a comparatively low, as well as at a high temperature, consist of different compounds, none of which, however, have a durable existence, and therefore recurrent, fixed relations of composition are not to be met with. Alkali-metal amalgams of fixed composition would probably be obtained no production of larger quantities of amalgam ; perhaps also by heating considerably above the boiling temperature of mercury

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The Motor of the Future.—In the opinion of most of the scientists of Great Britain, electricity is to take the place of steam in driving machinery and moving cars, and is to be generated by the action of tides, winds, and falling water. They predict that wind power will be utilized to a greater extent than any persons in a previous age ever believed it would. Wind will generate electricity for moving machinery, for lighting streets, and warming dwellings in Ireland, Belgium, Denmark and other countries where there are few streams that afford water power. The movement of tides will produce the same effects in most countries that have an extensive sea coast, while the fall of water in rivers and streams will generate electricity in all mountain regions. The great electrical exhibition at Paris did much to draw attention to what is called the motor power of the future. A picture called " The Queen of the Nineteenth Century" hangs in many of the shop windows. It is a female figure surrounded with a halo, and emitting rays of light from the hands, which are raised as if to enable the being to fly. The light gives the hands the appearance of wings. The artist is an enthusiast, and is regarded by many as a prophet. We all hope that his fair predictions will be realized. The steam engine is a good thing, but we are ready for something better. It has done so well that till recently scientific men and inventors have not troubled themselves to make something better.

In North Germany, and especially in the provinces of Hanover and Brunswick, peat has been worked to a considerable extent lately into a product suitable for littering (stables, &c.) This " peat-straw" (*Torfstreu*) is in fibrous pieces of nut size, not earthy or dusty, but very absorbent of water. It takes up as much as 860 per cent., or nine times its weight, whereas sawdust absorbs only 386 per cent. By reason of its great absorbent power for odorous substances, especially ammonia and carbonate of ammonia, it is well adapted for stables and water-closets. By keeping the air pure, it favours the health of cattle, and less of it is required than of straw, &c. A Hanover engineering paper reports experiments with it in the water-closets of a school ; the results of which were very satisfactory. A handful is thrown into the closet each time. On clearing out the closet, the contents, it is stated, were conveyed in a cart along the streets by day, without any one noticing any unpleasant smell ; (German noses are not, we know, too sensitive !) Dr. Hoppe says 1 cwt. of the material serves for 9 cwt. of faecal stuff. The wholesale price is about 1s. 6d. per cwt.

AN ELECTRIC ELEVATOR.

Of the numerous applications of electricity, which of late have multiplied with astonishing rapidity, not the least interesting and novel is its employment as the motive power for elevators ; and to judge from the success that has attended the first efforts of inventors in this direction, it is highly probable that this application of the agent may develop in time into considerable importance.

The first elevator actuated by electricity ever placed in actual service, was constructed, it is claimed, by the celebrated makers of electrical appliances and machinery—Messrs. Siemens and Halske, of Berlin. It was built for a lookout, some 60 feet high, at the Industrial Exhibition in Manheim, Germany, during the early part of last year. This elevator was found to answer its intended purpose very satisfactorily, and was in operation throughout the entire progress of the exhibition, during which it safely transported 8,000 persons up and down.

The application of electricity for this special service has so much of mechanical interest attached to it, that we deem it of sufficient importance to warrant a detailed description. The apparatus here spoken of is represented in the accompanying engravings, in which Fig. 1 represents the mechanism of the electric elevator, Fig. 2 the carriage, and Fig. 3 the elevator at the top of the lift.

Referring to the mechanism (Fig. 1), we may introduce its description by explaining that it differs essentially from that of other elevators in the fact, that, while the cars of the usual constructions are raised and lowered by means of ropes or cables passing over pulleys, or by telescopic tubes, the car of the electric elevator ascends or descends by the movement of two pinions which engage with the rack or ladder L. The latter is made of corrugated sheet steel, and is securely fastened at both ends to strong beams. The car is furnished with an upright cylinder or tube, through which the rack passes, and which has also a pair of guide rolls at both extremities. The car is suspended from ropes D, passing over two pulleys above the highest point of the lift, and balanced by adjustable counterweights, as is usually the case.

The motive power is placed entirely beneath the platform of the car and enclosed in a box H, Fig. 1. It consists substantially of the electric motor M, carrying on the lower extremity of its shaft the worm S. This engages with two intermeshing pinions, on the shafts of which are placed two gear wheels R R (one of which is visible in the cut), which engages with the teeth of the rack L on opposite sides of the same. A dynamo-electric machine at the engine house supplies the power for actuating the electric motor M, the electric connections being formed on one side by the rack L, and on the other by the suspension cables D. A hand lever, controlled by the operator serves to throw the current on or off, and thus raise, lower or stop the carriage. The current is automatically thrown off when the car arrives at the top or bottom of its run.

The elevator is claimed to realize very fully the conditions of safety. Should a rope break, the result would simply be the stoppage of the car, as the pitch of the worm wheel is so small as to present great resistance to its movement in the opposite direction ; while, on the other hand, the balance weights would prevent the car from sudden descent should the rack or toothed wheels give way.

The construction is worthy of attention by our mechanical readers, as representing an interesting and novel application of electricity.—*Manufacturer and Builder.*

THE ANTRHACITE PRODUCT OF 1881.

The official report of the anthracite tonnage of the Pennsylvania railroads for the past year shows a traffic of 28,500,016 tons, an increase of 5,062,774 tons as compared with the previous year. Of this amount the Philadelphia and Reading Railroad carried 6,840,823 tons, the Lehigh Valley Railroad 5,721,869 tons, the Central Railroad of New Jersey 4,085,423 tons, the Delaware, Lackawanna and Western Railroad 4,388,968 tons, the Delaware and Hudson Canal Company 3,211,496 tons, the Pennsylvania Railroad 2,211,363 tons, the Pennsylvania Coal Company, 1,475,385 tons, the New York, Lake Erie and Western Railroad 465,230 tons. Of the total production, 48·96 per cent was from the Wyoming region. 18·58 per cent fromthe Lehigh region, and 32 46 per cent from the Schuylkill region. The stock of coal on hand at tide water shipping points was 497,024 tons.

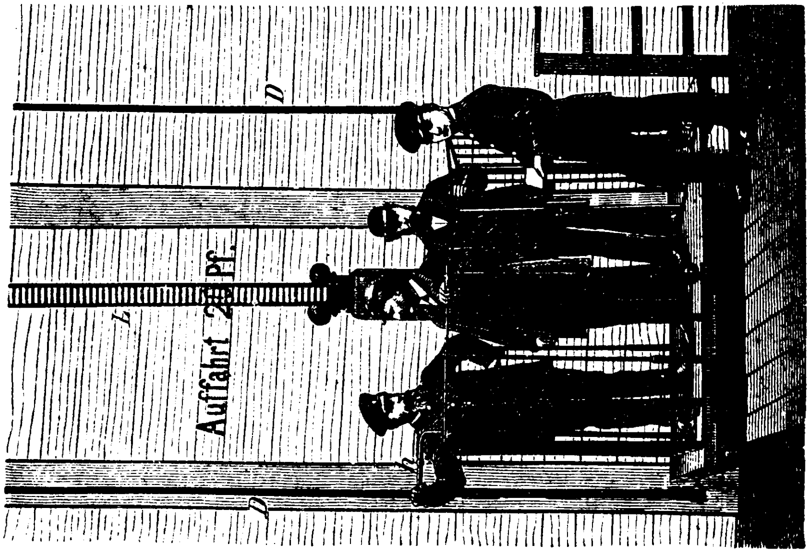


FIG. 2.—ELECTRIC ELEVATOR CARRIAGE.

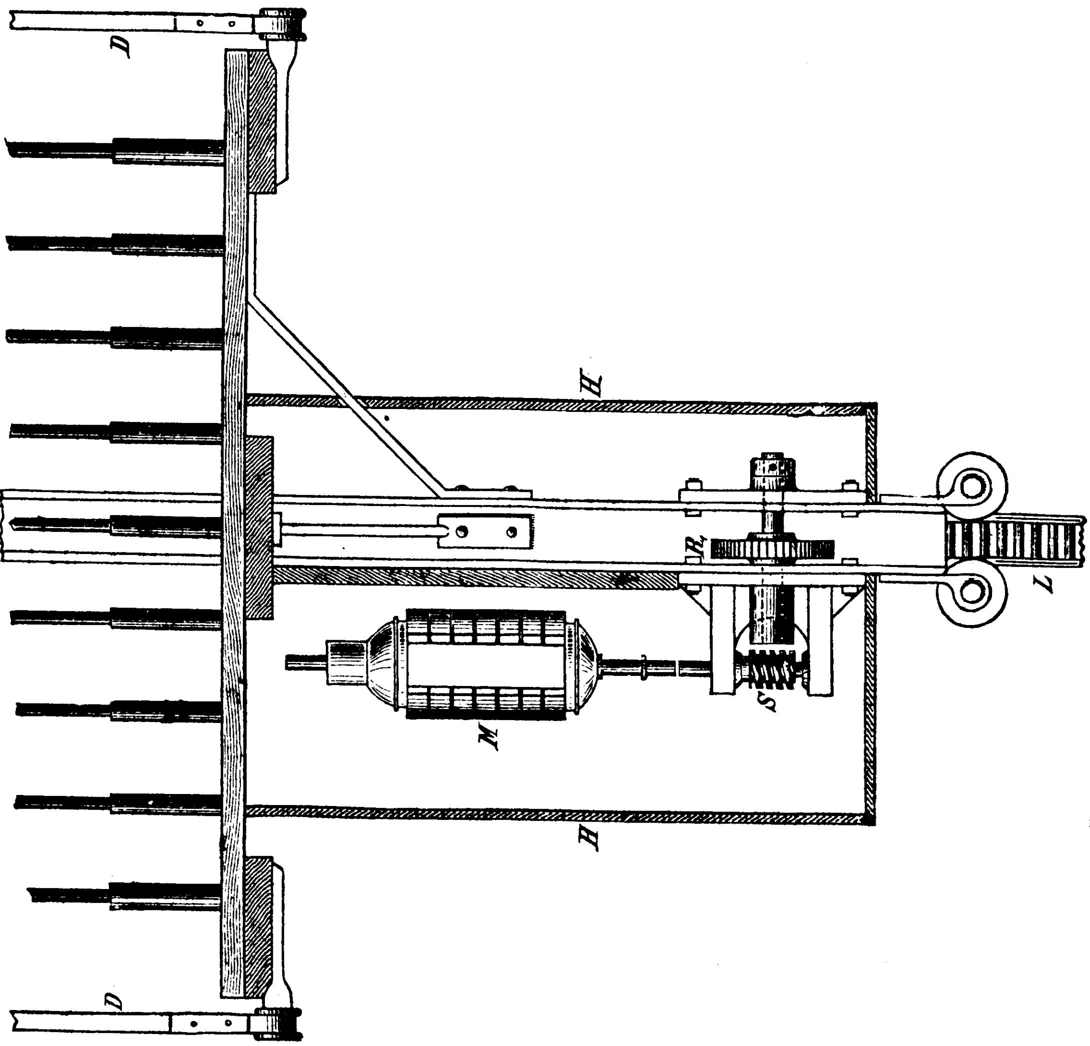
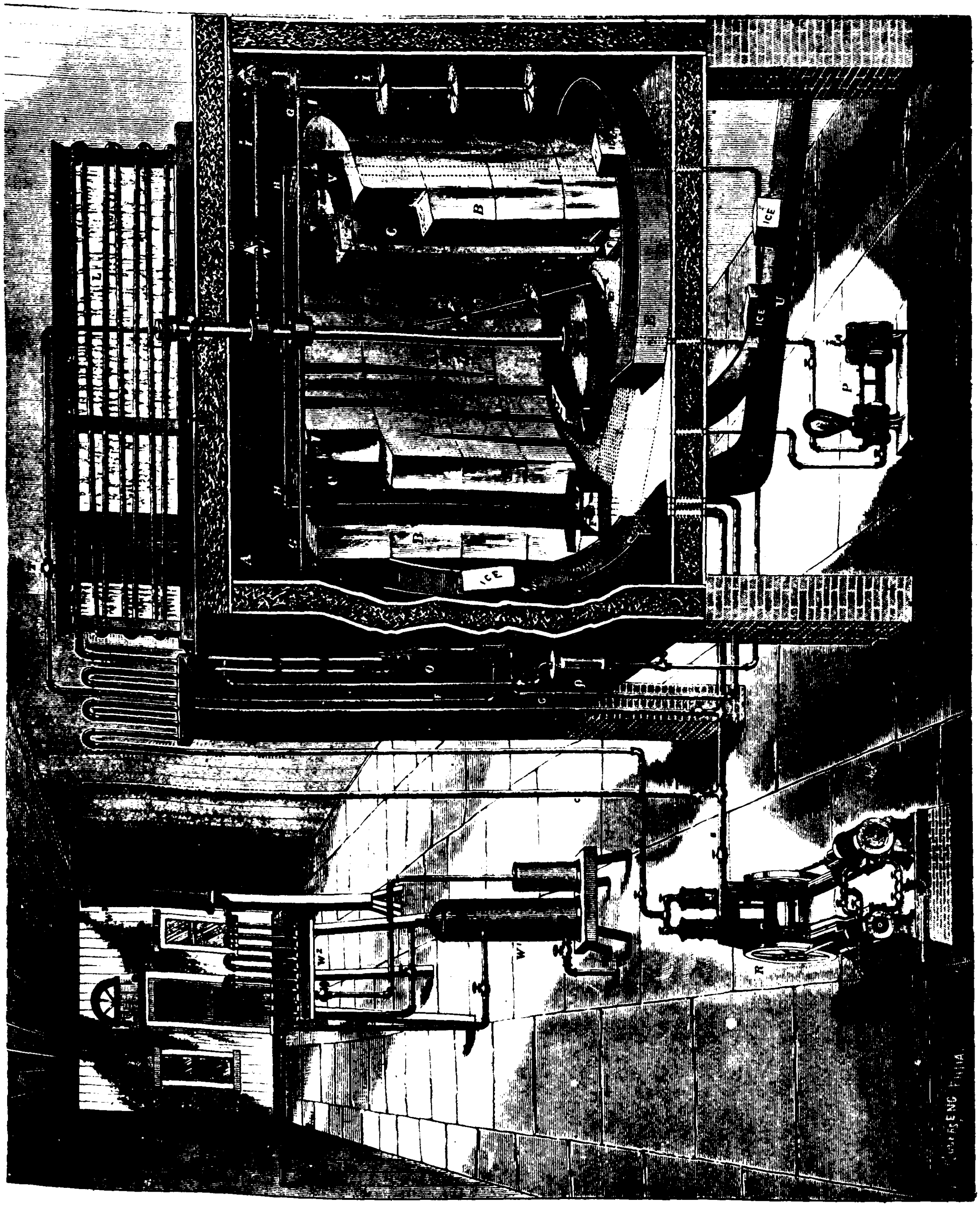


FIG. 1.—THE ELECTRIC ELEVATOR MECHANISM.



HOLDEN'S NEW ICE MACHINE.

Trade Industries.

IMPROVED ICE MACHINE.

We give an engraving of a new machine for manufacturing ice on a commercial scale, which possesses many points of novelty and interest. It is the invention of Mr. D. L. Holden, of Philadelphia, the well-known inventor of ice machinery. The cooling agent employed in this machine is ammonia, which is manipulated in much the same way as is usual in this class of machines; but there are several improvements on pumps, valves, etc., which add greatly to the perfection and efficiency of the machine.

The freezing, as will be observed by reference to the engraving, takes place in a chamber A, thoroughly protected against external heat and provided with a hollow central shaft, D, arranged to receive the non-congealable liquid from above and the water to be frozen from below.

Around this central shaft, and some distance from it, there are two concentric metal walls, C, resting in a circular trough, F, for receiving the non-congealable liquid, and in the center of the space between the plates, C, there are vertical pipes, V, in which the liquid ammonia is expanded into gas. Above these pipes, and in communication with the upper portion of the hollow central shaft by a pipe, H, there are two roze nozzles which receive a supply of the non congealable liquid from the trough, F, through the pipes, G, I, the circulation being maintained by the pump, O.

The water to be frozen is forced by a pump, P, through the lower portion of the shaft, D, and through the nozzles carried by the tubular arm, G. The water is directed in a stream against the circular wall plates, C, upon which it freezes and forms the foundation of the solid coating of ice that gradually forms within and outside of the walls, C.

When the cylinders of ice have acquired the desired thickness they are sawed up into rings by the circular saws which are carried by the shafts, *i i*; one set of saws being arranged for the inner cylinder of ice and another set for the outer cylinder.

The ice is loosened from the circular walls by temporarily elevating the temperature of the non-congealable liquid sufficiently to detach it. The ice is then cut into cubes and discharged through chutes in the bottom of the chamber.

In starting the machine the aqua ammonia is warmed in the still, W^1, and drawn through the dehydrator, W^2, and drier, W_3, by the pump, R, and forced through the cooling coils, L, where it is condensed, and from which it is conveyed to the reservoir, Q, in a liquid form.

After this reservoir is once filled the valves of the pipes leading to the pumps are changed so that the cycle is from the pipes, V, in which the liquid ammonia is expanded into gas, to the pump, thence to the coolers, L, thence back to the reservoir, Q.

This machine is continuous in its action and easy to manage. The engines and pumps used in this machine are duplex, and so arranged that either pump or engine can be stopped and the other continue to work. The pump pistons are converted into valves, and are as automatic as a slide valve. This is an important feature that will be appreciated by users of pneumatic pumps. The improvement in valves, connections, etc., is of great value, making them, as we are informed, absolutely ammonia tight.

Perhaps the greatest improvement is the method by which the water is frozen, insuring perfect clearness and great rapidity in making the ice. The uncongealable fluid performs a double function: first, it conducts the heat from the water to be frozen through the iron plates; it refrigerate the room down to a low degree of temperature, and by this means causes surface freezing, thus permitting of freezing ice welve inches thick in twenty-four hours, whereas by the old system of conduction alone it required from six to eight days.

The water flows in a stream upon the freezing surface in sufficient quantities to allow a surplus to run down and fall in the tank or pan beneath, washing off all air bubbles and other foreign substance, leaving the ice perfectly transparent and as hard as Kennebec ice.—*Scientific American.*

THE SAWMILL CHANGES OF THE CENTURY.

Among the most marvelous of the many wonderful things which distinguish the United States from other nations, are the results which have grown out of the possessions of immense forests of valuable timber, in stimulating inventive genius to the preparation of an article of building material so cheap as to enable the poorest to have a comfortable home, while at the same time so excellent in character as to be not only suited, but indispensable, to the working classes. Those more readily accessible regions, of the continent which possessed these forest growths in the greatest abundance were among the first to receive large accessions to their population, drawn together at these centers which presented the easiest access to cheap building material, not less than for their personal safety from a savage foe. It was not until the demand for lumber far exceeded the ability of the "greatest" mills of half a century ago to supply, leading the manufacturers to feel the need of a more extended system of production, that the star of empire made any progress westward, or it became a possibility to settle upon the prairies of the West, or to develop the mineral resources which have already shown our nation to be the peer of, if it does not excel, all others in the extent of its possessions. To possess is to need. And the cheap building material which the cheap mills of the days long gone by enabled a scanty population to utilize, stimulated a more extended immigration, with its increased needs, as well as a higher order of inventive genius to increase the supply.

The mills of the olden time were, first, the windmill, with its uncertain power, scarce exceeding that of the men who ran the pit saws which were then in a measure superseded, and whose indignation at the effort to lessen their manual labor caused them to mob the owner and tear down his machinery. Second, the adaption of a current water-wheel of scarcely greater power, if more reliable, run by the natural current of a small stream. Next came the simple flutter-wheel, to impart motion to which required the building of dams to hold large bodies of water, which should at all times be available. But for large operations the flutter-wheel was found to possess too little power, and the overshot or under-shot wheel became a necessity, to be superseded later by the adaptation of turbine-wheels, now so much in favor with mill owners who control water power. For the first fifty years of our national growth, as well as during the preceding portion of the world's history, none of the mills were equipped with anything more than a single upright saw working in a gate, and when another saw was added, as the inceptive idea of the gang, which quickly succeeded with its large number of saws, words could scarcely express the astonishment of all who saw the working of the bold innovation.

Up to this time, all the lumber which was manufactured had been edged upon the top of the log after it was turned down; an auxiliary saw was not thought of, for the buzz saw, just beginning to be used, was considered a most dangerous piece of machinery. But the increased manufacture growing out of an increase in the power and an increase in the number of saws, led to the introduction of the small circular or "buzz" saw, which was at once found to nearly double the capacity of the mill. It is needless for us to enlarge upon the introduction of steam power in the saw-mill, or to follow the original idea of an engine, 6 x 8 inches, attached to the lower end of the pitman or saw gate, through its successive stages of devellopment and enlargement to the present time, when the Corliss, or Estes, or other well known engines, of a power from ten to one hundred times greater capacity than was the original device, are by the thousand in number engaged in turning out lumber, each in one season aggregating a greater manufacture than were all the sawmills of the country combined at a period scarcely fifty years in the past.

The old gate saw was superseded by the mulay, with a reduction of friction equal to thirty or fifty per cent increase in cutting capacity. The mulay gave way to the circular, and with its introduction may be dated the commencement of an era which has been prolific of innovation, improvement, and advantage to the sawmill world. As the use of the circular became better understood, and men became expert in so dressing it as to make true lines and smooth surfaces, they found themselves able to produce more lumber in the rough than they could properly edge and prepare for market. The old edging-table could not keep up with the cut of the saw. This was remedied by the introduction of gang edgers, which no mill doing any considerable business could now dispense with. Now the work of the main-saw could be safely increased, for the gang—or, as it was at first known, "double"—edger was abundantly able to keep pace with it, and while at first a capacity equal to 1,000 feet per hour was doubtfully claimed, later developments have shown in not a few instances an entire season's work at the rate of 6,000 feet per hour.

This increase in capacity called for a more speedy method of handling the logs on the carriage, and the lumber as it left the saw, and a multitude of inventive minds were concentrated on mill dogs, which should successfully take the place of the lever and pike, driven by a mallet, and the modern sawmill could not now be operated with the original method of dogging the log. The "nigger," for turning the log on the carriage, as well as rolling it on the skids, has supersed the cant-hook and muscular power formerly relied upon, while the lumber, as it leaves the saw, drops upon a system of live rollers, which does the work to much better advantage than it was formerly accomplished by a hard worked "off-bearer," who could not in these days by any possibility keep up with the work which would crowd upon him.

Plenty of lumber, cheaply manufactured and sold at reasonable prices, has enabled the settling up of a nation at the rate of nearly fifty per cent increase of population during each decade. This in turn has demanded a network of rail roads, and carriage by them has not as yet been reduced to a science, which enables us to believe that rates have reached a minimum which they will realize in the future. The manufacturer of lumber, bearing this in mind, must reduce the weight of his product to the lowest possible point, and the trimmer became a prime necessity as an economizer, not less than for an advantage in an æsthetic point of view. And the old gang mill, from its original adaptation of two saws, hung in a cumbrous frame, upon monstrous posts which headed in a weigh beam, made from the largest stick of timber which the forests afforded, and footed in the mill foundations, shaking the structure and the surrounding country, and keeping the machinery about one-half the time in the repair shop from its everlasting jar, has been displaced by the neat, effective, and comparatively noiseless devices of more modern times, developing a sawing capacity of which the fondest anticipation of the original inventor of the idea had not the remotest conception. The heavy weigh-beams have disappeared, the monstrous wooden posts have given way to equally advantageous and strong but less cumbersome and more sightly iron supports, resting upon foundations independent of those which support the mill frame. The old, stiff, and full-of-friction gate has been superseded by oscillating slides, giving to the saws the same motion which the pit sawyer seeks to obtain in order to accomplish the most work with the least outlay of strength.

Time would fail us to trace out all the changes which a quarter of a century has developed in the sawmill. Should a Rip Van Winkle of the last century be suddenly awakened from his long sleep, still dreaming of the last act of dogging the log on his old-fashioned carriage, in the old mill, when he took long naps between the cuts, and esteemed a production of 1,000 feet per day something to brag of, and open his eyes on the floor of a modern mill of the smallest size, he would truly think that the world had turned upside down, and if he saw the army of men carrying off a quarter of a million feet of boards per day from the saws of some of the larger mills, he would not believe the evidence of his senses. All has changed; the water-wheel has given place to the steam engine; the single small cylinder boiler, to the monstrous tubular or flue in large batteries; the upright saws in a gate, to the mulay and the circular; the two-saw gang, to a forty-saw; the rag-wheel, to the steam feed, adding countless possibilities to the ability of the circular saw to cut up logs; the single buzz saw, to the double edger; the rough end lumber, to the well trimmed; the vast piles of worthless slabs, to a useful article of lath and pickets; and the final *débris*, in many localities, to usefulness in the manufacture of other commercial articles. The pioneer knew nothing of lath and shingle manufacture; live rolls had not entered his noddle: gang slab cutters would have been by him pronounced an invention of the devil to feed the flames of his insatiable furnace. Endless chains would have had no use in his mill economy; saw sharpeners and gummers would have had no value in his eyes, for he could cut all the lumber he expected to, and find plenty of time for dressing his saws by hand.

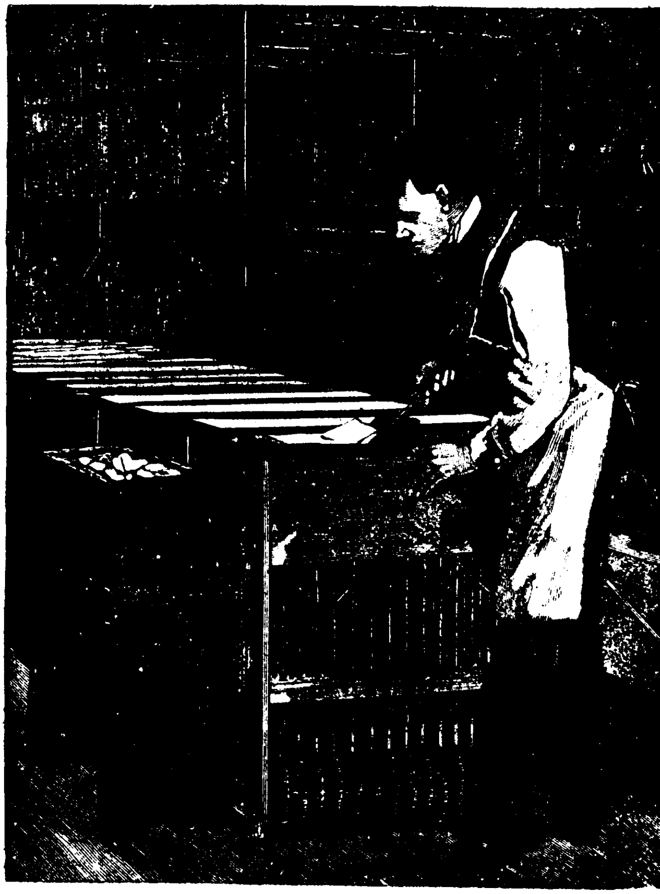
The modern sawmill is indeed full of improvements, down to the last device for sorting by machinery. The production in one day, by one saw, of more lumber than was accounted the work of a year in former times, is not only the result of the genius of invention such as marks the spirit of the age, but has rendered possible the remarkable development of the youngest in the sisterhood of nations, forming no unimportant factor in the influence of this country among the people of the earth. All hail to the modern sawmill, and the wise intelligence of nearly every man who is connected with it, either in the production of logs from the forests or the manufacture and sale of lumber, for each progressive step in the march of improvement has reduced the cost of manufacturing lumber, keeping pace with the inevitable increase in the cost of timber, due to the gradual decadence of the forests!—*Northwestern Lumberman.*

THE MANUFACTURE OF CANDLES.

It is only the history of the modern candle that is written—the graceful, sightly, and tapering cylinder which burns with a clear white and brilliant light; that neither smokes nor "drips;" which retains its hardness in the hottest weather; which can always be handled without greasing the fingers, and does not require snuffing. The primitive character of the candle by which the last generation read its primers and studied its Euclid, is a curious phenomenon when viewed as the product of unnumbered centuries of intellectual growth. The vision is easily conjured up in the memory, of their yellow light, their smoke, their unpleasant odor, and their frequent need of attention from a deft hand and the old-fashioned snuffers.

One quarter of the nineteenth century had followed its predecessors before it occurred to man that tallow candles might be made hard enough to keep the year round without melting, that the smoke was caused by imperfect combustion, that the substance which hindered a perfect burning might be removed from the fat, and that a simple method might be contrived to make snuffing unnecessary. These remedies, simple as they were, had to wait for riper scientific knowledge than even the *savants* of the last century possessed. A condition precedent was a knowledge of the nature of fats and of that energetic display of chemical action which we now call combustion.

The progressive steps in candle-making from the age of the primeval savage up to the nineteenth century were not many. First, the pine knot, then the oil nuts on a skewer—which is now the means of illuminating used by the Otaheitans and Society Islanders, who are not far behind the rural housewife of not long ago, who gathered rushes, peeled them on one side, and soaked the pith in the skimmings of the bacon pot, or our mothers, who hung a row of wicks of cotton yarn upon a stick, and dipped the wicks into the melted tallow prepared only by the removal of the membranes, etc., in the shape of cracklings. The operation had to be repeated several times, until sufficient tallow had hardened around the wick to make a not very shapely cylinder, the sticks being supported, while the tallow cooled, by parallel bean poles or quilting frames. Dipping day then was not looked forward to with pleasure by the cleanly housewife; it was dirty work at best—the kitchen floor was bound to suffer unless the weather permitted the dipping to be done out of doors. For this reason it was usually the cooler days in the spring or fall which were chosen, so that the tallow might harden quickly and evenly, and if the attic supply gave out in the midst of warm weather, the grocery had to be patronized for the crude mould candles just coming into use. In those days the construction of kettles specially adapted to melting the tallow and keeping it at an even temperature, and a contrivance for expediting the dipping by putting the rods with the rows of looped wicks upon a revolving rack, marked substantially all the advance of the tallow chandler's art. Aided by all these appliances, a workman could dip probably three or four thousand candles in a long day, and congratulate himself on his luck and his skill, but in the warm weather he had to do the dipping in the cool of the very early morning, and doubtless he often wondered if the time would come when his work could proceed in defiance of the thermometer. This method of dipping candles for the trade came down to our own day. Moulds were invented in Paris, in the eighteenth century, but it was not until the whole process of candle-making had undergone a change that they came into general use and stopped the domestic manufacture. The history of tallow-candle making up to the invention of the modern method is a curious one, because of the long time that the crude methods obtained, and it has its complement in the fact that wax candles are still made by kneading the softened wax to the wick with the fingers; the candle is then given a symmetrical shape by

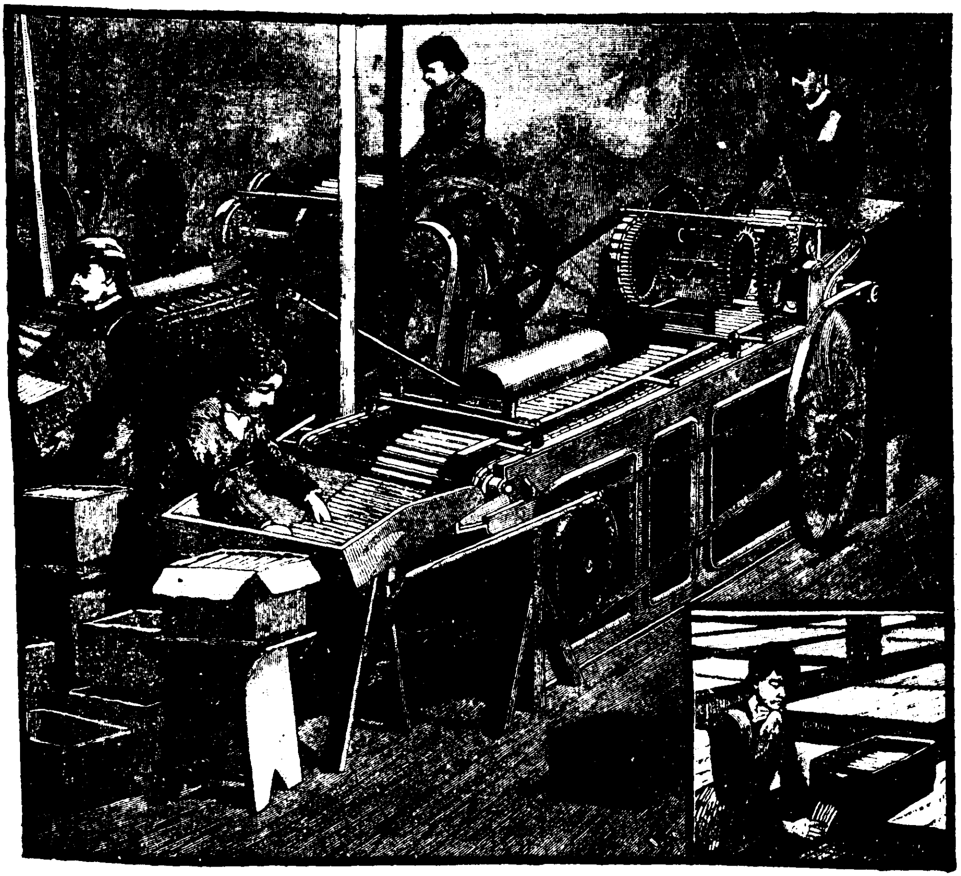


SCRAPING OFF SURPLUS.

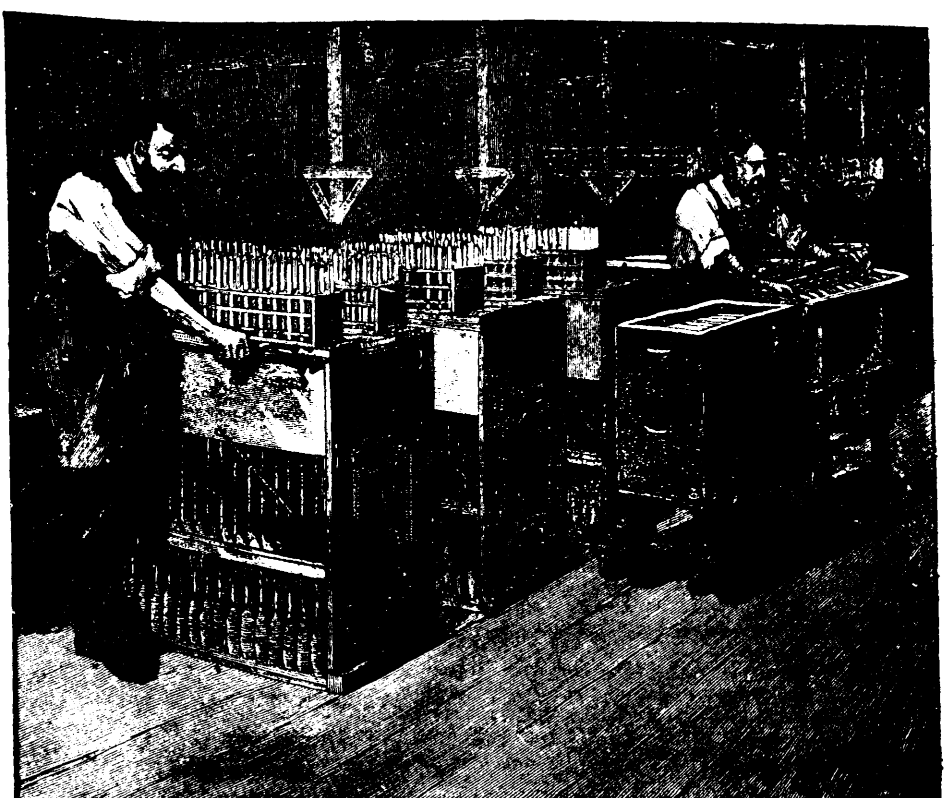
rolling it between marble or wooden slabs. Moulds cannot be used here, because of the great shrinkage which melted wax undergoes while cooling. Doubtless the wax candles were made in this way which King Alfred caused to be marked into divisions and shut up in his horn lantern, that by their graduated burning he might apportion his hours to study, and devotion and sleep. "Asser's Annals" preserve the great king's directions: "He commanded his chaplain to supply wax in sufficient quantities, and he caused it to be weighed in such a manner that when there was so much of it as would equal the weight of seventy-twc pence, he caused the chaplain to make six candles thereof, each of equal length, so that each candle might have twelve divisions marked across it." Each of these divisions burned one-third of an hour, so that the six candles lasted one day.

The discovery of gas lighting and improvements in lamps

HAND POLISHING.



POLISHING.



CUTTING AND CARRYING OFF.

have done much to curtail the manufacture of candles, but it is yet a vast industry. An estimate of the consumption in the United States, places it at twenty-two millions pounds annually. Candles are still the staple illuminating medium for the poor of large cities, and for all classes in small towns and villages where there are either insufficient or no gas works. Country hotels and taverns are large consumers, and the preference of many people for candles over lamps, as portable lights, keeps up a constant demand in all sections. Candles likewise are the true aristocrats among illuminators, and the renaissance in art taste, which holds no illuminating medium to be quite so beautiful and effective as the candle for dinner tables, and party and ball rooms, calls for an extensive manufacture of fine grades, Now, it is not the beauty of the polished brass or silver candelabrum alone which makes appeal to the æsthetic judgment, for, except the yet imperfect electric light, no illuminator can give so pure and white a light as a perfect candle. The finest fruit of science applied to the once homely industry is the stearic acid mould candle of to-day, which is not only quite as handsome in appearance as the wax candle, but burns with equal brilliancy and purity, and has to a great extent usurped the place of the more costly light. The mines of the far West share with the boudoirs and *salons* and dining-rooms of the East in the consumption of the best of these candles. A very large proportion of the finest grades goes to Nevada, Colorado, and the other mining States and Territories of the Pacific slope, the high temperature of the mines demanding a very hard and pure candle. The old candle would be entirely useless here, for tallow melts at from 90 to 104 degrees Fah., and the temperature of the deep mines of Nevada often reaches 120 and even 130 degrees. A good stearic acid candle will withstand a temperature of from 15 to 20 degrees more than this.

To the vast manufactory of Procter & Gamble, in Cincinnati, the most complete and extensive on this continent, we go for our illustrations and our description of their process, for there the most recent and most perfect of scientific and mechanical appliances are kept at work, and the latest of scientific research is constantly utilized. More than *one hundred thousand* candles are sent out from this factory every day, which, if moulded into one candle, would make it *eleven miles* in length. Every step of the process through which they pass, from the time the fats are deposited into the emptying room until the pretty cylinders, snugly packed in boxes, are sent to all parts of the world, is full either of interest to the student or entertainment to the simply curious. For the edification of the seeker after knowledge as well as those whose curiosity interests them in wishing to know "how to make candles," we will give both the scientific and the mechanical means of candle-making.

The stearic acid candle, which is now the principal candle of trade, represents the high-water mark of the progress in candle-making which began fifty years ago. Unlike its primitive predecessor, the tallow dip, it is a product of scientific study, and one of the many triumphs of philosophic chemistry.

The movement which effected a complete revolution in the industry, and ran a rapid growth after once it was started, was an outcome of the discoveries of M. E. Chevreul, the French chemist, published to the world in 1823, in his book, "Recherches sur les Corps Gras, d'origine animale." In it lies the foundation of all our present knowledge of the chemistry of fatty oils, and this knowledge is the starting point of modern candle-making. Chevreul established the scientific fact that, as a rule, all fatty oils, both liquid and solid, are neutral compounds of glycerine and the so called fatty acids. In tallow and other candle fats, these acids are stearic and oleic. A third acid, called margaric, also enters in small proportions, but it occupies very little attention. Stearic acid is a crystalline substance, unctuous to the touch, but not greasy. It melts at a temperature a little short of 150 degrees, and when burned through a wick gives out a white and clean light. Oleic acid is liquid at common temperatures, and was the cause of the melting of the old tallow candles at a temperature 50 degrees lower than is withstood by pure stearic acid. The glycerine base caused them to turn yellow, and to smoke with an offensive odor. The discovery of the chemical properties of these constituent elements of candle fat led with a single step to the fundamental idea of the improvement in candle-making; the oleic acid and glycerine are deleterious to the candle, and must be removed; and all the steps since taken—and they followed hard on the heels of the first—have looked to the doing of this in the most expeditious and cheap manner, and the perfection of the moulding machinery. Naturally the first processes were chemical, but they put a great obstacle of costliness in the way of the manufacture which almost proved fatal. The early industry, after surmounting this difficulty by combining mechanical means with chemical in separating and purifying the fats, again came near suffering shipwreck from another cause. It was found by the French chandlers, to whom belongs much credit for developing as well as originating the modern method, that the stearic acid on cooling in the mould crystallized, and the candles became unsightly, brittle, and uneven of combustion. The remedy appeared to lie in breaking the grain of the acid, and this was done by the introduction of a powder. Unfortunately, white arsenic was the powder chosen, and the result was so noticeably injurious to health that Chevreul's discoveries were brought into disrepute, and the early art of stearic acid candle-making was almost annihilated. Better study found a simple and harmless remedy to lie in lowering the temperature of the acid before pouring it into the mould, and in heating the mould to receive it. Improvements were also successively made in the methods of preparing the fat, and when, finally, American ingenuity was brought to bear upon the mechanical side of the problem, a machine was developed out of Sieur de Brez's last-century mould that has marvelously simplified and cheapened the manufacture of candles. The purification of the fat had done much to improve the combustion, and the smoke had been abolished; the flame, too, had become much brighter and cléarer, and the snuffing of the wick had become less necessary, for, the combustion being more perfect, the wick, whose only duty is to conduct the oil to the flame, was more nearly consumed. A little attention to the making of wicks soon banished the snuffers and the snuff tray to the curiosity shops of the antiquaries.

The old-fashioned wicks were simply twisted. Cambaceres conceived the plan of plaiting them, with one strand drawn tighter than the others. In the candle the wick is kept straight by the hardened fat, but, when released by the flame, the tightened strand draws the end of the wick over to one side, so that it is brought in contact with the outer envelope of the flame, where the combustion is more perfect, because of the liberal supply of oxygen received from the air, and thus the wick is continuously consumed. The process is helped by steeping the wick in boracic acid, in order that a glassy bead may be formed at the end of the wick, and drop off by its own weight. This plan was suggested by De Milly in 1830.

Fortunately, a promenade through the factory in fancy is attended with consequences much less disagreeable than the actual walk, for all that part of the process which is scientifically the most interesting is carried amidst environments that are not the most inviting to a visitor who is afraid of greasy floors and unctuous vats. The moulding, polishing, and packing, however, have picturesque phases which appeal to even a dainty æsthetical sense. Three processes are necessary in the preparation of the fat for the mould. The glycerine must be removed, the acids must be freed from the new base combined in getting rid of the old, and the solid acids must be separated from the liquid. In the first process the principle followed is the law in chemistry, according to which a strong base under favorable conditions will separate a weaker one from its acids by combining with the acids and taking the place of the weaker base. The fat is thereby saponified, a soap being formed, which is next decomposed, the fatty acids liberated and then separated. In this last process begins the employment of mechanical instead of chemical means, for, though repeated dilutions would effect a more perfect separation of the acids, the plan pursued is quicker, cheaper, and sufficiently effective for the purposed desired.

The saponification of the fat is accomplished in an apparatus called, in chandler's parlance, the "digester." It consists of a copper cylinder inclosed within an iron one, and a pump arranged to force the contents of the inner cylinder from the bottom to the top. Into this the fat, which has been melted out of the barrels by steam, is run and is mixed with lime and water. The mixture is kept at a heat of 600 ° Fah. by steam which is let into the outer cylinder at a pressure of two hundred and fifty pounds to the square inch. The water, being the heavier, sinks to the bottom of the copper cylinder, whence it is pumped and thrown on a perforated plate above the fat, that it may fall through it in many little streams. This agitation is kept up for eight or nine hours, after which it is found that the lime has united with the fat acids and formed a soap, while the water has consorted with the dissociated glycerine. The contents of the cylinder, after being permitted to remain at rest for a time, separate into two strata, the lime soap on top, the crude glycerine and water below. These are blown off to separate vats by the power of steam. It is from the candle factories that the enormous supply of glycerine comes, which is now a very important article of trade. A few years ago it was wasted; now it is sent to the manufacturing chemist, who purifies it by distillation and filtration through bone charcoal, and puts it upon the market. It is put to a great variety of uses, many of which depend upon its peculiar properties of non-volatility and absorption of atmospheric moisture. Harness makers and leather workers use it in making leather pliable; it is put into gas meters because it does not freeze except at a very low temperature; modelers keep their clay studies moist with it; tobaconists sweeten chewing tobacco with it, and ladies apply it to their hands and faces to soften the skin. Much of it goes into the manufacture of the terrible explosive nitro-glycerine, which is made by treating it with a mixture of sulphuric and nitric acid, or concentrated nitric acid. Not less than three million two hundred thousand pounds of glycerine are produced by the candle factories and utilized every year in this country, and yet so late as the year 1854 it was counted as worthless, and was run off into the sewers.

When the French chandlers first began the manufacture of the new process candles, and for a long while after, they permitted the lime soap to become hard, and then ground it up in order to dissociate the lime from the fat acids Now this is done without delay, the liquid soap being run into red-lined vats with a proportion of sulphuric acid added. The chemical principle involved is the same as in the more laborious process of saponification; the glycerine base has been supplanted by the lime base, and this must now be got rid of. The sulphuric acid takes hold of the lime, forming sulphate of lime, and the acids float off free. In these vats, between which the paths are narrow and the walks greasy, the liquid settles in three strata—the first, the fat acids, now free of their base, but still mingled; the second, an acid water; the third, sulphate of lime, awaste. They are easily drawn off without mixing, and the fat acids by washing in boiling water, are cleaned of all traces of the sulphuric acid, and we are now done with the chemical processes, and our product is a fat which contains the solid and the liquid acids. If cooled rapidly or kept agitated while cooling, the acids become so intermingled that they cannot be separated by mechanical means, which at this stage of manufacture must replace the chemical, on the score of cheapness. If the fat is cooled very slowly, however, it has been found that the solid acids will crystallize, while the liquid acid, the oleic which it is desired to banish, will lie snugly ensconsed between the crystals, to be afterward forced out by heavy pressure.

The cooling of the fat is a slow process. It is run into shallow pans, lined with enamel to prevent the acids from eating the metal, and permitted to remain in a warm room two or three days These pans are arranged in sections, like alcoves in a library, one row of pans underneath the other, and each extending a slight distance alternately to front or rear beyond the one above it. The hot fat is conducted over the top of the alcove in a wooden chute, and the filling of all the pans down to the floor is accomplished by taking a plug from the chute immediately over the top pan. When this is full it overflows at the front end by means of the slight depression made at that end, and the overflow is caught by the pan below, and so on down to the bottom. When the fat is become hard it is a cake of a brown greasy mass, not unlike unrefined maple sugar. The discoloration comes from the oleic acid, which permeates the whole cake and can be forced from between the crystals of the hard acids by pressure with the thumb. The cakes are wrapped in heavy woolen cloths, piled into hydraulic presses between iron plates, and the pressure applied. A dark oil gushes from the woolen, pours over the edge of the plates, and is caught beneath the press to be used in soap-making. The cakes have now been squeezed down to less than two-thirds of their original thickness, and the mass presents a yellowish-white appearance. By breaking it, its crystalline texture can still be seen despite the fact that the shape of the crystals has been ruined by the pressure it has undergone. They are still somewhat greasy to the touch, foa in this first pressure only fifty per cent. of the oleic acid has been removed. They now succeed to a second pressure, this time in a horizontal press, and between hollow iron plates that are kept hot by steam. Still wrapped in the woolen cloths, they are suspended between the plates in bags of horsehair cloth, and a very heavy pressure is applied from the end. When the cakes issue from this process they are white almost as snow, very hard and dry, and when broken into small particles have a flaky appearance. The mass is now almost pure stearic acid, and is ready to be moulded into star or adamantine candles. Without an exception, this single hot pressing is deemed by other manufacturers to be sufficient for their higher grades of candles, such as are used for mining, dining room or library, but Messrs. Procter & Gamble have learned that by again breaking up the cakes, melting, panning, and pressing inthe hot press, a much better candle is produced, better because there is no smoke, the light is whiter, and consequently much stronger and the candles last longer. These are strong points, especially where the candles are to be used for mining or in a close room, or where a pure, soft, white light is desirable, such as at a dinner party or reception.

These are the scientific phases through which the stearic acid candle goes; what follows it is simply the fruit of the inventive faculty of our day. The visitor emerges from dark basement rooms, where he has been moving between tubs and under pipes and chutes all dripping with liquid grease, into a room on the ground floor. Here there is light in plenty, and opening off one side is a vista of a room vast in extent, with a glass roof like a hothouse, with long rows of tables separated by narrow paths, on which, bolt upright, stand thousands of shapely candles undergoing a brief bleaching process by sunlight. One end of the first room is filled with vats in which the prepared candle fat is melted, purified, sometimes colored, and brought to the temperature requisite for moulding. Utility is here, of course, the guiding consideration, but the group of big and little tubs, with the men moving among them, is not without its picturesque element. Upon the edges, and hanging from the spouts at which the moulder fills his double-lipped can, the candle fat has hardened in fantastic shapes, with surfaces of ivory-like smoothness and sheen. The floor of the room is covered with moulds. In these moulds there is little remaining of the group of tin tubes through which the domestic candle maker, who had got beyond dips a few years ago, laboriously drew her wicks to fasten below with a knot, and above by looping them over little sticks. The tubes are now fixed in a frame having troughs along the top, into which they all open. They end below with the shoulder of the candle, and the moulds for the tips are the upper ends of piston rods, which, by a rack and pinion are forced upward through the tubes to expel the candles, and which, when at rest, fall snugly into the shoulders. These rods are hollow, and the wicks pass continuously through them from bobbins placed in the floor of the frame. Care is exercised to have the fat at a temperature just above the melting point, to heat the mould to receive it, and immediately to cool it rapidly by forcing around the tubes a blast of cold air, so that the fat shall not crystallize as it did in the panning. When the candles are hard, the surplus fat in the troughs is removed, and a few turns of a handle forces them upward out of the moulds and into a rack placed on top of the machine to receive them. The lower board of the receiving rack is slightly shifted, so that the edges of the openings through which the candles pass catch the shoulders of the candles, and prevent them from dropping back into the moulds with the piston rods. These rods in expelling the candles draw up with them wicks for the next pouring and in falling back into position pull the wicks taut and into place through the middle of the tubes. The candles in the rack are left until the next mouldful is cold; then the wicks are cut by passing a knife between the mould frame and the rack, and they are emptied into boxes, which are mounted on trucks, and pushed from mould to mould. Bleaching, polishing, stamping, and packing are all that remain to be done. The first process takes place in the adjoining room already mentioned; a few hours of sunlight bleaches the yellowish tinge out of the fat. Common grades are then rubbed with cloths and packed; better grades are polished by a machine, into one end of which they are fed by one womau, while another packs them into boxes from the other. The process is very simple: a grooved cylinder receives the candles from the feeder, and after carrying them past a revolving saw, which cuts off the butts evenly, deposits them upon a bed plate between the rods of an endless frame with linked sides, kept in motion by cog wheels. Over this bed plate they roll under a revolving buffer, which gives them a vigorous brushing from end to end, and gives them the beautiful porcelain finish as they pass towards the end where they roll off into the packer's box. All grades are stamped with the name of the maker, and in some instances the trade name of the candle, "Composite," etc. This stamp is melted into them by a branding iron as they pass through a small machine, which, like the polisher, is fed by a grooved cylinder.

NEW USES FOR OLD TIN CANS.

BY A. W. ROBERTS.

I give below the result of an extended experience in the utilization of old tin cans, such as are used by the million by packers of fruits and other articles. These cans, after serving their original purpose, are usually thrown into obscure corners, battered and rusty, a nuisance to every one.

Fig. 1.--Bird-houses made from Old Cans.

By the method given below these troublesome articles are made useful and even ornamental, such articles as flower-pots, hanging baskets, bird-houses, etc., being produced by them with little trouble or expense.

The cans were prepared in the following manner: Procuring a large dishpan, as much asphalt was melted in it as it would hold with safety. Into the boiling asphalt the cans were dipped; as each can was taken out it was rolled in dry sand, to give it a natural ground color; without the sand the effect of the black asphalt coating would be sombre and out of keeping with the color of the surroundings. To give some of these bird-houses a still more picturesque effect, they were rolled in the ordinary dry packing moss used by florists and wood mosses; also short dry twigs, small cones, and burrs were fastened on the cans. In this way very nice effects of color were produced. It is a well known fact that birds avoid brilliant or artificial colors; for this reason greens, grays, browns, and neutral tints are best for bird-houses. Where cans had been opened so that the top piece was still attached by a small piece of metal, it was bent down so as to form a rest for the birds when feeding their young, or a porch or rain screen over the entrance. All these little points when carried out gave character, variety of form, and completeness. The different ways of fastening and suspending the bird-houses are shown in Fig. 1. I sometimes fastened branches of vines over the bird-houses to more thoroughly obscure them.

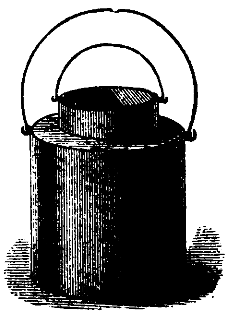


Fig. 2.—Glue Pot.

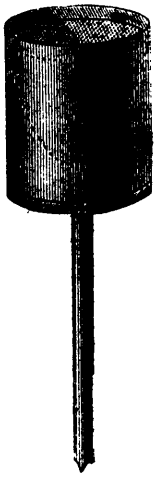


Fig 4.—Fruit Gatherer.

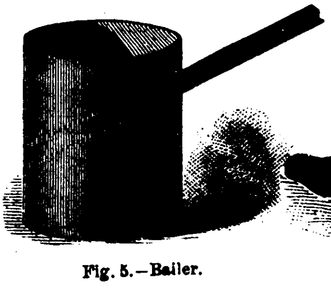


Fig. 5.—Bailer.

Fig. 3.—Bread Grater.

Fig. 7.—Hanging Flower-pot.

Fig. 8.—Hanging Log.

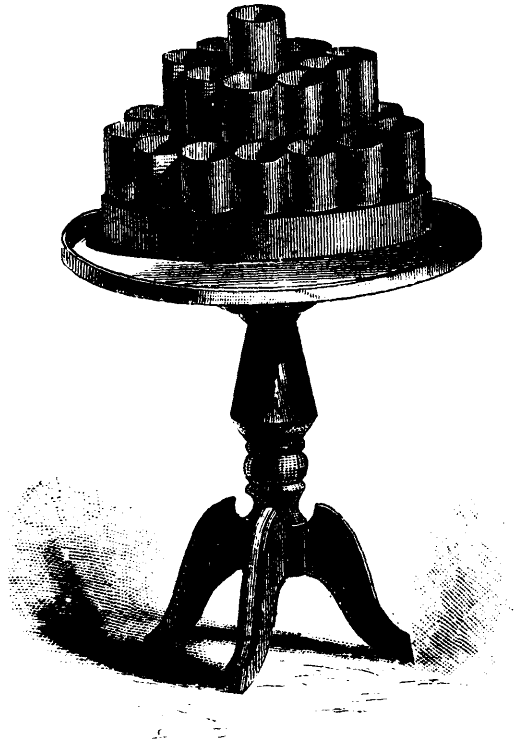


Fig. 9.—Plant Standard, empty.

Fig. 10.—Plant Standard, filled.

A glue-pot, a grater, a fruit gatherer, and a bailer, are shown respectively in Figs. 2, 3, 4, and 5. The glue-pot, Fig. 2, was made in the following manner: Selecting an empty two pound can, enough tin was cut away to admit of an empty one pound can. This inner can projected one inch above the top of the one pound can and was held in position by four wooden pegs, which were slightly tapering, so as to bind. Holes were made in the shoulders of the cans, through which wire bails were fastened.

Fig. 3, a bread grater, is so simple that it hardly needs describing. Out of a piece of one inch board a holder was shaped on which a perforated piece of tin was fastened. This piece of tin consists of a side of a fruit can flattened out. Tines were then drawn diagonally over it for guides when punching in the holes. The tin was laid on a piece of wood, in which a hole had been made of the exact depth required for the uniform projection of the buried cutters of the grater. The tin was then nailed to one side of the holder and bent over in as per-

Fig. 11.—Rockery.

Fig. 12.—Vase.

fect a curve as possible to the other side, when it was again fastened.

Fig. 4, a peach gatherer, was made by attaching a circular piece of board to the end of a long pole and fastening to this a can. Inside of the can there was a bag to receive the fruit without bruising. The bag was sewn inside of the can through a circle of small perforations. The rim of the tin was sharpened, so that when pressed against the stem of the fruit it would cut through it.

Fig. 5 shows a liquid measure or a water bailer. A hole is made in a can two inches below the edge; through this hole a handle is inserted which presses against the opposite side and is secured with a nail or screw.

Fig. 6 represents a fruit can converted into a respectable looking flower-pot. The can to be operated on was first dipped in the hot asphalt. A piece of well-seasoned white birch bark was cut out of the same height as the can and sufficiently long to reach around it. This piece of bark was so shaped that it flared out from the bottom of the can, leaving considerable space between the can and the bark. This space was filled in with hot asphalt. For ornamentation of the pots burrs of the liquid amber, black alder, and acorns were used. A hole must always be made in the bottom of the pots for the drainage of surplus water.

Fig. 7 is a hanging pot, planted with ferns. This was also covered with white birch bark, fastened on the straight sides of the can with asphalt. Three wires, by which it was suspended, were fastened to the rim of the can. In using cans for flower-pots or hanging baskets care should be taken to thoroughly coat the insides and outsides with the asphalt; this secures the tin from rusting.

Fig. 8, a hanging log, was made by partially telescoping two cans together, after the opened end had been entirely removed. A section of the side of each can was cut out, to leave an opening for the reception of the soil and plants. The cans were then heavily coated with asphalt, particularly where the cans joined, so as to strengthen the joint. Barks of chestnut and oak trees were used for covering the cans.

Fig. 9 is a standard for plants and flowering bulbs. Having secured an old centre-table, two cheese-boxes of different sizes were placed one on top of the other, the smaller one on top. Around the side of the lower box fruit can flower-pots were ranged, above these ranged another circle of pots, which stood on top of the largest cheese-box and against the side of the smaller one. On top of the smallest box more pots were placed, so that but little of the cheese boxes could be seen. All the pots were ornamented with burrs, cones, lichens, or barks. The spaces left between the boxes were filled in with wood mosses. Around the rim of the table was nailed hooping from a flour barrel. The inner angle formed by the hooping and the top of the table was patched with putty. Over the entire top of the table, the hooping, and the putty, hot asphalt was applied with a brush. This rendered the top of the table watertight, so that when watering the plants water could not run on to the floor. A hole bored through the top of the table afforded an escape for surplus water. The cheese boxes were coated inside and outside with asphalt, to prevent them from warping. The open space between the first circle of pots and the rim of the table was filled in with earth, on top of which moss was built up to the first circle of pots. The plants used were tradescantia, German ivy, English ivy, vincas, saxifraga, hyacinths, and calla lily.

Fig. 10 shows the complete plant standard. In hanging baskets, pots, and standards, where the plants are planted closely together and in a comparatively small bulk of soil, they require frequent watering and occasional applications of liquid manure. Our fowls provide us with a very fair article of "domestic guano," from which we make good liquid manure of sufficient strength by mixing one shovelful to a barrel of water. Still there is danger in a too generous use of liquid manure; if too strong or too frequently used the tender roots of the plants are injured and the leaves begin to fall.

Fig. 11 is a fern rockery for table or Wardian case. For the rockwork the most picturesque of rocks in form and color were selected. The rocks were fastened together with plaster of Paris, which was mixed with dry colors, grays and browns predominating. As fast as the plaster was applied sand was thrown on it. The effect of the coloring and sanding of the plaster was to destroy its whity glaring look, and to harmonize it with the general colors of the rock work. The cans used for the flower-pots were first wrapped in wet paper, to increase them in size, before applying the plaster against them when building the rock work. In a few hours the paper wrappings had so dried that the pots were easily withdrawn, after which the paper was removed and the pots put back in their places.

Fig. 12 is a vase for dried grasses and autumn leaves, which was constructed as follows: To the top of a broken-off lamp standard of glass was fastened a fruit can that had been previously dipped in asphalt. The outside of the can was then carefully covered with selected lichens and tufts of "sealing wax moss." Shells and parts of pine cones were used for ornamentation.—*Scientific American.*

Architecture and Building.

IS IT ADVISABLE FOR A BUILDER TO MANUFACTURE HIS OWN JOINERY?

The question as to whether it is more economical for a builder to buy ready-made joinery, or to manufacture it himself, is very important, and is one on which great diversity of opinion exists: so that we do not feel sanguine of being able to decide in such a manner as to attach to our opinion the whole or even any great majority, of those who may care to discuss the views advanced in this article.

The question indeed is, after all, one of opinion rather than of clearly definable fact, and yet so is it one which is regulated by circumstances. That the question—or at least the economical part of the question—is one more of opinion than of fact is assured by the reason that no builder can accurately know what his joinery work does cost him when he manufactures it himself. He may indeed be able to make a pretty shrewd guess at the cost; but, after all, his calculation is nothing more than a guess. We will occupy a little space by pointing out our reasons for urging this.

A builder buys a parcel of deals, which he intends to use for the making of joinery work, and when he has them piled in an open manner (so that the wind can season them) for some time, he selects out a number, and has them sawn into boards and reared on his "perches" to dry. Here, as a rule, we have two elements of cost entirely lost sight of; first, the cost incurred by the lapse of time whilst the process of seasoning was being conducted; secondly, the increased value of the selected deals, which follows by reason of the incurrence of loss arising through the rejected deals being eventually employed for purposes for which an inferior and less valuable brand would do equally as well.

The deals, now boards, being "perched," a precisely similar cost is added to the joinery work constructed from them, when the seasoning and selecting processes have been repeated. Considerable labor will now have been spent upon the wood —we do not refer to the labor of sawing, because this work may have been, as it mostly is, done at a public saw-mill, and therefore the cost is to be reckoned (although we strongly suspect that in counting the cost of an article of joinery work the cost rarely is accurately reckoned)—but the labor of piling, selecting, removing, and repiling will have necessitated some expenditure. It may have been 2½ or 5 per cent. upon the first cost of the wood; it is more likely to have been 7½ or even 10 per cent.; however, as in no two instances is it likely to have been precisely the same, it can only be guessed at roundly.

When, however, the labor charges of the joiner for making the required articles have to be formed into an item of the cost of the production, the estimater in the generality of cases, is in a very hopeless position. It may be argued that the workman would willingly engage himself on piecework, but as against this must be placed the fact that not only has the builder no time to spend over making a number of special contracts with his workmen, but there is also to be considered that a builder is constantly requiring his men to leave off their work, and undertake some other task of immediate necessity. It also happens that it is an exceedingly rare circumstance for builders to engage their joiners on piecework terms. Thus, as a matter of fact, the cost of the labor of constructing joinery work is not reckoned out. It is guessed at sometimes, and at other times, and very often, it is "lumped."

This being the case, the data for argument as to the comparative cost of home made and bought joinery work are destroyed, or rather are not fully furnished, and so the difficulty of comparison in this respect is very materially enhanced.

One more item of cost may, however, be noted, and that is that the joiner takes ready money every week in the shape of wages, and does not allow any discount to be deducted therefrom. Of course, it is not expected that he should; but the point of cost is worth noting, as we are of opinion that in reckoning the cost of construction it is one of those small items of cost which are very frequently lost sight of; and other items of cost present themselves as we write, of which are the charges always necessitated by the finding of room, light, warmth, etc., so as to enable the workman to labor, and although taxation is trifling it is something.

Many of these items appear at first to be merely trivial; but collectively they represent no inconsiderable portion of the finished article.

But we have sufficiently argued upon the impossibility of arriving at the exact cost of the home made production. Possibly, the manufacturer, who makes and sells joinery work wholesale, cannot—although he is continually occupying himself with estimating the cost of production—accurately arrive at the cost. That he can gauge it much more accurately than the builder will, of course be admitted.

We have then to inquire what are the probabilities, or rather what are the certainties, which assure us that the wholesale maker can produce a joinery article at a less cost than the builder? No doubt the most powerful help to the production of cheap joinery work is an abundance of machinery immediately applicable to the various required purposes. For instance, there is the steam mortising machine, which, in the hands of a boy trained to its constant working, gets through an immense amount of work; and there is the tenoning machine, the cross-cut circular saw, the trying-up machine, and the heavy planing-machine, most or all of which may be found in the workshops of the larger joiners, but most or the greater part of which are not to be found in the workshops of the smaller or even moderate-sized builders. When the machines are possessed by the large builders, they are rarely kept in full work, and when worked they are usually worked by men. At the large joinery establishments, boys can be trained to the service of particular machines, in the use of which by constant and undivided practice they become remarkably expert.

Large joinery factories are, or at any rate they certainly should be, established at one of the ports.

When this event is secured, two advantages arising therefrom become apparent. The first of these is that the considerable expense of carrying into the country a quantity of waste wood is avoided, insomuch that one-sixth, or possibly, all things considered, one-fourth, of the cost of carriage of the wood is saved. On this head, however, some portion of the advantage gained is lost to the consumer by reason of the extra rate charged by the railway companies for carrying joinery. At the ports there are always special parcels of stock, say middle quality stuff, which possess peculiar fitness for the making of joinery work, and these parcels the watchful and intelligent manufacturer, being on the spot, secures. As a rule, too, the wholesale maker can take larger quantities of stock than can a builder, and some cost is saved in this respect.

One thing is quite certain, and that is that he can devote his undivided attention to the economical production of the work, and this is what a builder cannot do. He has to relegate the duty to a sort of half-foreman.

Economy in the production of a manufactured article, if secured, is secured by the weight of a number of collective savings, the possibility of securing which rests entirely, in the case of joinery work, with those establishments which are conducted upon an extensive scale, and which are situated at the ports.

The question of the comparative quality of the joinery work made by builders, and that turned out of the large joinery factories need not be discussed, because the factories turn out precisely the quality which is desired by the buyer, and this quality is no doubt in all cases regulated by the price paid for it.

Our argument is that at these large works the joinery articles can be produced at a cheaper rate than they can be manufactured at by the average builder, and our further contention is that, inasmuch as the multifarious duties of a builder's business sufficiently occupy his attention in other branches of his calling, he will do well, for economical as well as for other reasons, to delegate the making of the greater part of his joinery work into the hands of those who, having an abundance of machinery at their disposal, and who, being able to devote their entire energies to its economical production, are in every respect the best fitted and most likely to produce it at the cheapest possible rate.—*The Timber Trades Journal.*

ONE of the features of the Electrical Exhibition at the Crystal Palace was a Christmas-tree, on the branches of which were hung Edison's incandescent lamps.

THE LATE MR. G. E. STREET.

The funeral of this distinguished architect, in Westminster Abbey, was attended, with every sign of personal esteem, and of regret for his death, by many of his professional brethren, and by personages of social or official rank. Mr. George Edmund Street, whose Portrait is presented in this number, was born at Woodford, Essex, in 1824, and educated at the Collegiate School, Camberwell. His architectural studies were begun under Mr. Owen Carter at Winchester, and completed under the late Sir Gilbert Scott, with whom he remained five years. Like his master, Mr. Street adopted the Gothic style in the buildings he designed, and the numerous essays and lectures which he has written upon architecture have all been directed to illustrate the history and principles and promote the progress of that style. His principal literary efforts are "The Brick and Marble Architecture of North Italy in the Middle Ages," 1855; and "Some Account of Gothic Architecture in Spain," 1865. Mr. Street has for many years been largely engaged in the work of erecting and restoring churches and other ecclesiastical buildings all over the country. To mention only the most prominent among his architectural works, he was the architect of the Cuddesden Theological College, of the new chapel and school-rooms of Uppingham College, and of new churches at Bournemouth, Garden-street, Westminster; St. Philip and St. James's, Oxford; St. John's, Torquay; All Saints', Clifton; St. Saviour's, Eastbourne; St. Margaret's, Liverpool; and St. Mary Magdalen, Paddington. Among his restorations may be noticed the churches of Eccleshall, Wantage, Uffington, in Berks, and Stone, in Kent, and Jesus College Chapel, Oxford. He was also the architect of the Earl of Crawford and Balcarres' house at Dunecht. Perhaps his most considerable work in church building was the erection of the nave of Bristol Cathedral in the Early English style. He was engaged upon the restoration of the nave and building of a new choir in Christ Church Cathedral, Dublin, and on building a new synod-house in connection with the Cathedral for the Irish Church. But in London, Mr. Street's reputation will mainly rest upon the Royal Courts of Justice in the Strand, now approaching completion. He was appointed architect for this gigantic undertaking in 1868, after a competition in which the most famous architects of the day, including Sir Gilbert Scott and Mr. E. M. Barry, took part. Although a great deal still requires to be done before the interior of the building is finished, the outer shell is fairly complete, and the public are able to judge of the imposing effect which the New Law Courts will present as they are approached from the Strand. Mr. Street was appointed in 1850 diocesan architect to the diocese of Oxford, and he subsequently filled similar posts in the dioceses of York, Ripon, and Winchester. He was a Fellow of the Institute of Architects, of which he has been a Vice-President, and a Fellow of the Society of Antiquaries, and of other societies. In 1866 he was elected an Associate of the Royal Academy, and was advanced to be a Royal Academician on June 29, 1871. He was also a member of the Imperial and Royal Academy of the Fine Arts at Vienna and a Knight of the Legion of Honour.

Our engraving of the Portrait of Mr. Street is from a photograph by Messrs. Lock and Whitfield of London, England.

THE STRENGTH OF WOODEN COLUMNS.

Some important tests of the strength of wooden columns, such as are in common use in the construction of cotton and woolen mills, have lately been made at the instance of Mr. Atkinson, President of the Boston Manufacturer's Mutual Fire Insurance Company. The tests were made with the testing machine at the Watertown Arsenal. The formulas in use for computing the strength of wooden columns are based on tests applied to columns of pine and oak of the size and length used in actual construction. All but two were round, hollow columns of from eight to eleven inches diameter, the two being about nine inches square. The greatest amount of pressure exerted in any case was about 265,000 pounds. The tests have disclosed frequent instances of defective boring in the columns. The object in boring is to open an air passage through the heart of the stick for the prevention of dry rot after it is in position in the building. It is essential, of course, that the bore should extend from end to end, but this has not always been effected. The sticks were bored first from one end and then from the other, and the borings have sometimes failed to meet in the middle of the stick. The tests also show that to taper the stick is a mistake, inasmuch as it weakens the column more than has heretofore been estimated.

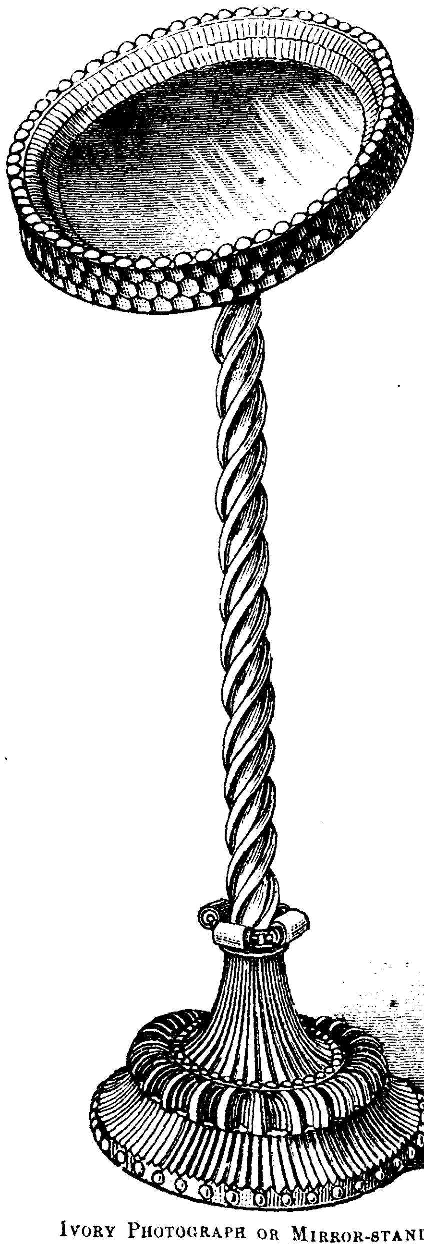
THE LATE MR. GEORGE EDMUND STREET, R.A., ARCHITECT.

Carvers' and Gilders' Work.

IVORY PHOTOGRAPH OR MIRROR-STAND.

By J. H. Evans.

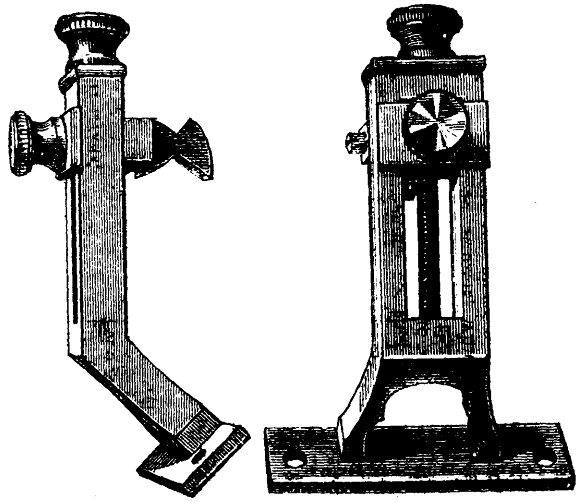
The present illustration, as above named, affords scope for bringing before our readers' notice the manner and use of a variety of tools connected with the ornamental turning lathe. I have already described a number of tools, but the present specimen is one in which many of them have been applied, and, although it looks a simple thing, no fewer than five separate parts of the apparatus were employed to produce it, viz., spherical slide-rest, spiral apparatus, universal cutter, oval chuck, and drill spindle. Any amateur turner possessing these tools as adjuncts to a good lathe, need not crave for more, and with such can, in a short time, have an elaborate collection of



Ivory Photograph or Mirror-stand.

specimens. I will not dilate, however, upon what any one might do, but presume that those who take sufficient interest to read these subjects will be better pleased with the information how to reproduce the same. The pillar or column does not appear to present any difficulty with regard to the material; but, unless a turner has a large stock of cut-up ivory, it is not an easy thing to get without waste. This, again, I must leave to the turner and his own resources, and will proceed at once to describe the way to make a stand similar to the illustration.

The base is 4in. in diameter, and, on the extreme edge, it will be seen, are a series of half-beads. There are 40 of them, obtained by using the 120 circle of division, and advancing three at each cut; it will require what is termed the astragal or flat-ended drill to give these beads a prominent effect, and it is the flat end of the drill that clears away the superfluous material between each bead. In some cases it is preferred to leave a point between each bead; then the pointed drill may be used.



Having this row of beads cut to satisfaction, the concave curve will form the next part to do. This should be turned to the curve by hand, and the horizontal cutter will then be necessary to cut the pattern; a double hollow tool will be the one to use, and must be extended sufficiently from the centre to allow the tool to cut the same curve as turned. It may happen that, having been turned by hand, it will be difficult to set the tool to exactly the radius required; should this be the case, it must be set as near as possible, and it will be cut up to a perfect curve with the revolution of the cutter. The division of 96 was used, cutting at every hole, consequently, 96 cuts are the natural result. We now come to the convex curve: to do this it will be necessary to use the spherical slide-rest; but the turner about to copy this need not have such a tool; other means, of which there are plenty, must be used. The present having been, however, cut with the spherical rest, I will show how it was done. In order to facilitate the proportions, it is better to rough it all out first; therefore, this curve may also be turned by hand, prior to being finished with the rest. To turn this curve with the circular rest, the tangentwheel must be adjusted so that its centre is under the centre of the curve to be turned; this done, the drill-stock takes the place of the fixed tool in the slide-rest, and in it a step-drill with four steps; there are 24 cuts round this piece, and to do them nicely it will take about four or five cuts, and for the last cut the tool should be taken out and set, as it naturally becomes dull after such a deep pattern. The next part, it will be seen, is simply a small ring of ivory, having upon it 30 beads smaller than those upon the base, but with a drill of similar character. The following piece is a long concave curve: this is also cut with the horizontal cutter, which forms the curve; it has 30 cuts in all, as will be seen by each one pointing to every consecutive bead. At the top of this part the points were again cut with a very fine-pointed cutter, in order to vary the patterns; the next, and last piece, forming the base, is turned somewhat after the shape of a crown, and cut over the curve with the spherical slide-rest. To effect this pattern there must be so many cuts and the same number of divisions passed, so that the plain parts show the same width as the cuts. This pattern might be cut to correspond with a crown exactly; but this is a matter of taste, and must be left to the operator. The base may be now looked upon as finished, and it contains five separate pieces. The parts may be screwed together or fitted with plain fittings, but screws should always take precedence of plain fittings, and this for very many reasons, one of which has just come forcibly under my notice; for one rather elaborate piece of work has come to grief through plain fittings, from the material shrinking or the cement giving. While being moved by the servant the body fell off, and broke away much of the ivory. I need scarcely say how annoying this is, and, therefore, as a preventive recommend nothing but screws to put any work together with.

We now come to the stem, which is cut with the aid of the spiral apparatus, and as it is a simple specimen of this class of work, it forms an excellent lesson in the production of the so-called Elizabethan twist. In setting about this part, the ivory should be placed in a box-wood chuck of small diameter, so that it will not in any way interfere with the working of the apparatus. It will be seen that there are in this piece three strands, which indicates really that there are three starting points, and these adjustments must be effected with the spiral chuck, which, having a wheel of 96 teeth, must be divided into three parts. The ivory having been turned to a perfect cylinder with the slide-rest, remove the fixed tool and place the drilling instrument in the rest with a round-nose drill. The wheels used to produce the twist were—on the chuck 120, on the arbor 36 and 60, and on the slide-rest a pinion of 24. Being long and slender, it is not one of the easiest part to do, and will require great care, and as the material is gradually cut away with the tool, it naturally becomes more susceptible to vibration. In cutting spirals in ivory, I would here suggest that it is always better to let each and every finishing cut end in the same direction. I have heard many amateur turners argue that there is no grain in ivory to matter; but this is a great mistake, and experience would soon verify the fact that there is a great deal to contend with in this respect; therefore, if the cuts are all finished in the same direction, it will save a deal of trouble in finishing off the work. As stated, there are three different cuts in this particular stem, but as they all terminate differently to each other at the bottom, to finish them it must take three consecutive tools, but the round-nose drill will do for all to clear away the rough material; this done, the same drill may be set to a fine cutting edge, and one of the cuts finished out with it. The next, it will be seen, although perhaps not very distinctly, from the nature of the engraving, is cut with a drill of the same shape but about three-hundredths larger, and the third has two distinct hollows in the bottom; but here, as in many cases, a little deviation from the illustration will not much matter, and it is very often that, having a pattern to look at, the turner may suggest an improvement in his own mind; however, the three spirals being cut and finished at the bottom, it may be seen that the top of each has been cut with a bead tool. To do this the drill-stock must be removed, and the universal cutting frame substituted, in which a bead tool the desired size is placed, and the cutting-frame must be then set to an angle to correspond as near as possible with the pitch of the screw, or twist that is being turned. I think I have mentioned before that in all cases I prefer to use the universal cutter where most convenient, but sometimes the drill is of great assistance, especially for step patterns; when all the material is cut away from the centre of such a piece of work as this, it will be, as I saw, subject to much vibration, and will, in some cases, necessitate the support of a slender guide. There are several kinds of this instrument; but the one which is of most service is that which is fitted to the front of the slide-rest, and in order to better explain it I give an engraving of the same. This, then, being fixed to the rest, travels with the tool; the consequence being that the resistance is equal to the pressure throughout the whole distance of the work so traversed. It will be obvious that something of this kind is absolutely needed in long and slender work. It may occur to many of our readers that the guide being made of steel is likely to injure the work; but it does not if the correct amount of pressure and no more is brought to bear on it. At the same time, there is no reason why the rubber should not be made of ivory just where, it bears upon the work; but if properly used no harm will come to the work.

I will now leave the spiral part, for anyone trying such a thing to have a little practice, and I should strongly recommend such to be upon boxwood, or with many failures it might be deemed expensive. On the top of this stem I have made a ball-and-socket joint, so that the photo or mirror, whichever is fitted to the frame, may be placed in the most convenient position. With the base and stem finished to satisfaction, great progress may be said to have been made, and it brings us to another class of work—viz., that of oval turning, and as the frame mounted upon this is a simple specimen, it will also form a good subject for this class of turning, and a gentle reminder of what has been before said upon the same subject. A piece of ivory cut from a well-selected hollow will, of course, be the best, and this glued to a sound beechwood chuck with a metal back may be faced over, and the recess for picture or glass turned out. When done so far, it must be removed from the chuck and reversed by the fitting on to another, where it should also be held with glue. I will take the opportunity of referring to the fact of the necessity of not moving the sliding ring of the oval chuck, and to prevent this I now add to the ring a small set-screw, so that if it is necessary to remove the ring for any purpose, by fixing one of the screws the ring may always be placed back in its original place. When I say that this idea was suggested to me by so efficient an amateur turner as General G. C. Clarke, it will be sufficient guarantee of its efficacy. This point, then, being well looked to, there will be no difficulty in turning the second chuck to fit the recess turned in the ivory. To proceed with the turning and ornamentation of the oval frame: the first thing will be to rough it all over, and determine the shape of the front moulding, which for this is a simple ogee; the pattern was cut with one large drill of the same shape, which I made for the purpose. There are 96 cuts, and although there is a difference between these at the two axes, it is not very noticeable in a pattern of this nature. We now come to the beads on the front of the frame, and these are what we call compensated; that is, all the same relative distance apart. This I effected with with the segment apparatus. There is a small apparatus called the "compensator" for the oval chuck, but it is rather an expensive tool, and I think I can explain how to effect its purposes without its aid. The present beads, at all events, were so done. It is simply to set the bead tool each time with the aid of the segment wheel, and, by a little careful testing, the beads or hollows, whichever are being cut, may be brought to a correct termination. So far, then, the front of the frame is finished, and it only remains to ornament the edge, and all is done connected with this specimen. The pattern on this part is what I call the honeycomb pattern, and is produced in the following way. Have in the drillstock a sharp, clean cutting, round-nose drill; set division at 96, cut round at every hole; move the slide-rest two whole turns forward; adjust the index peg one hole forward, and cut round again; return the index to same hole used at the start; move slide-rest again two whole turn forwards. and so on. I have a massive ivory box cut with this pattern which is most effective, and it is a most simple one to do. It involves only a considerable amount of patience. This forms a conclusion to the frame, and it only remains to mount it on the ball of the universal joint. This I did by fixing a cross piece of ivory on the back of the frame, held to its place by two small screws. The whole of the back is covered with a piece of white velvet. The stand, as finished, makes a very pretty specimen, and is as useful as most things produced as specimens of ornamental turning.

JAPANESE LACQUER.

The Japanese lacquer is laid usually upon articles of wood, and not upon articles of *papier maché*, as many suppose. It is produced by the saps of the *Rhus vernicifera*, which is taken in its natural state into a large wooden tub or vat, and then stirred in the sun with a large spatula, until its excess of water is evaporated. In some cases the varnish so produced undergoes careful straining; in others, it is mixed with sulphate of iron, with vermilion with red oxide of iron, or with indigo; oil is sometimes employed, likewise powdered stone. Into some inferior varnishes, a sort of paste made of rice enters in considerable proportion. There are a dozen methods of employing the various varnishes, differing according to the nature of the object to be produced. In the best lacquer numerous coatings are applied, dried, and polished successively. The first polishings are done with a stone named *tsu shimada* (suitable for hones), the latter by means of water and a charcoal made from *Andromeda ovalifolia*, and the last with pulverized stag's horn. All the polishings are effected by the hand. When gold is used in smoth surface lacquers, where it is not to be in relief, the process is as follows: The design to be produced is traced on a leaf of paper, which is then reversed, and has repeated upon the opposite side of it the outlines and other features of the design in a mixture of varnish and vermillion, softened over a mild fire. This side of the paper is then applied to the lacquer to be decorated, and the paper is rubbed and pressed upon it by means of a small spatula of bamboo.

The transfer of the pattern from the paper to the lacquered surface is further assisted by gently beating the paper down with a small silken bag containing powdered stone. The paper is then peeled off, and can be used again if desired. The slight relief of the pattern so produced upon the lacquer is rubbed down with carbon polish, and the design, and that alone, is then lightly covered with a thin layer of quickly drying varnish. Gold, in powder, is then applied to the moist surface by means of a camel hair pencil, if the gold pencil be fine, and by means of a small tube if it be comparatively coarse and heavy. The article is then dried for a day in a warm closet, such as is used for drying the ordinary lacquer varnish. The design is next lightly coated with a very thin layer of varnish, applied by means of paper steeped in it and passed very delicately over the object, which is then re-dried in the closet. The object receives further extremely light coatings of varnish and subsequent polishings before it is complete. Silver is applied in powder in the same manner. When gold or silver is applied to designs in relief the details of the process vary considerably, but the application of the metals is effected in substantially the same manner. When gold and silver are applied in leaf, they are laid upon the varnished surface prepared for them, and dealt with in the usual manner, the varnish acting as a "size" for the metallic leaf. When mother of-pearl is used as an incrustation for lacquer, it is laid on during the varnishing processes, earlier if it be thick than if it be thin, and the final polishing is proceeded with until the pearl is brought to the surface.—*Oil and Colourman's Journal.*

HOW TO TELL GOOD FROM BAD GILDING.

It may be ascertained whether gilding is genuine or not by the fact that on the latter a weak solution of protochloride of copper produces a black precipitate, which it does not on the former. In the case of gilt paper, the simplest method consists in slowly burning the paper in a bright flame that gives out no smoke; in the incinerated remains of good gilt paper there are traces of the gold left behind, which are quite perceptible to the naked eye, in the shape of glittering spots while base metal on paper oxidizes in burning, and leaves nothing but a lot of red spots behind. This method, however, is scarcely accurate enough; a very much safer test is to be found in the use of mercury, either in metallic shape or in solution of salts of mercury. The former test is performed by putting a few drops of pure quicksilver on the gilt article, and either rubbing it in or slighly heating it. If the gilding be genuine, though ever so thin, the mercury combines itself with it, producing white spots on the surface. This does not occur in the case of sham gilding, and in rubbing mercury in no change of color whatever can be noticed. Another test consists in the application of a watery solution of nitrate of mercury. In this case the exact opposite takes place as in the former, for genuine gilding remains intact, while a "duffer" at once takes a white color when brought in contact with the precipitate of mercury.

Miscellaneous.

Life of Steel Rails.—An engineer of the Rhenish railway, which has had the longest experience in steel rails, has made a calculation according to which the average duration of steel rails, when 24 trains pass over them every day, is 30 years, while that of iron rails, with a traffic of 17 trains, is 11 years. Steel rails, according to this calculation, last four times as long as iron rails, although they are but one-third more expensive.

To Prevent Wood from Shrinking.—Carefully conducted experiments have shown that wood, well saturated with oil, when put together, will not shrink in the driest weather. Wheels have been known to run for many years, even to wearing out the tires. Very many dollars might be saved annually if this practice was adopted. Boiled linseed oil is the best for general use, although it is now known that crude petroleum, on even old wheels, is of great benefit.

Varnish for Imitating Gilding.—A very perfect imitation of gilding on brass and bronze articles, it is said, may be made by means of a varnish composed of 160 grains of gum-lac, 40 grains of dragon's blood, 10 grains of turmeric and 3320 grains of alcohol. The metal should be brushed with the varnish in all directions, by means of a sponge, and then immediately warmed over a gentle charcoal fire. The surface at first will appear dead, but will soon resemble the finest gilding. The varnish should be kept in well corked bottles.

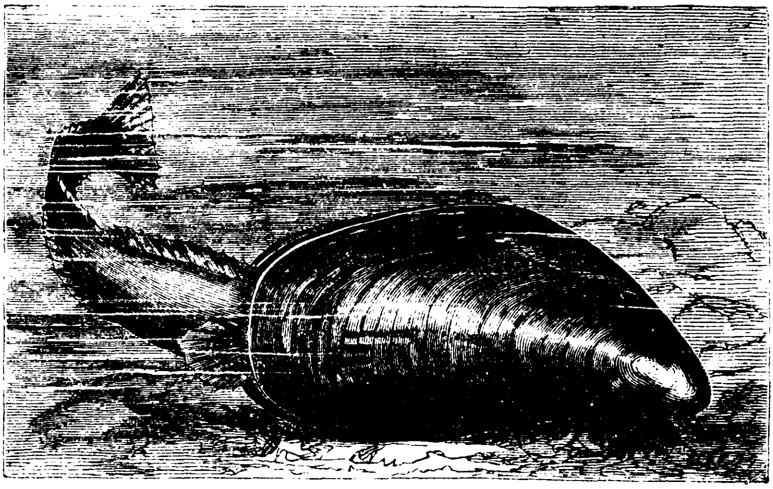
A balloon ascent was recently made by MM. Duté, Poitevin, and Du Hauvel, at the instance of the French Society of Aërial Navigation, with the special object of studying the conditions of formation of clouds. The observations made verified the following provisions.—(1) Clouds are formed in the zone of mixture of two layers of air saturated with moisture; (2) these clouds arise in the warm layer while they are dissolved in the cold layer which shares in the mixture; (3) their direction is that of the zone of air whose temperature is the higher; (4) the winds observed on the surface of the ground, which are merely reaction-effects of the principal wind, may measure several hundred metres in height, and have a different direction in neighboring localities, while the upper current has great regularity of direction and intensity.

The Tensile Strength of Glass.—Traulionie gives the tensile strength of glass at from 2,500 to 9,000 lbs. per square inch, according to kind; crushing strength 6,000 to 10,000 lbs. per square inch; transversely, by his own trials, Millville (N. J.), flooring glass, one inch square, and one foot between the end supports, breaks under a certain load of about 170 lbs. consequently it is considerably stronger than granite, except as regards crushing, in which the two are about equal. It is suggested that glass will shortly be used, for many purposes where other and much inferior materials are exclusively employed. Glass may be used as water conduits to better advantage than cast iron or terra cotta, as it is impervious to moisture and proof against corrosion or chemical action. It is already considerbly in use for flooring, and it has lately been successfully experimented with for railway sleepers under exceptionally severe conditions.

In a recent comprehensive paper to the Hanover Society of Engineers and Architects, Herr Schering makes a comparison of various kinds of glass roofing that have been constructed, and their cost of maintenance. The results of experience prove that there is less risk of injury from hail for such roofs than has generally been supposed, and that by far the greatest amount of fracture has occurred, not through hail, but through dead-weight, or casualities. Accordingly, in determining dimensions, dead-weight is primarily to be considered. Against hail, a glass-thickness of 5mm. to 6mm. (1 5 in. to 1 4 in.), with the usual construction, may be considered quite safe; with thicknesses over 3mm. (⅛ in.) no considerable damage from hail is on record. It appears, on the other hand, that the thickness should not be carried beyond 10mm. to 12mm. say ½ in.), else (probably on account of imperfect cooling) the glass is apt to break.

The oxyhydrogen or limelight has not been much heard of lately, in presence of the electric light. If its excellent illuminating power has not found much industrial or domestic application, this is probably due to the high price of oxygen and the quick destruction of the matter which is made incandescent. A Russian naval officer, M. de Khotinsky, has been lately trying to improve the system. He has devised a lamp in which the refractory substance proves much more durable. A thin pyramidal crayon of lime or magnesia is supported (adjustably) in a vertical position, with its thinner end facing the orifice of the burner below, which surmounts two tubes, for coal-gas and oxygen, both controlled by one stopcock. The two gases only mix at the mouth of the burner. The crayon, immersed in the flame, is successively heated from below, without any sudden difference of temperature occurring in its different parts. The same crayon will last fifteen days, with daily use. The burner consumes about 0·014 cub. m. of oxygen per hour, and as much coal-gas, giving a light equal to about 1·5 Carcel burner. M. de Khotinsky proposes to prepare oxygen from permenganate of potash (the Tessié de Motay process), or by another method he is working out, and to convey it to houses in a compressed state, each subscriber having a reservoir for storage. M. Tissandier, who reports on the system in *La Nature*, is unable to speak of it from an economical point of view, but he was highly satisfied with the light.

GREBES AND THEIR NESTS.



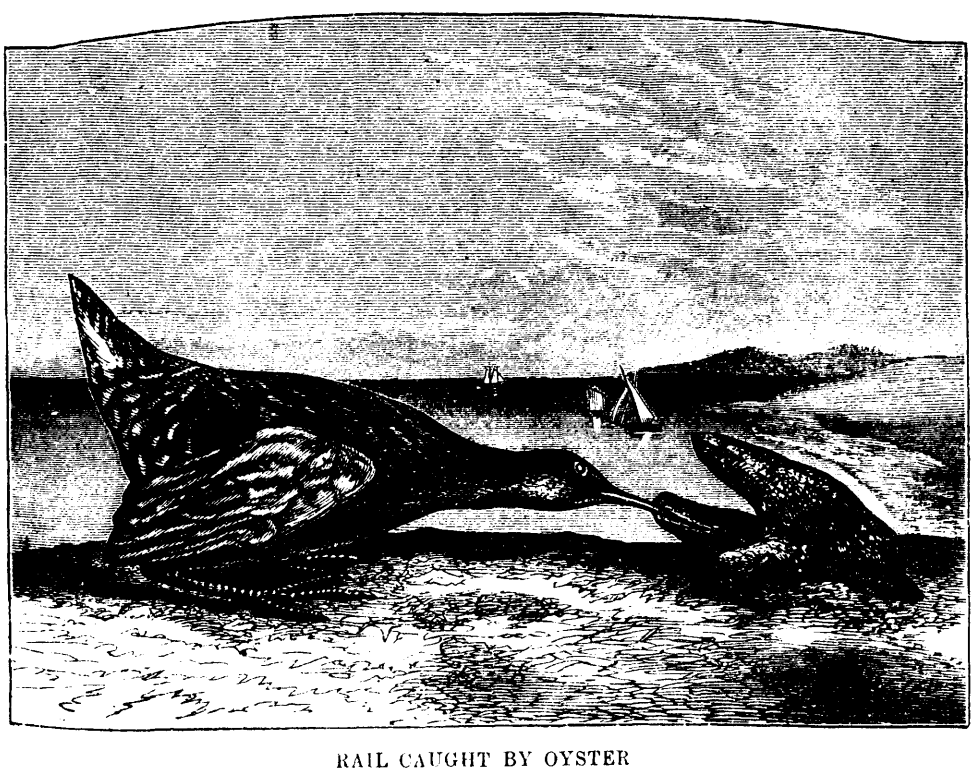
SHANNY CAUGHT BY MUSSEL

CURIOUS CAPTURE BY AN OYSTER AND A MUSSEL.

A correspondent of *Land and Water* lately forwarded to the editor of that journal a box containing a shanny and a mussel, which he describes as having been taken in the harbor at Looe, Cornwall, in exactly the position represented in the accompanying illustration. The shanny and mussel were taken by a fisherman who was gathering mussels for bait at Looe. Mussels are found in great numbers at the bottom of the harbor there, and the fishermen use a long-handled, four pronged fork for catching them. A boat is moored over the spot on which the mussels are to be found, and the fork is employed to bring them from below into the boat. In the case in question the shanny and mussel were brought out as shown in our illustration. The fish was alive when taken, and its head firmly fixed in the mussel. This certainly may be considered a curious capture, and from the evidence it may be fairly assumed that the shanny, seeing a tempting mussel with its mouth open, was induced to pop his head in—an operation which the mussel doubtless resented by immediately closing its valves, retaining the fish in its deadly grasp.

In the same periodical some time ago was recorded an even more extraordinary capture than the above by Mr. Frank Buckland. We reproduce Mr. Buckland's remarks and the illustration which appeared at the time :

"Some time since, when examining the famous oyster beds at Helston, near Falmouth, Mr. Fred Hill, of Helston, was



RAIL CAUGHT BY OYSTER

kind enough to accompany me and my friend Mr. Howard Fox, of Falmouth, in our expedition. Mr. Hill mentioned to me at the time that he had a curious specimen of a bird that had been caught by an oyster. The bird and oyster had been mounted in a case by Mr. Vingor, of Penzance. I have received from Mr. Hill a photograph of the event, which I have since had engraved. The history is that a woman who sells oysters went one morning to the Helford River and found the bird—a common rail—quite dead, with its beak held quite firmly by the oyster, which was still alive.

"The bird in all probability was wandering along the foreshore, looking for his dinner, and the oyster—possibly left longer by the tide than usual—was opening his shells waiting the incoming water. The hungry rail, seeing something that looked like a white and dainty bit of food, pecked at the body of the oyster, and probably pricked him sharply with his beak. The oyster then snapped his shells together as quick as a rat trap, and the poor bird instantly became a prisoner to die (or possibly get drowned as the tide rose) in his prison."

Domestic.

AN IMPORTANT QUESTION—HOW DO YOU SLEEP?

One of the most important things to know about any man upon whom you are going to place any dependence, is how he sleeps. Sleeplessness may sometimes be involuntary. There may have been some shock to the man's nerves which has made him insomnolent; but sleeplessness is more frequently voluntary. Men choose to push their studies or their work into those hours when they should sleep. It does not matter for what cause any man may do this, the mere fact of not sleeping spoils his case. He may spend his nights in the theatre, in the study, or in the "protracted meeting." It will make no difference; the result to the body will be the same. The sleep was not had, and for that the man must pay.

One man may do with a little less sleep than another; but, as a general rule, if you want a clerk, a lieutenant, a lawyer, a physician, a legislator, a judge, a president or a pastor, do not trust your interests to any man that does not take eight good solid hours of sleep out of every 24. Whatever may be his reason for it, if he does not give himself that, he will snap some time just when you want him to be strong.

The intellectual and moral connections of sleeping have, I think, not been sufficiently appreciated. Men and boys have been praised for "burning the midnight oil." Now this "midnight oil" is a delusion and a snare. The student who is fast asleep at 11 o'clock every night, and wide awake every morning at 7 o'clock, is going to surpass another student of the same intellectual ability who goes to bed after 12 and rises before 5. In sleep, the plate on which the picture is to be taken is receiving its chemical preparation; and it is plain that that which is the best prepared will take the best picture.

Men who are the fastest asleep when they are asleep, are the widest awake when they are awake.

Great workers must be great resters.

Every man who has clerks in his employ ought to know what their sleeping habits are. The young man who is up till 2, 3 and 4 o'clock in the morning, and must put in his appearance at the bank or store by 9 or 10 o'clock, and work all day, cannot repeat this process many days without a certain shakiness coming into his system, which he will endeavor to steady by some delusive stimulus. It is in this way that many a young man begins his course to ruin. He need not necessarily have been in bad company. He has lost his sleep; and losing sleep is losing strength and grace.—REV. DR. DEEMS.

THE TAPE WORM.

Most of my readers know that the domestic pig is subject to a disease known as "measles," in which the muscles are more or less filled with *cysts*, which render the pork unfit for food; but I think few are acquainted with its cause.

Man, it is well known, is occasionally infested by a parasite —the so-called "tape worm" (*Tænia solium*)—which may be described as having a tape-like body of varying length, with a differentiated "head" or *scolex* at one extremity.

This apparently single animal is in reality a colony of mothers and daughters, the scolex being the parent of all.

This "head" is provided with a *rostellum*, or, as it might be called, proboscis, encircled by a crown of hooks, below which are the suckers; each segment added to the scolex is a complete individual containing a complicated and perfect reproductive system.

The last segment—*proglottides*—which are filled with eggs, break off at intervals and either the eggs are set free within the intestine of their host, when they are passed out with their fæces, or the segments themselves are evacuated.

The tape worm feeds on the juices of the bowel by absorbing the nutriment through its skin, and does not appear to seriously inconvenience its host in any way. In Abyssinia *tænia helminthosis* is constant and general; indeed the animal is there regarded as a sort of hygienic agent and cultivated rather than discouraged, yet the people are healthy; certain it is also that wild animals, almost without exception, harbor at least one species of tape worms as a natural condition.

But what has this to do with "measles?" Now to the point. Let us suppose one of the before-mentioned eggs taken into the stomach of a pig, either by its eating the excrement of a person affected or through the water or air; here it hatches, not into a tape worm, but into an animal of oval form, transparent, contractile, in the middle of which are six stylets arranged in pairs; with these it cuts its way through the tissues until the muscles are reached, when, having arrived at its destination, it stops burrowing and surrounds itself with a sheath.

Here the stylets atrophy, a new and different crown of hooks is produced, and the parasite becomes a *cysticercus* or vesicular worm, the cyst being about the size of a hazel nut. This constitutes "measles;" the exhaustion or even death attendant on the disease is caused by the scores, hundreds, or even thousands of animals boring through the tissues; once encysted there is no further suffering or danger.

The cysticercus remains encysted for months or years, or until the piece of flesh enveloping it *is introduced into the stomach of man*, in which case it instantly quits its torpid condition leaves its sheath, makes its way to the intestine, where, attaching itself by its suckers and hooks, it grows—or rather reproduces—so rapidly that in a few weeks a tape worm of several yards in length is formed, which reproduces eggs, and so *ad infinitum*—from pig to man, from man to pig.

Should the eggs be introduced into man itself or animal other than the hog, the cysticercus penetrates the tissues in the same manner, but it is "not at home," and instead of resting in the muscles it makes its way to other organs, such as the brain, heart, or eye, where its presence has caused in man several instances of insanity or death. Should a piece of meat containing a vesicular worm be eaten by a pig or animal other than man a *tænia* is developed, but it also is "not at home," and does not attain its full development.

Both eggs and cysticerci are killed by a temperature of 200° Fah., so there is no danger in eating well-cooked pork, even if it contains cysticerci.

To prevent hogs contracting "measles" it is only necessary to prevent them having access, either through their food or water, to the secretions of man, and they will not suffer.

Throughout the genus *Tænia* we find this dual life; for instance, the cat has a tape worm, the cysticercus of which she gets from the mouse, and the dog one which he obtains from the sheep.—*Scientific American.*

A CHARACTERISTIC OF AMERICAN LIFE.

In the summer of 1836 a barefooted boy was on his way to Honesdale, Pa., walking the tow-path of the Delaware and Hudson Canal. When four miles from Port Jervis, and still forty miles from his destination, he was overtaken by a canal boat. He was asked to jump aboard the boat and ride, which he did. On the boat was a Scotch family, just landed in America, who were on their way to the Pennsylvania coal fields. One of its members was a boy the same age of the young pedestrian, eleven years. A strong friendship grew up between the two boys by the time they reached Honesdale. The Scotch family went on to Carbondale, the center of the Lackawanna coal field. The boy who had been given the ride in the boat obtained employment on the Canal. His friend, the Scotch boy, worked in the mines for a short time as mule boy. Both he and the former barefoot boy rose in the company's service. The Scotch boy of forty-six years ago is Thomas Dickson, President of the Delaware and Hudson Canal Company. His friend, the other boy, is Col. F. Young, General Manager of the company, and President of its Albany and Susquehanna Railroad system.—*N. Y. Sun.*

A BAD CASE OF GLOBUS.

Dr. Myers, of Paterson, N. J., was recently summoned in great haste, at midnight, to see a woman who was suffering the most excruciating agonies from having swallowed a set of false upper teeth, sixteen in number. Several women were about her, who had been called in to help her. Anodynes were administered to relieve her temporarily. Dr. Myers then closely scrutinized her mouth and throat, but could find no evidence of laceration. Moreover she could swallow readily. He suggested that the teeth might have been mislaid, but this was indignantly scouted by the attendants who declared that they had searched the house from top to bottom.

A further search under the pillow failed to disclose the missing property, and the case began to look serious, as the poor woman declared that she could not stand it any longer, as she felt the edge of the teeth cutting into the sides of her stomach. Finally, at the suggestion of the doctor, the inside of one of the pillow-cases was examined, and there the teeth were found, perfectly safe and harmless.

The patient, who had, a moment before, been suffering from the laceration of the teeth "against the edges of her stomach," recovered instantly, and the doctor was promptly dismissed.—*Medical Record.*

SALT IN DIPHTHERIA.

In a paper read at the Medical Society of Victoria, Australia, Dr. Day stated that, having for many years regarded diphtheria, in its early stage, as a purely local affection, characterized by a marked tendency to take on putrefactive decomposition, he has trusted most to the free and constant application of antiseptics, and when their employment has been adopted from the first, and been combined with judicious alimentation, he has seldom seen blood poisoning ensue. In consequence of the great power which salt possesses in preventing the putrefactive decomposition of meat and other organic matter, Dr. Day has often prescribed for diphtheritic patients living far away from medical aid the frequent use of a gargle composed of a tablespoonful or more of salt dissolved in a tumbler of water, giving children who cannot gargle a teaspoonful or two to drink occasionally. Adults to use the gargle as a prophylactic or preventive, three or four times a day.

A COMFORT TO FAT PEOPLE.

No doubt, says the London *Lancet*, it is unpleasant to be excessively obese; but the morbid dread of fat which has in recent years become fashionable has no foundation in physiological fact. Fat answers two purposes; it acts as a non-conducting envelope for the body, and protects it from too rapid loss of heat, and it serves as a store of fuel. In the course of exhausting diseases, it not unfrequently happens that the life of a patient may be prolonged until the reserve of fat is exhausted, and then he dies of inanition. Fats supply the material of the heating process on which vitality mainly depends. In great excess it is inconvenient; but the external laying-on of fat is no certain measure of the internal development of adipose tissue; much less does a tendency to grow fat imply or even suggest a tendency to what is known as "fatty degeneration." It is time to speak out on this point, as the most absurd notions seem to prevail. Again it is *not* true that special forms of food determine fat. That is an old and exploded notion. Some organisms will make fat, let them be fed on the leanest and scantiest and least saccharine descriptions of food; while others will not be "fattened" let them feed on the most "fattening" of diets. The matter is one in regard to which it is supremely desirable and politic to be natural, adapting the food taken to the requirements of health rather than substance. Simple food, sufficient exercise, and regular habits, with moderation in the use of stimulants, compose the maxim of a safe and healthy way of life.

THE ELECTRIC LIGHT vs. GAS IN THEATERS.

It is said that a marked improvement has been noticed in the acoustic properties of the Grand Opera House, Paris, since the introduction of the electric light. A layer of heated gases acts as a screen for sound, hence the volumes of hot fumes arising from the old gas-foot-lights obstructed and marred, to some extent, the voices of the singers. With the electric light, inclosed in air tight bulbs, no fumes can be emitted, and very little heat is given off. Hence it benefits the ear as well as the eye.

THE SHARK FISHERIES AT NEW SMYRNA, FLORIDA.

(SEE NEXT PAGE.)

Our illustration represents a somewhat noted shark fishery near New Smyrna, on the Florida coast. The sharks are caught for the oil they afford, one sometimes gives seven or eight gallons. Some attempts have been made to collect the fins for exportation, but it does not pay. About $100,000 worth of fins are yearly taken to Bombay and shipped to China. The shark fisheries are generally owned by one person, though sometimes the party works on shares. The fit-out consists of boiling pots to try the liver, barrels for the oil, a mule team, and fifteen or twenty lines. The lines are about as large as a clothes-line, the hook being a foot long and connected to a three-foot chain by a swivel. The season commences the last of March or April, and at this time, every morning at sunrise, a boat-load of negroes can be seen rowing out towards the mouth of the river to the place where sharks most do congregate. The men generally keep time to the oars with song and laughter, and, in fact, the business has more of a sporting character than falls to the lot of many. Arriving on the ground, the boats are hauled up, the fires started, and the lines spread along the beach at a distance of about 200 feet from each other. They are now baited with fresh shad or bass, and taking the coil of line and slowly whirling the heavy hook around his head, the "line" man steps quickly to the edge of the water and puts the bait out beyond the breakers into the channel that here runs close to the bank. From forty to fifty feet of line is generally thrown over, and one hundred more kept as a reserve to play the fish, if he proves a large one. The line is coiled near the edge and passed over a crotch of wood and caught tightly; this is done to all the lines. After throwing over the decayed remains of the catch of the previous day to bait up the game, the men lie on the sands and wait for a bite, and their patience is not generally taxed. The shark usually bites very softly, sometimes nosing the bait and producing a tremor in the line; and then it is jerked up, and the fish slowly moves off. Now the line must be allowed to run out at least twelve feet to give him a chance to attempt to swallow it. Four or five negroes have it well in hand, and when the leader thinks the time has come, he gives the word and they stop paying out; in a moment it is taut, and with a yell they jerk the hook into the fish and then the sport commences. As he feels the cold steel the shark rushes towards the deep water, dragging the men sometimes in knee-deep before they can stop his headlong rush. Now he makes a rush to the right, stopping suddenly and running right at them; with a leap cleaving the water and showing his whole length, and shaking his ugly maw in vain efforts to get rid of the chain, down he comes with a terrible splash, only to find himself deeper in the toils, as the men have taken in every inch possible. Now, perhaps, another line is seen going out, and two men are obliged to leave it short-handed and attend to to that; this gives the shark a better chance, and he pulls the men fairly into the water, suddenly slacking and sending them all down in a heap, and as quickly starting off again; but the men, finally weary of this treatment, and giving him more line, run down the beach, dragging him through the surf to and fro, until, half-drowned, he grows weaker, and, getting close to the chain, they run him, flapping and gnashing his teeth, upon the sand. All but one now go to the help of the other line. The one left takes a sharp knife—carried by all—cuts the hook out, severs the head, rips open the stomach, and soon has the liver out. The fins are cut off by the boys, and the vertebræ are saved for canes. The work at the end of the day—when twenty or thirty sharks have been caught—begins to tell, as many of them are from twelve to fourteen feet long, and five or six men are needed to overpower them. The oil is often sold as whale-oil, and makes very good "dips." The capacity of some of these sea wonders is enormous. The writer caught one at Tortugas, Fla., that weighed about 900 lbs. It was a white shark, and for a longtime had lived around the slaughter-house located on the edge of the channel. It took about twenty men to get him in ultimately. In the stomach was found the skull and horns of a steer that had been thrown over the day before, three hoofs, besides a heterogeneous mass of old rope, seaweed, and two or three old tin cans that perhaps retained some of the meats that had been packed in them. The jaw was saved. It had eight rows of serrated teeth, and fitted over a man's body easily. It is now in the Museum of Natural History, Central Park. The fossil sharks of the tertiary period grew to an enormous length, exceeding 150 feet. At Charleston, S. C., their teeth are found buried in vast quantities, some measuring seven inches in length.

THE SHARK FISHERIES AT SMYRNA, FLORIDA.