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SCIENTIFIC CANADIAN

MECHANICS' MAGAZINE

AND

PATENT OFFICE RECORD

Vol. 7. JULY, 1879. No. 7.

BAD PLUMBING, BAD TILE-DRAIN LAYING, AND BAD SANITARY ARRANGEMENTS IN THE INTERIOR OF HOUSES, IS:—

THE CURSE OF CITIES;

THE CAUSE OF SCARLET AND TYPHOID FEVERS, DIPHTHERIA, SMALL-POX, AND ZYMOTIC DISEASES OF ALL KINDS; AND, ALSO,

THE CAUSE OF DEPRESSION OF SPIRIT, LANGOUR, GENERAL DEBILITY AND NERVOUS DERANGEMENT OF THE SYSTEM.

—

AMONG the cities of North America, Montreal has attained the notorious and unenviable position of being the most unhealthy, for its size and population—and the cause of that unhealthiness, we boldly proclaim, is owing to *bad plumbing, bad house drainage, imperfect ventilation,* and *defective sanitary precautions and inspection.* We, moreover, assert that no matter how much money is spent upon perfecting a system of drainage in our streets; no matter how often those drains may be flushed, it will avail but little, if the discharge pipes, tile-drains and water-closets are to be made so imperfect that they become ventilators to the street drains, through bad workmanship in plumbing and other unsanitary imperfections.

There are but few houses in this city in which, if thoroughly examined, defects in the pipes could not be found; and among the many examples of inferior work, wilful neglect, and gross, blundering ignorance, we may enumerate the following:—

I.—Over-flow pipes not soldered, but joined together with slip-joints, through which the poisonous gases have a steady flow, passing under floors and up between partitions until the whole of a house is impregnated with poison. These pipes are generally cased in with wood as soon as placed, so that the cause of foul gases leaking out of loose slip-joints is not perceived, and therefore the enemy is concealed while doing its deadly work.

II.—Over-flow and discharge pipes to baths discharging directly into the water-closet trap without any intervening bend or trap to prevent the foul odour of a water-closet trap passing through them into the chamber. This pernicious arrangement actually makes a ventilator of the bath pipes for the foul closet-trap, and frequently, when there is a small quantity of water lying at the bottom of the bath-tub, the gas may be seen bubbling up when the lever of the water-closet is pressed down. This method of carrying off the water of a bath-pan into a foul closet-trap (for foul the water will be in it in spite of flushing, and coated will its side be always with foul mucous matter) is most objectionable; and, strange to say, it is a plan adopted by the majority of plumbers, from many of whom we certainly would expect better judgment.

III.—Imperfect connection between the soil-pipe and the tile-drain in the basement; this frequently occurs, either from bad workmanship, or from the sinking of the house; but in either case hardly any provision is made by which the fault may be found out and remedied without tearing up the floor.

IV.—Drain-pipes laid in the basement without the joints being cemented, and then covered up with earth. Thus every pipe leaks at its joint, and the earth in the basement becomes permeated with filth, from whence are bred germs of disease. Sometimes the apertures in the walls for these pipes to pass through into the street drain, are never built up close to the pipe, and any foul gas issuing from defects in the pipe outside, is carried into the house from this neglect.

V.—The imperative necessity of ventilating pipes at the head of the soil-pipe, and placed in such a way that these ventilators will act in all cases, and not become, as they sometimes do, mere ducts for forcing foul air into the house every time the water-closet lever is raised.

The foregoing are a few of the special evils we desire to point out: to enumerate all would require a pamphlet.

Now, we would ask, who is responsible for this inferior work? If the city drainage is of such importance as to require immense sums of money to be spent upon it, and large amounts annually required to be disbursed for new drains and repairs, is it not the very height of folly and neglect to allow our citizens, after all this expenditure and heavy taxation to meet it, to be at the mercy of plumbers—or tinsmiths calling themselves plumbers—who, by their ignorance, bad workmanship and materials, are the cause of admitting into our residences the foul gases from the drains which we are spending so much money to improve? Is it not perfectly ridiculous for any municipal body having the affairs of a city entrusted into its hands, to allow any landlord, tenant, or plumber, to render nugatory all the money expended for sanitary purposes, when it can be so easily remedied by the enforcement of stringent laws and a proper supervision by competent officers? Is it not time, then, that the corporation of this city took this matter in hand, and make such by-laws and appoint such competent officers as would enforce them, which would at once put a stop to inferior workmanship and materials employed in all sanitary house arrangements in this city?

Let us, in the first place, consider what staff of sanitary officers are required in a city like Montreal, having a population of, say, 150,000 inhabitants:

I.—A Sanitary Inspector and a deputy, and aided by sanitary police.

II.—An Inspector of Plumbers' Work, and an assistant.

III.—An Inspector of Drains.

Such a staff would probably be found sufficient, if the right men are put in the right place.

Let us now consider what the qualifications and duties of such a staff of sanitary officers should be.

We know nothing of the qualifications of the present Sanitary Inspector or other sanitary officers of Montreal. We trust they possess all the qualifications which public officers holding such important situations should have, which virtually places in their hands the health, and, in fact, the lives of many of the citizens; but as we have our own opinion of the qualifications necessary, and the duties to be performed, we will briefly state them:

A Sanitary Inspector should be, by profession, either a civil engineer or an architect, in order that he should be thoroughly acquainted with the construction of houses, public buildings, drains, plumbers' work, &c. He should possess a practical knowledge of chemistry sufficient for the detection of gases. He should be a man of energy, judgment and determination, but even-tempered and courteous in the performance of his onerous and disagreeable duties, so as to enforce them with the least possible annoyance. His deputy should be an active, intelligent and practical man, capable of carrying out his instructions most minutely.

The duties of a Sanitary Inspector should be to thoroughly investigate every complaint and find out the cause, and be able *himself to direct a remedy—without depending upon the advice or opinions of others*—and he should see that the instructions he has given are fulfilled to the letter, by personal inspection of the work being performed. He should, in the course of time, make an inspection of every house in the city—*nolens, volens*, the objections of its inmates. We know many people who are so indifferent to bad odours that, rather than be put to any little inconvenience, would prefer to risk the lives of themselves and their children, and only be awakened up to the result of their apathy by death carrying off one or more of its inmates, who had contracted disease from breathing an atmosphere impregnated with germs or gases bred or formed in foul closets and drain pipes. We know landlords who, in the presence of the most offensive odour, would declare that the house was perfectly sweet, rather than expend a dollar to do that which would save some human life. Are such people to be allowed, by their own disregard of health, or is a community to suffer from the apathy or stinginess of landlords, to live in an unsanitary atmosphere which will breed infectious diseases to be spread among them?

He should also visit every yard and lane, and every public building and store in which is carried on manufactures deleterious to health, and prosecute, with the utmost rigour, all infractions of the sanitary laws of the city. He should see that every yard was properly drained, and that the fall of the earth was sufficient, so that the surface water did not run towards the house instead of from it, as is frequently the case, carrying with it, under the foundations, impure matter, from the vile custom that is permitted to exist of throwing soap-suds and refuse matter into wood-boarded yards. He should see that every privy was furnished with a high ventilating shaft, and emptied when he considered it requisite, and not when the landlord thought so. The filthy state of many of the privies, and the want of ventilators to them in some of our wholesale establishments in this city, is a disgrace to the merchants; and, as for a proper supervision over them by the sanitary staff, we do not believe that such places are ever inspected, unless upon complaint.

An Inspector of Plumbers' Work should be a properly qualified person, in every respect, for the position, and not a man selected by favouritism. It would be well, indeed, were there a by-law compelling every person practising as a plumber to pass an examination, and not be allowed to undertake any plumbers' work of a sanitary nature until he received his certificate of competency, and that a penalty should be enforced in every case where work contrary to law had been performed. Any party closing up plumbers' work in a new house without receiving from the inspector a certificate that it was complete in every respect, should be heavily fined. An Inspector of Plumbing, upon receipt of an order from the Sanitary Inspector, should thoroughly investigate every case of complaint, and make the work perfect, the cost of the same to be charged against the party in fault.

The duty of an Inspector of Drains should also be to see that the drains were properly laid and cemented in every new building, and give a certificate of the same.

The architect or builder should be obliged to supply to the inspector of plumbers' work, and to the inspector of drains, a plan of the sanitary arrangements of the building, so that a fault could easily be traced and rectified, without pulling the house to pieces to trace out where the pipes and tile-drains were placed, and a duplicate of the plan should be given by the architect or builder to the proprietor.

Such are but a few of the sanitary improvements necessary in this city, to which we desire to call the attention of its citizens. There has always been a difficulty and vexatious delay in getting sanitary imperfections rectified, until people get disgusted with the apathy shown to their complaints. If the corporation would adopt the law of London in sanitary matters, this difficulty would soon be rectified. The law of London and other large cities in England, is as follows :—

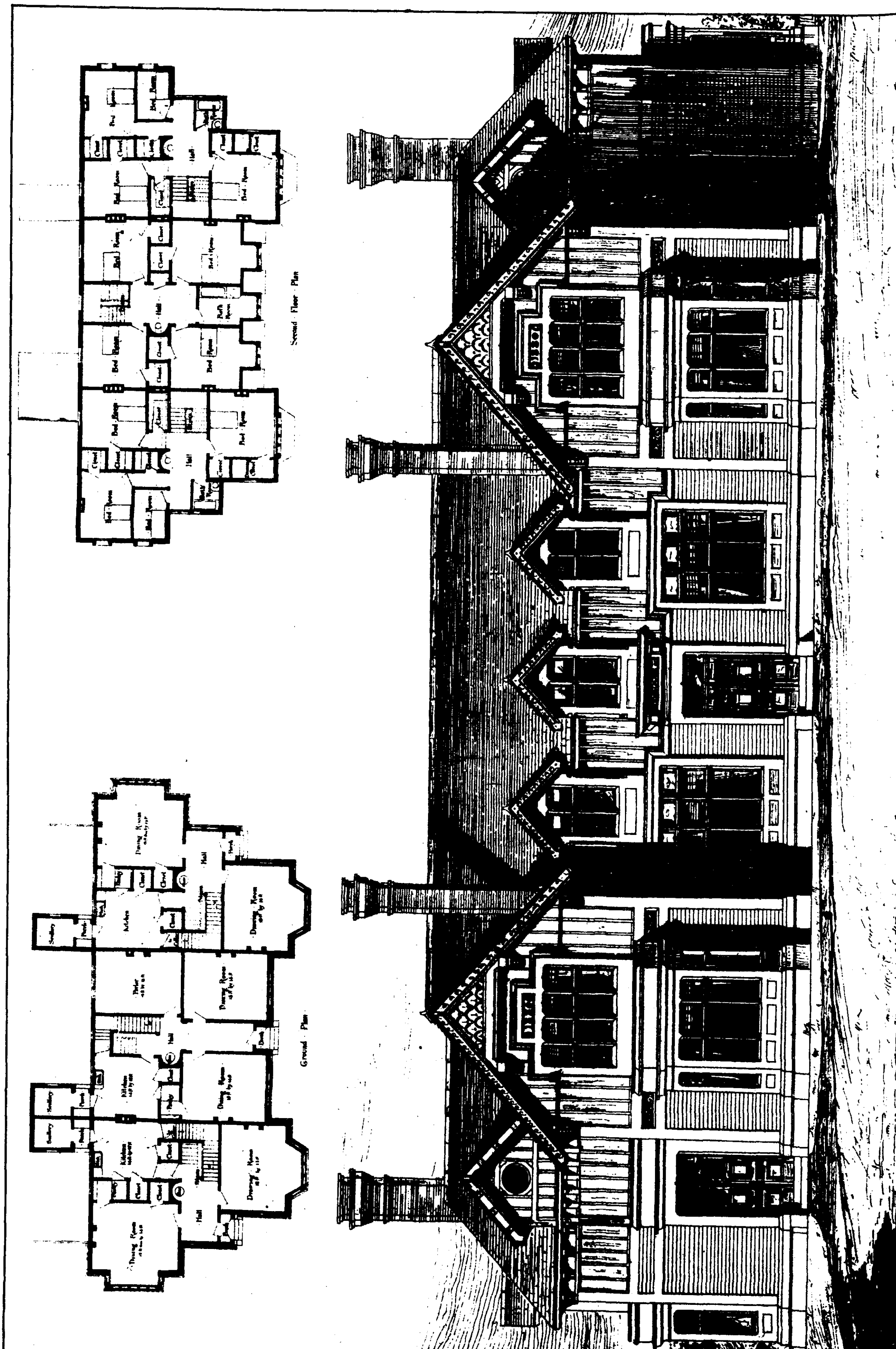
Upon the complaint of a tenant or landlord, or on the suspicions of the Sanitary Inspector himself, notice is given to the tenant, that in a week's time, between the hours of 10 a.m. and 4 p.m., the Inspector will call to inspect the building, to find out the cause of the complaint. If, at the time he arrives, the house has not been put into a sanitary condition, the power of doing so is at once taken from the landlord, and the work done by the sanitary staff, under the Inspector's direction, and the cost of the same levied upon the household effects, if the tenant is in fault, and upon the property if it is the landlord's fault. If the complaint is very urgent, then the Sanitary Inspector can give an order for the immediate rectification of the same, and if not at once attended to, he can then enter with his workmen and perform the work. There is no delay, trifling or bungling in the matter, and thus it happens that sanitary evils are at once crushed out by a power that cannot be resisted, and London, with about four millions of citizens, is, from its statistics, shown to be the healthiest city in the world.

That it may not be supposed the evil complained of is at all exaggerated, we will give our own experience of the unhealthy state of houses in this city from bad drainage and bad plumbling.

A house in St. Denis street recently occupied by the family of the late Capt. Penton, Chief of Police, was previously resided in by the writer. His complaints to the landlord of the unhealthy state of that house met with a positive refusal to do anything to remedy it, but when at last two members of the family were taken ill with scarlet fever and diphtheria, we brought in a sanitary policeman and laborers, who ripped up the basement floor, and there were found, at least, 6 inches deep of the foulest muck covering the whole kitchen basement, and a broken water pipe was pouring out a copious stream, flooding the entire floor under the boards. There was no drain whatever to carry off the sink water, which had—how long it is hard to say—been emptying its greasy and foul contents under the flooring, and the only semblance of a drain was what had originally been a four inch square brick drain, which had entirely collapsed. The sink water had no place to discharge itself into except under the floor, and from thence percolated under the basement of the house into the street. Could any doubt remain as to the cause of sickness in the house?

Having suffered so severely in this case, and finding a very unpleasant odour in the next residence we occupied, after some trouble the landlord consented to have an examination made to find out the cause of the same, and after taking out the closet seat and pan, it was found to be underneath little better than an open privy. The closet itself was built up against a lath and plaster partition, but the portion underneath the closet seat was not even plastered, and as a natural consequence the foul effluvia found its way upwards through the lathe and plaster partitions into every room in the house.

Our next case is a recent one, and is worth recording. It happened in a residence in St. Denis street, in what is called a first-class cut-stone house and quite new; and when the landlord was asked whether the drainage was perfect, he spoke as if he prided himself upon the completeness of his precautions and sanitary arrangements. The house was rented upon these recommendations, but in a very short time he found he had been deluded. The landlord could not be brought to believe that anything could possibly be the matter with the drainage, particularly as he said the previous tenant made no complaint; but upon enquiry it was found that some members of that family had always been sickly while in the house, though fever did not break out. It was not, however, until he insisted upon an inspection being made by the sanitary inspector that he consented to remedy the nuisance. The inspector came, looked at the sink, to which a trap had recently been fixed (it had never been trapped before), and sagely gave it as his opinion that the fault was there; the only part, in fact, that was free from smell. Arrangements were then made with a well-known plumber to examine and rectify the evil, and he had a *carte blanche* to do whatever was necessary. Upon examination it was found that the joints of every overflow pipe in the house had only slip-joints, through which the gas from the drain passed up; that the discharge pipe from the bath was not trapped, but discharged into the water-closet trap, and, consequently, a foul odour from that trap was constantly passing up through the bath pipe into the bath-room. It was also found that the soil pipe discharged into the tile drain in the cellar, the mouth of which was left open; and, further, that to the wash tubes and sinks there was only one small trap in the basement, which had sagged down by its own weight, flattened, and was useless. It was further found, upon uncovering the tile-drain in the cellar, that not a single joint in the whole of them was cemented; they were all open for the soil from the closet to pass out and poison the earth around them. There was no ventilation to the water-closet in the basement, nor is there now, and there was no ventilation to the soil pipe. The plumber having a *carte blanche* to put the house into a thorough sanitary condition, it was naturally expected that he would do so, and that the Sanitary Inspector would personally call and see that it was done; but the sanitary condition of the house is still imperfect, because the plumber did not think fit to examine the pipes under the water-closet in the basement, and after all the money expended the house is still in an unsanitary condition from foul gases coming up from the closet through the partitions of the house. To give a further example of how sanitary work is performed in this city (it happened in the same house quite recently). Water having been found to come into the cellar (which it never did before), and having a most foul odour, it was naturally supposed that, from its position, there was something the matter with the pipes in the next house. A sanitary officer came to see it, and the proprietor, next door, was called upon to examine the state of his drain. This he most unwillingly did, at a great inconvenience to himself, as he had removed to the country. He opened the drain in his yard, at which a man was employed for four days, and he broke up his fine cemented floor also, and the result was that his drains were found to be perfect; on further examination it was found that the cause of the water in the cellar was from the sinking of the earth in front of the house, by which a surface drain had been formed, which carried the rain water towards the walls of the house instead of into the street, and had eventually worn a hole to the foundation; down this was carried the wash of manure from the garden and under the founda-



COUNTRY HOUSES, ST. JOHN, N.B.—R. BROWN & J. C. ALLISON, ARCHITECTS.

tion of the house. We ask in the name of common sense how was it that neither the inspector or any of his staff could see this at first without putting this gentleman to so much inconvenience and expense?—and we ask also who is to pay for it, *he* or the Corporation?

Much more could be said on this important subject; there are thousands of people in this city suffering in health from the incompetence of plumbers, and the want of a proper supervision of their work.

We appreciate the well-directed intentions of several of our medical men and health committees to endeavour to abate the cause of sickness in this city, but this we know, that they may meet in solemn conclave night after night, and learnedly and scientifically discuss the causes of zymotic diseases in the city; trace them to this or that fault in our system of drainage, and talk of sanitary reformation being necessary, and bring forward many practical and impracticable theories; and men may write essays on sanitary matters, excellent in the suggestions they contain, if only carried out by those who write them, but this we desire to say, that until the Corporation of the city appoint a thorough practical man, gifted with sound common sense, and with a mind not mystified with theories which are only practical according to circumstances, to take charge of the sanitary affairs of this city, and empower him with full authority to prosecute every delinquent, the sanitary condition of the city will not be ameliorated. One such man would in one year do more to cleanse the city of impurities and disease-breeding causes than the councils and deliberations of all the health committees or sanitary boards that have ever considered the subject.

Book Notices.

We are in receipt of a book—Ames' Alphabets, sold by Messrs. Bicknell & Comstock, publishers of architectural works, New York—and we feel much pleasure in highly recommending it to architects, draughtsmen, engravers, engineers, artists and sign painters. It contains 32 pages of every description of letters plain and ornate. The work is got up in the very best style, and is sold at the low price of $1.00. Parties wishing to buy the work can obtain it through the editor of the *Scientific Canadian*, by remitting a P. O. order for $1.10, which will cover cost and duty.

We also have to acknowledge the receipt of a copy of the *Carriage Monthly*, published by I. D. Ware, 414 Arch street, Philadelphia, price $2.50 per annum. This is also a very valuable work, and should be in the hands of every carriage-maker. Any one remitting to us $4.00 will receive this work and the *Scientific Canadian* for one year.

The *Horological Gazette*, published by D. H. Hopkinson, 42 Nassau st., Philadelphia, is another very valuable American work to which we desire to call the attention of jewellers and watchmakers, not only on account of the valuable information contained therein, but also for the advertisements which will be found of much service to intending purchasers. The price of this work is $2 per annum, and can be clubbed with the *Scientific Canadian* for one year by remitting to us $3.50.

"THE YOUNG SCIENTIST."

This is a very valuable practical journal for amateurs, published at 176 Broadway, New York, at the low price of 50 cents. We know no more useful work; it is one that should be in every school boy's hand. Subscriptions can be sent direct to the office in New York, or through the Editor of the *Scientific Canadian*; or we club it with our Magazine on receipt of $2.25.

Correspondence.

St. Catharines, June 19th, 1879.

To the Editor of the *Scientific Canadian*.

Dear Sir,—I read the *Scientific Canadian* with a great deal of interest, but I have noticed that your illustrations in my line are chiefly borrowed from the *American Architect*; and of course they are good and well worthy of publication, but I think Canadian architects ought to have some pride in regard to architectural designs of our own production, and I would like to see some good Canadian designs published in this our only architectural publication. Cannot something be done in respect to this matter?

Yours, &c.,

S. R. B.

Editor's Note.—We have solicited over and over again architects who are subscribers to contribute original designs for this periodical, which is the only one of the kind published in the Dominion. We should be most happy to publish original designs of merit, and it is not our fault, but our regret, that the architects of Canada take so little interest in matters connected with their profession.

Montreal, 21 June, 1879.

To the Editor of the *Scientific Canadian*.

Sir,—Will some of your readers kindly inform me what is supposed to be the proper seal for a trap connected with a water-closet, and also if the excreta is discharged wholly out of the trap at each flushing of fresh water, and if not, how many times will it require to be flushed to cleanse it thoroughly? I have reason to believe that the water in the closet trap is always foul, and that any atmospheric pressure passing upwards through the soil pipe, will force a foul odour through the basin as soon as the closet lever is raised. By giving this insertion, it will much oblige a constant reader of your valuable and useful Magazine.

R. J.

PROPOSED COUNTRY HOUSES, ST. JOHN, N. B.

MESSRS. R. BROWN AND J. C. ALLISON, ARCHITECTS, ST. JOHN.

The designs for these country houses we take from that excellent journal, the *American Architect*, published by Messrs. Houghton, Osgoode & Co., Boston, Mass. While we appreciate the spirit of the publishers in giving publicity in their publication to our Colonial architectural designs, we cannot but regret the indifference evinced by our own architects generally to supply designs for illustrations of works erected in their own country.

These houses are intended to be built a few miles from St. John, and are designed to suit the requirements of middle-class people. It is proposed to build them in terrace form, with sufficient variation externally to avoid too much uniformity in appearance. In houses of this class ample closet accommodation is needed, and the position of the several fireplaces is important, as conducing to sufficient warmth during the winter months. The "hall stove," which is one of the essentials of the country, is placed in a curved recess, and from its position will distribute heat throughout the house, and the stove-pipes, often the most unsightly things in a house, are here carried to the smoke-flues without being obtrusively in view. As each house has a basement, the heating, if preferred, could be effected from below by a furnace; the smoke pipe taking the same course as shown for the hall stove. Externally, a departure has been made from the usual stereotyped style of country house in this district. So far as known there are no houses here modelled in the Old English style of half-timbered work, with projecting eaves, and carved woodwork in the gables. In the design shown the lower part of the building would be clapboarded and the upper part covered with vertical boarding with filletted joints.

SEEING THROUGH A PLANET.

By R. A. Proctor, B.A.

Very strange news has recently reached us from an Australian observatory. Mr. Todd, of Adelaide, using a very fine telescope 8 in. in diameter, believes that he has two or three times seen a satellite of Jupiter, through the edge of the planet's disc as it were. Thus on July 2, he saw the innermost of the satellites for a few minutes through the southern dark belt at that time present on Jupiter. "The definition was very good," he says, "or I should think I might be deceived." On this occasion, he adds in a note, "The satellite was distinctly seen through the edge of the planet for the space of its (the satellite's) full diameter." If no optical explanation can be found for this observation, we should have to accept the inference that the apparent outline of Jupiter's disc lies more than 2,000 miles from the real surface of the planet. We should have indeed to infer much more than this. For it is quite certain that one of Jupiter's moons could not be seen through the atmosphere of the planet, if that atmosphere extended about 2,000 miles below the level at which it seemed to form the visible outline of Jupiter. The conclusion to which we seem led if we accept Mr. Todd's observation is so startling that many will be disposed to think that he must have been deceived. Yet other observations, quite as remarkable, have been made before now. Thus, on one occasion, a satellite which had entered on the planet's face at the beginning of transit, was seen four or five minutes later outside the planet's disc, as though this moon had changed its mind and gone back for a while. Three well-known observers—Admiral Smyth, Sir Richard Maclear and Professor Peacock—all witnessed that strange sight. We can only explain what they saw by assuming that the outline of the planet's disc had changed in position, owing, perhaps, to some change in the condition of clouds floating at an enormous height in the atmosphere of Jupiter.

An attempt has been made to explain Mr. Todd's observation as a mere optical illusion. It is well-known that a bright object shining on a dark back-ground appears larger than it really is. A sort of fringe of light surrounds the bright object, this fringe being due apparently to an extension of the action produced by the object's light outside the space really occupied by the image on the retina. Now, in consequence of this optical illusion, when the disc of the moon passes over a bright star, a phenomenon, which at first sight seems to resemble what Mr. Todd saw, is occasionally observed. The star seems to pass within the edge of the moon's disc to a perceptible distance before disappearing, which it does quite suddenly. The appearance presented just before the star disappears is as though the star were shining through the edge of the moon. It is suggested that the appearance seen by Mr. Todd may be thus explained. In reality, however, there is no real resemblance between the two cases. The star is very much brighter than the disc of the moon, and is a mere point; whereas the satellites of Jupiter are about the same brightness as this disc, and are not mere points, but in such a telescope as Mr. Todd's have discs of appreciable size. If we consider what effect irradiation can alone produce when a small disc passes behind a large one of equal brightness, we perceive that there could not be at any moment such an appearance as Mr. Todd observed—namely, a small disc seen within the outline of a large one.

It appears to me that it is wiser to accept observations such as Mr. Todd's and other observations even more remarkable which have been made by experienced observers, and to endeavour to find an explanation for them, than either to reject them utterly, as some do, or to attempt to explain them as mere illusions. It is only because the conclusions to which such observations seem to point appear surprising, and involve conceptions of the solar system differing widely from those commonly adopted, that objection is raised against these observations. Jupiter and Saturn must be utterly unlike our earth if the changes of shape and other amazing phenomena which have been noted by observers have really taken place. But all the evidence we have tends to show that these giant planets are utterly unlike our earth. Thus we know that, despite their enormous volume, these planets are of much less density than the earth—Jupiter's density being only a fourth of hers, Saturn's only a seventh. Despite their enormous distance from the earth, they appear to be enwrapped in tremendously deep envelopes, such as the sun's small heat could never have raised. The appearance of the cloud-belts in these mighty atmospheres favor the belief that the vapors forming the clouds have been thrown up from enormous depths. And—to mention no other form of direct evidence at present—it appears from the observed movements of the moons of Jupiter that the central part of the planet must be of very much greater density than the outer part. I myself attach great weight to the indirect evidence derived from the theory of the development of our solar system; for certainly, according to that theory, in any form which can be reasonably adopted, Jupiter must be much younger in development (though probably much older in years) than our own earth. He must be in the condition which our earth was in many hundreds of millions of years ago. If so, we can well understand that with his nuclear regions in a state of intense heat, the exterior and cooler regions which we can alone see should present from time to time some otherwise inexplicable phenomena as have been described above. I do not know of any valid reason for believing that Jupiter and Saturn resemble the earth in condition, though differing from her so immensely in volume and mass. Yet I know of no other reason for rejecting the strange observations of Jupiter which have been made by many astronomers, except the existence of the foregone conclusion in the minds of some students of astronomy, that all the planets have been made to one pattern—our earth being the model. The conclusion is as little likely to be correct as the old-fashioned notion that all the planets were made for one purpose—viz., for the convenience and profit of our little world.

Scientific.

ANOTHER NEW METAL.

The services the spectroscope is capable of rendering to science become more and more evident daily, the latest proof of the fact being the discovery of a new metal called scandium. In some of the mines in Sweden and Norway small quantities of earthy minerals are found, called gadolinite and euxenite, composed of oxides of very rare metals. The bulk of the substance is of a rose-color, arising from the presence of erbium, and is called urbine. At first it was supposed to be simply mixed with some earthy substances which rendered it impure, but not long ago M. Marignac discovered the presence of another metallic substance, which he called ytterbine, the oxide of ytterbium. However, great uncertainty existed as to the composition of these bodies, and M. Nilson undertook a series of experiments on the subject. M. Berthelot, at the late meeting of the Academy of Sciences, gave an account of what had been done so far, the result being the discovery of a new metal to which M. Nilson has given the name of scandium, to indicate that it is of Scandinavian origin. Erbine is, as before mentioned, of a brilliant rose-color, while ytterbine is white. But the separation of the two substances can only be effected with extreme difficulty. The earth has to be dissolved in boiling nitric acid, and the ytterbine then precipitated by sulphuric acid; and M. Nilson found that the operation repeated more than 20 times did not completely separate the two bodies. When he had obtained a comparatively pure ytterbine he commenced an examination of it, and then he found that it gave absorption bands in the spectrum unknown to any substance previously examined. After repeated trials he became convinced that he was dealing with a metal never before suspected, and he continued his researches. He is unable to say at present what may be the chemical properties of the new body, as the quantity of material at his disposal was insufficient to allow him to isolate the metal. Nor can he decide as yet the place the new metal is to take among the older ones, but he considers that its properties differ materially from those of erbium and ytterbium, and that it should rank between tin and thorium, as the atomic weights of these two are 118 and 234, while he calculates that of scandium at from 160 to 180.—*Galignani's Messenger.*

The Nobility of Science.—And as to nobleness of character, how can one accuse science of striking at it when he sees the minds that science forms, the unselfishness, the absolute devotion to life work that she inspires and sustains? With the saints, the heroes, the great men of all ages we may fearlessly compare our men of scientific minds, given solely to the research of truth, indifferent to fortune, often proud of their poverty, smiling at the honors they are offered, as careless of flattery as of obloquy, sure of the worth of that they are doing, and happy because they possess truth. Great, I grant it, are the joys which a firm belief in things divine confers, but these the inward happiness of the wise equals, for he feels that he toils at an eternal work and belongs to the company of those of whom it is said, "Their works do follow them."—*Renan's Inaugural Address.*

OATMEAL AND MILK DIET.

Why are the Scotch people, who drink a great deal of whisky, the best developed, physically, of any of the English race? According to Dr. Edward Smith, who carefully investigated this subject, their fine bodies are in great part the result of their diet of oatmeal and milk. The Scotch women and children do less factory work, and live more out of doors.

When the writer was in Edinburgh, the celebrated Dr. Guthrie called his attention to the size of Scotch people, and to the fact that the average size of their heads was greater than that of any other nation in the world, not excepting even the English; and when asked how he accounted for this, he replied that he thought it was owing largely to their universal devotion to oatmeal.

Indeed the writer observed that the national dish was found upon the table at almost every meal, in the house of the rich as well as the poor. In the morning came the mush, and in the evening the traditional cake, about the size of the crown of a hat, and a little harder than a sun-dried brick.

For further confirmation on this important question, let the writer add that he has found a great advantage to follow the daily use of (honest) brown bread and oatmeal in his family. A child whose first teeth came through in a starved condition, so that they began to decay at once and cause much suffering, is now blessed with as fine a set of second cutters, as any one could ask, while the general health of all has improved. In fact, we all vote that we must daily have our brown bread and its twin-sister dish of oatmeal.—*Dr. Holbrook.*

THE CAUSE OF CONSUMPTION.

Dr. Rollin R. Gregg, of Buffalo, New York, is confident that he has solved the mystery of consumption. Regular physicians will be apt to say that he has mistaken a condition for a cause; nevertheless we are inclined to think that good may come from the emphasis he lays upon that condition, since it seems calculated to work a beneficial change in the customary treatment of the disease.

Dr. Gregg argues that as the loss of albumen from the blood through the mucous membrane of the kidneys in Bright's disease, rapidly and fatally depletes the system, much more must the more rapid loss of albumen through the mucous membranes of the lungs be serious in all stages and speedily fatal in its results, if proper measures are not taken to stop such waste before fatal conditions have arisen. The expectorations of consumptives, and all their other catarrhal or mucous discharges from whatever organ, are mostly albumen and a direct loss of so much of this constituent from the blood. It is this wastage which causes the great emaciation characteristic of consumption, and not, he thinks, any failure of the system to assimilate food. And this loss of albumen does mischief not only in robbing the muscles of their proper nutrition, but also in throwing the constituents of the blood into disproportion. The loss of one ounce of albumen destroys nearly a pound of blood for all purposes of healthy nutrition, and leaves in the blood a relative excess of 5½ ounces of water, 7 ounces of blood corpuscles, 9 grains of fatty matter, 15 grains of fibrin, and 41 grains of salts. These elements in excess act the same as foreign matters in the blood, and disturb the entire economy of the system. Night sweats and dropsy are the result of the excess of water. The blood corpuscles left in excess are decolorized by the too watery blood, and are deposited in the capillaries or smallest blood vessels, where they shrivel and become tuberculous corpuscles, so called; the fatty matters in excess cause the fatty livers and other fatty degeneration attending the disease; the excess of fibrin causes the adhesion of the pleura to the inner surface of the ribs, the heart, or to each other, often among the most serious of the complications of consumption; and, finally, the excess of salts causes calculi, enlargement of the joints, ossifications, and similar morbid developments.

In such cases of consumption as are characterized in their earlier stages by an absence of profuse expectoration, Dr. Gregg would attribute the beginning of the disease to a loss of albumen through some other organ or organs, the shriveled blood corpuscles lodging in the lungs, starting tubercules there and setting up a dry cough, with the resultant irritation of the mucous membrance and outpouring of mucus. From this point of view, there is but one source of hope to the consumptive in any stage of the disease, and that is through the healing of the mucous membranes and the stopping of the waste of albumen. By this means, in the earlier stages of the disease—with all who have not inherited the most feeble constitutions—there is much to hope from judicious treatment.

Whatever may be the primary cause of consumption, it is pretty evident that the mucous discharge which attends the disease and finds relief in expectoration is to be repressed rather than encouraged; and to do this must radically change the usual treatment of the disease, at least in its early stages.

DISEASE GERMS IN DIPHTHERIA.

The recent application of the microscope to medical inquiries has developed the important fact that many diseases are occasioned by malign attacks upon the vital domain by germs of various kinds. It is well known that typhoid fever, yellow fever, malarial fevers, and most other febrile diseases, are occasioned by the introduction of germs into the system; but it has not, in many cases, been the good fortune of physicians to discover the exact character of these microscopic enemies of human life. In the case of diphtheria, many most eminent physicians and scientists are satisfied that the mischievous germ has been discovered, after a long and painstaking search.

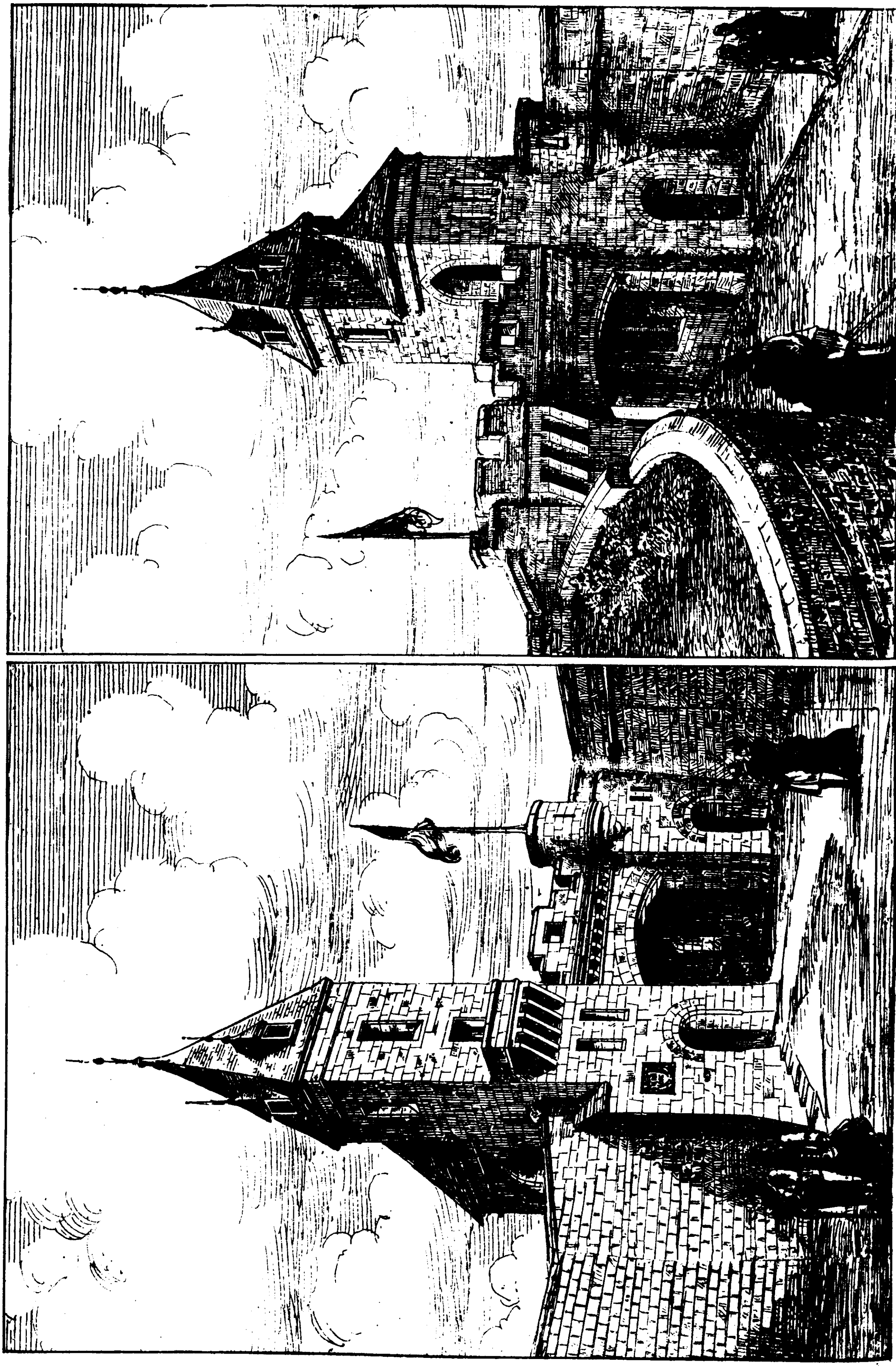
The germ causes of diphtheria are very minute organisms, being too small to be seen except by the aid of a very good microscope. They are so small that a row of them an inch long would contain from 10,000 to 20,000. Singly they are too insignificant to deserve attention, except as microscopical curiosities; but when massed together in the countless numbers in which they infest the mucous membrane in this disease, they acquire an importance which is often terribly great to the victim of their ravages. There are two varieties of these parasites, known respectively as *micrococcus* and *bacterium termo*; the names are certainly no more formidable than the creatures themselves, small though they are. The two organisms are always associated, and can be very easily studied with the aid of a good microscope, by anyone at all familiar with the use of the instrument, by examination of the false membrane, freshly taken from a patient.

We have just taken a small piece of diphtheritic membrane from the throat of a patient suffering with the disease, and placing it under the microscope, with a little mucous from the same source, the germs referred to are distinctly visible in great number, all actively swimming about, making the whole microscopic field alive with motion. Just so they existed in the throat of the patient a few moments ago, vigorously at work insinuating themselves into the mucous membrane, prying their way in between the cells, even getting into their interior and depriving them of the power to perform their functions, clogging the blood vessels, causing irritation of the membrane, and, as a consequence, the pouring out of fibrous matter which forms false membrane.—*J. H. Kellogg, M.D.*

The Lesson of a Sneeze.—As a rule, a sneeze is the warning nature gives that some part of the body is exposed to a cooler temperature than the other parts, that the sneezer is "catching cold." Next to the warning, what is the use of a sneeze? It throws open the pores of the whole body, and induces a gentle perspiration; in a word, it throws out the cold. A child rarely sneezes more than twice. Perspiration is readily induced in a youth; an old man, on the contrary, sneezes half a dozen to a dozen times with a loud "catchogue." It is harder to set him perspiring. When one is sitting by an open window, and finds himself sneezing, nature tells him he is taking cold. He should get up instantly, walk about, and take a full tumbler of cold water to keep up gentle perspiration that the sneeze set in motion. If he does this, he will not be telling an hour after, that he has a "cold in his head," or chest, or lungs.—*Eastern Gazette.*

For Utilizing Old and Waste Rubber.—Messrs. Danckwerth and Kohler have recently patented the following procedure in Germany. The rubber waste is subjected to dry distillation in an iron vessel over a free fire, with the aid of superheated steam. The product, when thickened and vulcanized in the usual manner, is declared to possess all the good qualities of first-class natural rubber. It is recommended that the lighter oils that come over should be separated from the heavier products.

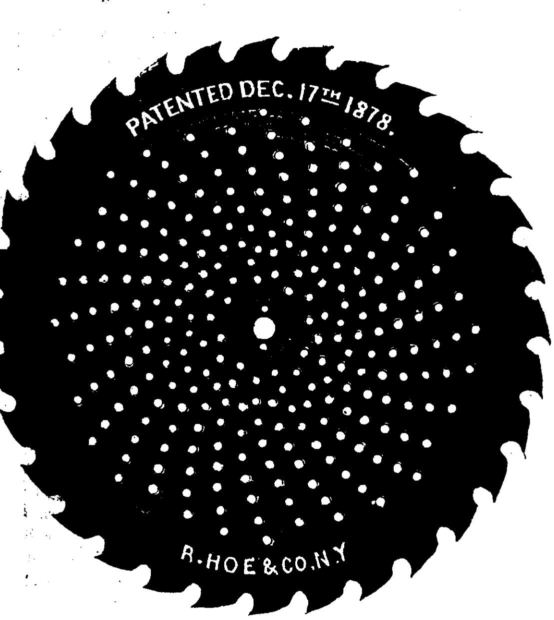
To Tin Zinc.—Make a bath of distilled water, 1 gallon; pyrophosphate of soda, 3½ ounces; and fused protochloride of tin, ½ ounce. A thin coat of tin can be obtained by simply dipping the zinc in the bath, and one of any thickness by the aid of the battery.



FRONT VIEW.

BACK VIEW.

THE KENT GATE, QUEBEC.



AN IMPROVEMENT IN CIRCULAR SAWS.

Our lumbermen and wood-workers will be interested in the improvement in circular saws shown in the engraving on this page. The improvement is a simple one, and yet those who have tried it assure us that its working is most gratifying and effective. It is styled the ventilated or perforated saw, and is one of the many useful inventions of R. H. Hoe & Co. Its style of manufacture has an influence both upon the quality of the saw itself and upon its working, as may be learned from the following review of the results obtained by perforating the blade in the manner shown in the engraving:

The manufacturers of circular saws tell us that all large circular saw plates warp badly in the process of hardening, varying from one to four or five inches from true. The tendency is to dish, because the periphery of the plate cools fastest, and has the same result as shrinking a tire on a wagon wheel. To obviate this difficulty the body of the plate is thickly perforated with circular holes. These allow of the contact of the cold oil and the escape of the gas generated by it and the hot steel, as freely throughout the body of the plate as at the periphery. The whole plate will therefore shrink equally, and remain straight through the entire process of manufacture. Plates frequently break while hardening, and many are broken while being drawn under the hammer, to counteract the buckle produced by hardening. A good working saw cannot be made from a plate that has been badly cast in hardening. The unequal strain of the metal caused by hammering for the purpose of trueing a badly warped plate, is the principal cause of a saw's breaking while in use, or making a bad cut. The small circular holes, instead of weakening the plate (as unprofessionals would suppose), add materially to its strength, and lessen its liability to break while working.

In the working of the saw it is found that all the chip that escapes from the throats of the teeth and is driven between the saw and timber, will fall into the holes and be carried out of the cut, thus relieving the plate from all friction and consequent heating. Furthermore, each beveled hole will act as a fan, causing a rapid current of air to flow through the body of the saw —air in motion absorbs heat rapidly—and will thus prevent the saw from heating. This method of ventilating large circulars is applicable to solid as well as chisel bit saws, and we shall be able to run much thinner saws than those not so perforated.

It will be remembered that the chisel tooth circular saws are also the invention of R. H. Hoe & Co. They have given wide satisfaction according to all accounts that we have seen. These were introduced on this coast by Tatum & Bowen, No. 3 Fremont street, S. F., and the same firm is now introducing the perforated saw which we have described. The perforated saw has been used in the Puget Sound lumber district and the report is that its operation is most satisfactory.

KENT GATE, QUEBEC.

The ceremony of laying the foundation stone of Kent Gate took place at noon in presence of the Mayor and Corporation and many leading citizens. The Vice-Regal party comprised His Excellency and Her Royal Highness, Major De Winton, Hon. Mr. Moreton and Miss Moreton, and Hon. Capt. Harbord, A.D.C. His Excellency wore the star of the Order of St. Michael and St. George. The Princess was attired in a plain black dress and silk jacket, trimmed with crape. The proceedings commenced by the city engineer reading the inscription plate and enumerating the documents and articles deposited in a leaden box which was placed in the stone. Her Royal Highness contributed some English shillings, having finely-cut profiles of Her Majesty, to the collection of coins. The Princess was then presented with an ebony-handled silver trowel, with the following engraved thereon, beneath a representation of the gate :—

Foundation Stone, Kent Gate, Quebec,
Laid by Her Royal Highness Princess Louise,
11th June, 1879.
R. Chambers, Esq., Mayor.
C. Baillargé, Chevalier, City Engineer.

On the reverse side were the letters "L. L." and an embossed likeness of the Princess Louise, intertwined in a wreath of maple leaves, the whole of exquisite workmanship. Her Royal Highness then proceeded to perform the ceremony, and covered the stone with mortar in excellent style, concluding that operation by saying in very audible and distinct words, "I declare this stone well and truly laid, and henceforth it will be called the Kent Gate, and the upper gate is to retain its old name, St. Louis Gate," a little speech which seemed to delight the multitude of on-lookers, who spontaneously rent the air with three cheers for "Her Royal Highness." His Worship the Mayor then thanked Her Royal Highness for having performed a ceremony of such interest to the loyal citizens of the Ancient Capital, and so interwoven with pleasant historical recollections of her illustrious ancestor, the Duke of Kent, whose memory was revered by the people of this country. His Excellency concluded the ceremony by congratulating the citizens of Quebec upon the laying of the first stone of the Kent Gate, one of a series of gates which would give worthy entrances to their ancient and beautiful city.

HIGH SPEEDS AT SEA.

The extraordinary speeds attained by those remarkable examples of the skill of the 19th century shipbuilder which the last two or three years have brought into prominent notice, cannot fail to exercise some effect upon the construction of our merchant steamers. The builders of our modern Atlantic liners have succeeded in astonishing their fathers, but we do not depreciate their skill and the results they have obtained when we say that the travelling and commercial world will not remain satisfied with even 16 knots an hour in fine and fair weather, and 13 knots throughout the passage in spite of wind and storm. To those who know or can apprehend what the fury of an Atlantic storm really means, we need scarcely say that the construction of a vessel which shall safely traverse 3,000 miles in all weathers with a punctuality that puts to shame some of our railway lines, is no mean achievement; and if we hint that still better results may be and ought to be attained, it must be understood that we merely think that where so much has been done more can be accomplished. Trial after trial of the new style of torpedo launch has been made within recent years, and each time a higher speed has been attained, and recently the highest rate of travelling through the water yet known was shown in the trial of Messrs. Yarrow & Co.'s new torpedo-boat. Three pairs of runs were made in Long Reach, with and against tide, and in the last pair—the best, because the engines had been put on their best behaviour—the mean speed was very nearly 22¼ knots per hour. That rate, by the Admiralty scale, represents the extraordinary speed of more than 25½ miles per hour. Such a speed is, we need scarcely say, the highest yet attained by anything afloat, but it is noticeable also from the fact that although, when running at rates varying from 17 to 19 knots, the vibration was so considerable as to be unpleasant, the shaking disappeared entirely when 20 knots was attained. At the highest speeds, in fact, the vibration was so completely reduced that it was possible to write legibly on a portion of the vessel immediately over the propeller. We do not pretend to offer any explanation of this phenomenon; it is sufficient that it is a fact, the elucidation of which may probably lead to a revolution in our methods of ship-building, and of applying the propeller. Such a fact, taken with the results of the trials of the *Iris*, serves to show that we have yet something to learn, and we allude to it now because it helps to prove that it is unwise to accept hypotheses which, if they can be accepted as true, would justify the Admiralty in refusing to make experiments to test new inventions which might be condemned as impracticable. For the last six years the Rev. C. M. Ramus, Rector of East Guildeford and Playden, has held his invention of the Polysphenic ship at the disposal of the Admiralty, and that body, acting on the report of Mr. Froude, has declined to make even an experiment, although there is much reason to think that Mr. Ramus is right and Mr. Froude wrong. We mentioned the invention of the rocket-float at the time when it was first introduced to public notice; but since that Mr. Ramus has developed the idea and evolved the polysphenic ship, a vessel which it is calculated will skim the seas at the rate of 40 miles an hour or more. The word "skim" discloses the secret of the idea, for the invention is mainly based on the fact that if a vessel can be made by the mere force with which it moves to ride over the waves instead of driving through them, there is *primâ facie* reason to believe that a much higher speed than anything with which we are acquainted will be achieved. The principle of Mr. Ramus's invention consists in making the bottom of the vessel a series of inclined planes, and his experiments tend to show that Mr. Froude's hypothesis as to the viscosity of water has little or no basis in fact, so far as a ship is concerned. In 1872 Mr. Ramus made a model having its bottom composed of two parallel and consecutive inclined planes; or the vessel may be described as made up of two wedges, the thick ends of which are placed abaft the thin ends. There is thus in the centre of the vessel a ridge where the thin end of the sternmost wedge abuts against the thick end of the foremost. It will be readily understood that any floating body thus shaped must, when driven forcibly through the water, tend to rise, and if the speed is high enough it will rise on the surface instead of driving through the water. These facts were demonstrated by some rough experiments made in the presence of credible witnesses; but it will suffice for our purpose if we give the details of one or two of the trials. The smaller model, with a 6oz. rocket attached, weighed 3 lbs. 3 ozs., and ran a distance of 105 yards in three seconds, being stopped by a bank before the propelling power of the rocket was fully expended. The line of the propelling force was inclined downwards, in the direction of the model's course, about two degrees from the horizontal. There might thus be a slight tendency to force the stern end down and consequently to lift the stem; but we are inclined to think that in practice the effect would be found to be very slight. In another experiment the small model was driven 480 feet in 4½ seconds, the water being much rippled by a strong breeze; but in spite of that the deck was found to be unwetted. The measurements of this model may be of interest. It was 29½ inches long and 4¾ inches broad, of solid fir. The inclines had a slope of 1 in 16, and the draught was ⅜in. of water. Weight, without rocket, 2½ lbs. Such a model drawn slowly over the water offers a greater resistance than a model of the ordinary shape; but when high rates of speed are imparted it travels safely where the ordinary forms would topple over—it slides on the surface instead of offering increased resistance. It will be seen that if the downward pressure of a vessel's weight is insufficient to remove a quantity of water equal to the vessel's displacement within the time allowed for passing over, the vessel must be borne upon the top of the water, just as cannon balls flying with high velocities and striking the water at low angles, ricochet and pursue their flight without burying themselves in a fluid which, under ordinary circumstances, offers no resistance to their entrance. In the rocket-float we have, then, a destructive weapon of war, which can possibly be made of more utility than torpedo-boats or those automatic torpedoes which are distrusted by those who may be called upon to employ them. But the principle underlying the rocket-float may be taken advantage of to construct polysphenic ships, for it has been demonstrated that the resistance to such vessels, which at first increases about as the square of their velocity, decreases as the speed is augmented, until after a certain period there is no further increase of resistance. Given the required machinery for propelling the polysphenic ship, there seems every probability that speeds of 40 miles an hour or more can be attained.

Objections have been urged against the polysphenic ship, but they do not appear to be of serious moment, and are easily met by Mr. Ramus. For instance, it has been urged that though it might act well enough on smooth water, it would fail to lift and pass safely over a chopping sea, or the long and large waves of the Atlantic. A consideration of the shape of the vessel will, however, tend to modify this opinion, and the inventor states hat the effect of rough water upon the polysphenic ship is nothing more than retardation; but if the waves are not of unusual size they actually favour the passage of the vessel. Rough water, of course, does something to retard the passage of all ships, but if they are so formed as to ride on the surface rather than to cut through the water, and the latter is obviously accomplished only at an enormous expenditure of force, the polysphenic ship must attain the higher speed. Such experiments as have been made serve to show that the polysphenic ship would, in a sea only moderately agitated, have its speed increased, while in a very rough one it would experience only that retardation which is common to vessels of the usual shape. It has been also urged that the new form of vessel would be liable to capsize, for being borne, when at high speed, upon the surface of the water, it is deprived of the support which a partially submerged vessel receives. Mr. Ramus, however, points out that nothing can well be further from probability, because from the very form of the vessel the side which becomes most submerged is the side which is most forcibly lifted. The polysphenic ship is, in fact, self-righting. A model was weighted so that one side was depressed, and in this state it was drawn swiftly over the water, with the result that it attained and preserved a perfectly level deck. Whatever doubts may, however, be expressed as to the feasibility of making a polysphenic ship capable of traversing the Atlantic at high speeds, there can be little doubt that Mr. Ramus has made good his case as regards the rocket-floats, for there is no difficulty in providing the propelling power required by the latter. It appears, then, that while the Admiralty should experiment with the invention as a torpedo, the great steamship companies might well devote some of their attention to the possibility of constructing steamers which, while safe and comfortable, would traverse the seas at much higher speeds than any yet attained.—*English Mechanic.*

Scientific Items.

SUBMARINE TELEPHONY.—Mr. Raymond, an engineer in New York, recently read a paper before the Society of Engineers in New York, in which he described some improvements he had made in using telephones in diving operations. The arrangements first employed consisted of two Phelps telephones, which, being oval and flat, are convenient for this purpose. One of these was fastened in the diver's helmet, in such a position that by simply turning his head the diver could place his mouth or his ear to the instrument. The other was placed on the scow which carried the assistants and the air-pump; and the two were connected by means of insulated wires inside the air-hose. This was found to work very well, so far as communication from the diver to his helper was concerned; but there was difficulty in sending messages the other way, since the bubbling of the air as it escaped from the helmet into the water interfered with the divers' hearing of the telephone. This difficulty was overcome by the use of Edison's "carbon-transmitter," which rendered the sound so much more audible that conversation could be carried on with the utmost facility. It was found that the diver could talk in the helmet without putting his mouth to the instrument, and be heard plainly, so that work and conversation could go on at the same time. In the discussion upon Mr. Raymond's paper, it was asserted that the cost of the necessary outfit for telephonic communication of this sort would be about one hundred dollars, and that, on the other hand, the work of a diver with ordinary means of communication costs about three dollars per hour. The saving of time effected by this means of quick and full transmission of intelligence would evidently soon repay the original outlay.—*Electrician.*

THE WRITING TELEGRAPH.

On the evening of February 26, 1879, the writing telegraph of Mr. E. A. Cowper, of London, was exhibited in operation before the Society of Telegraph Engineers, in that city. It is a curious and remarkable invention. By its use the handwriting of the operator may be transmitted, but a double circuit, that is, two telegraph wires, are used. The operator moves with his hand an upright pointer or stylus, with which he writes the message on paper. The stylus has two arms connected with it, one of which arms, when the stylus makes an upward movement, causes a current to be sent over one wire, while the other arm causes a current to pass over the other wire when the stylus is moved laterally. These two motions are, at the receiving end of the line, made to operate on the needles of galvanometers, and the latter are by silk threads combined or connected with a delicately suspended ink tube, from which a minute stream of ink falls upon the strip of paper below it; the arrangement being such that the combined motions of the galvanometers so move the ink pen as to make it correspond to the motion of the stylus at the sending end. The apparatus is said to work very well, and it is expected that it will form a useful adjunct to the art of telegraphy. We present herewith a facsimile of writing done by this new instrument, which has been worked with success over a line of forty miles' length. It is hardly probable that it can compete in rapidity with some of the telegraph instruments now in use; but for many purposes it is likely to become important, while in point of ingenuity it is certainly a great achievement, and the author is deserving of the highest credit.—See page 217.

Imperishable Water-Colors.—A new and important discovery is asserted to have been made by M. Mery, a Frenchman, which, if it prove to be true, will be valuable to the painting arts and trades. He has been experimenting a great many years, and he claims now to have hit upon the means of making and applying imperishable water-colors. He does not explain what he uses as a vehicle for his pigments, but it is something which, while it will mix with water, is not soluble in it. Whatever it is, it renders the colors unalterable, and, as it becomes after a time as hard as cement or stone, they may be said to be indestructible. It can be applied to any surface suitable for ordinary oil or water painting, such as wood, paper, glass, stone, canvas, etc., and can be prepared so as to dry in a few minutes or remain moist for an indefinite length of time. It is suggested that possibly M. Mery has re-discovered the long lost art of encaustic painting, which is supposed to have been applied and fixed by means of heat. It seems almost incredible that a paint can be applied by means of water, and yet not be affected by it afterward, but our authority is excellent for saying that such is really the case.—*Exchange.*

Communications with Lighthouses.—A new description of rocket, called the "buoyant rocket," has been produced by the Royal Laboratory Department, at the request of the Board of Trade. A rocket was required as a means of communication between the shore and lighthouses a few hundred yards from the main land during bad weather, and in circumstances under which the ordinary life-saving rock apparatus by which a line is conveyed to a wrecked vessel would be unavailable. The Laboratory have answered the demand by adapting the old-fashioned Congreve rocket to meet the required end. A small iron tube containing the composition is enclosed in a casing of cork, and fitted to a stick in primitive fashion, with a line made fast to the extremity, and the simple arrangement has admirably succeeded. Three of the rockets have been tried at Shoeburyness, being fired from a trough at the surface of the sea, and ploughing a direct course through the water with a strong line attached, by means of which an assistant or a boatload of provisions could be conveyed to the lighthouse keeper.

Red Fire.—There are certain recipes which, though often published, are still continually called for; and among these is "red fire," so much used in fireworks, amateur theatricals, and the like. The following is commended as both safe and cheap: Take by weight one part of shellac and four of well-dried nitrate of strontia; mix thoroughly in an unpowdered condition; heat in a tin dish to the melting point of the shellac; after cooling, the semi-fused mass is to be pulverized. This is not expensive, is safe, without tendency to explode, and burns quietly, slowly, even when strewed on damp ground, and produces a very good effect. The mixture for red fire is usually composed of nitrate of strontia, chlorate of potash and sulphur; this frequently takes fire spontaneously, especially when flowers of sulphur and imperfectly dried nitrate of strontia are employed.—*Boston Journal of Chemistry.*

Brine as a Preservative.—At a recent meeting of the Geneva Society of Physics and Natural History, Prof. Alph. de Candolle presented a glass jar containing fruits of the coffee plant collected before maturity in Mexico, preserved in a liquid which chemical analysis proved to be salt water. It is fifty years since the jar thus filled was hermetically sealed, under the eye of Aug.-Pyr. de Candolle, and to-day the coffee-beans which it contains are in a thoroughly satisfactory state of preservation. The water contains a solution of chloride of sodium and very small quantities of other chlorides or salts. No gas was found in solution; the water must then have been boiled, and introduced while hot into the jar. This experiment may give valuable hints as to the substitution of salt water for alcohol (of which every one knows the inconvenience) for the preservation of organic substances.
—*Nature.*

Indelible Ink for Zinc Labels.—A correspondent of the London *Garden* says: "Many years ago a friend gave me a simple recipe for ink for writing on zinc, which I have constantly used since. It is 12 to 16 grains bichloride of platinum dissolved in one ounce distilled water. If kept corked a small bottle will last many years. The zinc labels must of course be cleaned before using. This is readily done by rubbing, either with fine emery paper or with very dilute oil of vitriol. Then simply write the name and allow the ink to dry. I have used labels of this description for years, and have never lost a name since adopting them. They have been found equally suitable for the house or the open air."

Chloride of Lime as an Insecticide.—*Le Cultivateur* remarks that rats, mice and insects will at once desert ground on which a little chloride of lime has been sprinkled. Plants may be protected from insect plagues by brushing their stems with a solution of it. It has often been noticed that a patch of land which has been treated in this way remains religiously respected by grubs, while the unprotected beds round about are literally devastated. Fruit trees may be guarded from the attacks of grubs by attaching to their trunks pieces of tow smeared with a mixture of chloride of lime and hog's lard, and ants and grubs already in possession will rapidly vacate their position.

Another Cure for Hydrophobia.—A German gamekeeper (W. Gassel), 82 years of age, states in the *Leipziger Zeitung*: "I do not wish to bury with me my much-approved remedy against the bite of mad-dogs, but will make it publicly known; that is the last service I can render to the world. Take some warm wine vinegar and lukewarm water, wash the wound thoroughly, and dry it. Then pour a few drops of muriatic acid on the wound, because mineral acids destroy the poison of the saliva."—*Journal of Chemistry.*

A Good Glass Cement.—Mix 10½ pounds of pulverized stone and glass with 4⅔ pounds of sulphur. Subject the mixture to such a moderate degree of heat that the sulphur melts. Stir until the whole becomes homogeneous, and then run it into molds. When required for use it is to be heated to 248°, at which temperature it melts, and may be employed in the usual manner. It resists the action of acids, never changes in the air, and is not affected in boiling water. At 230° it is as hard as stone.

Solubility of Phosphorus in Acetic Acid.—G. Vulpius reports that, digesting phosphorus for some time in concentrated acetic acid at a moderate heat, about 1-100th of the weight of the latter is dissolved and kept in solution on cooling. If only a few drops of water are added, however, the solution becomes milky from deposited phosphorus, and when the addition reaches the volume of the solution used, no phosphorus at all will be retained in solution.—*Archiv de Phar.*

How to Bronze Plaster Statues.—In bronzing plaster statues the powder is dusted over the statue while it is yet sticky from a coating of turpentine varnish. The best way is first to give a few coats of alcoholic shellac varnish, and then the coating of turpentine varnish, as otherwise the latter is too quickly absorbed. Let it stand till half dry and sticky and then dust over any color of bronze-powder to suit the case.

Science in Nature.—"Everything," says Hugh Miller, "is writing nature's history, from pebble to planet. The scratches of the rolling rock, the channels of the rivers, the falling rain, the buried fern, the footprint in the snow, and every act of man, inscribes the map of her march. The air is full of sounds, the sky is full of memoranda and signatures which are more or less legible to every intelligent human being."

M. Camille Flammarion, of Paris, has recently published a number of articles to prove that the moon is inhabited, and is now organizing a committee to collect the necessary funds to construct a refracting telescope of sufficient power to see them. He calculates the cost of the instrument at one million francs.

Discovery of a New Planet.—The following has been sent by the Astronomer Royal:—Professor Peters, of Clinton, New York, announces the discovery by himself of a minor planet of the tenth magnitude, in R.A. 12 hours 16 minutes, dec. 6 degrees 46 minutes north, with a slow motion south.

A NEW FOOT LATHE.

It is an important matter for an amateur or mechanic doing work with small tools to procure such implements as will be a source of profit, pleasure and satisfaction, instead of lasting regret that tools of another make were not purchased. Among such tools a lathe is an important item, and once purchased is not likely to be soon exchanged. A lathe which appears to fulfil all reasonable requirements is shown in the accompanying engravings. The chief novelty of this lathe is its cylindrical bed, which possesses many advantages which will be apparent to our readers. The bed is 36 inches long, and the head, tail, and tool stocks are bored to fit it.

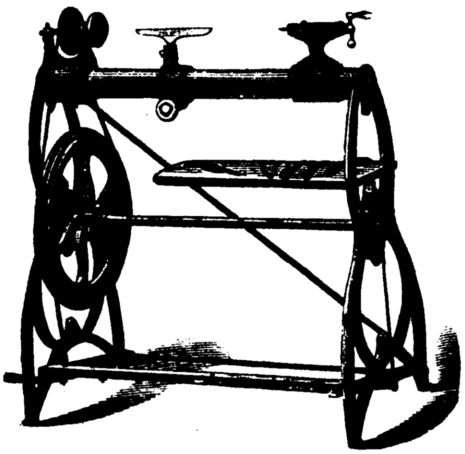


Fig. 1.

The head stock is fastened permanently with a set screw. The tail stock traverses the whole length of the bed, and is kept in line with front center by a groove in the bed, and is readily fastened at any point by turning a hand screw, which is on the back side of lathe and not shown in cut. The tool stock also encircles the bed, moves back and forth readily, and rocks to and from the work. It is sawed open on the bottom, and provided with a screw, which is sufficient to hold it at any point by a single turn of the hand. It has a steel mandrel, two steel centers, two T rests, and a tool shelf.

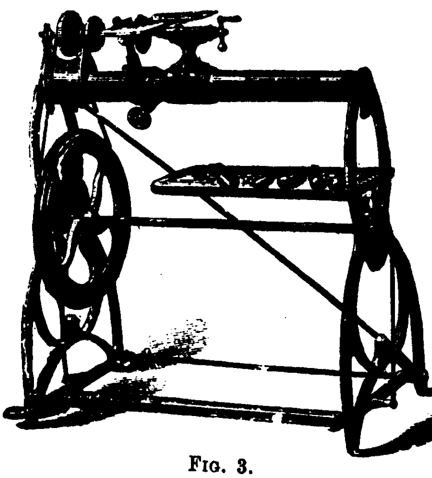


Fig. 3.

It has a brass box in front journal, and true bored iron bearings throughout. It has a three cone grooved pulley, turned up true, and polished. The balance wheel is turned and grooved to correspond with cone pulley, and is weighted to counterbalance the treadle. The crank shaft runs the whole length of lathe, resting in Babbitted journals, and has a crank on each end, thus avoiding any unequal strain upon the frame, and securing steadiness. It runs lightly and freely, with high speed.

This lathe has three useful attachments: a circular saw attachment, a bracket moulding device, and a scroll saw. The circular saw attachment, shown in Fig. 2, is easily applied, and the table, which is a light iron one, dressed up true, is supported by a standard set in the tool stock, and admits of being rocked and tipped so as to saw any bevel desired. It has two light running metal gauges for slitting and cutting off.

The scroll saw attachment (Fig. 3) is very simple, and useful for sawing all kinds of scroll and fret work. It is readily attached or detached without pulling the lathe in pieces. The driving

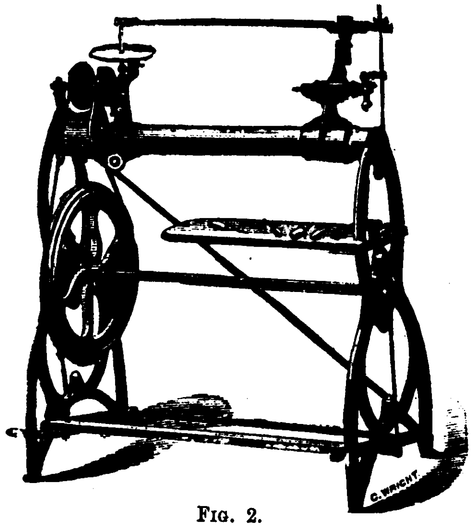


Fig. 2.

attachment of the saw has a perpendicular stroke, which is important in the perfect working scroll saw. The spring and tension are firmly attached to the tail stock without the removal of a bolt or screw. The table tilts 45° without losing its central position, and the swing around under the arm is 25 inches.

The attachment shown in Fig. 4, for moulding and ornamental brackets and other scroll work, adds, with very little expense, a very desirable feature to the foot lathe. The standard of the table is threaded, and is adjusted up and down by turning it around. The capacity of the cutter is such as to follow the scroll

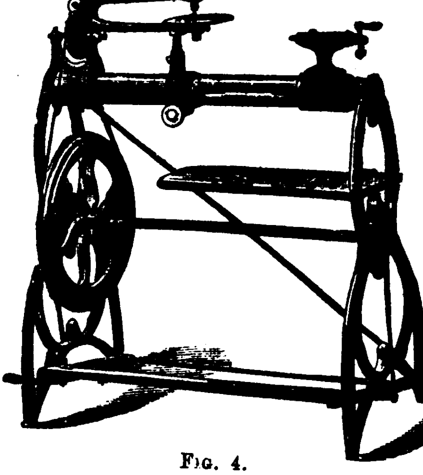
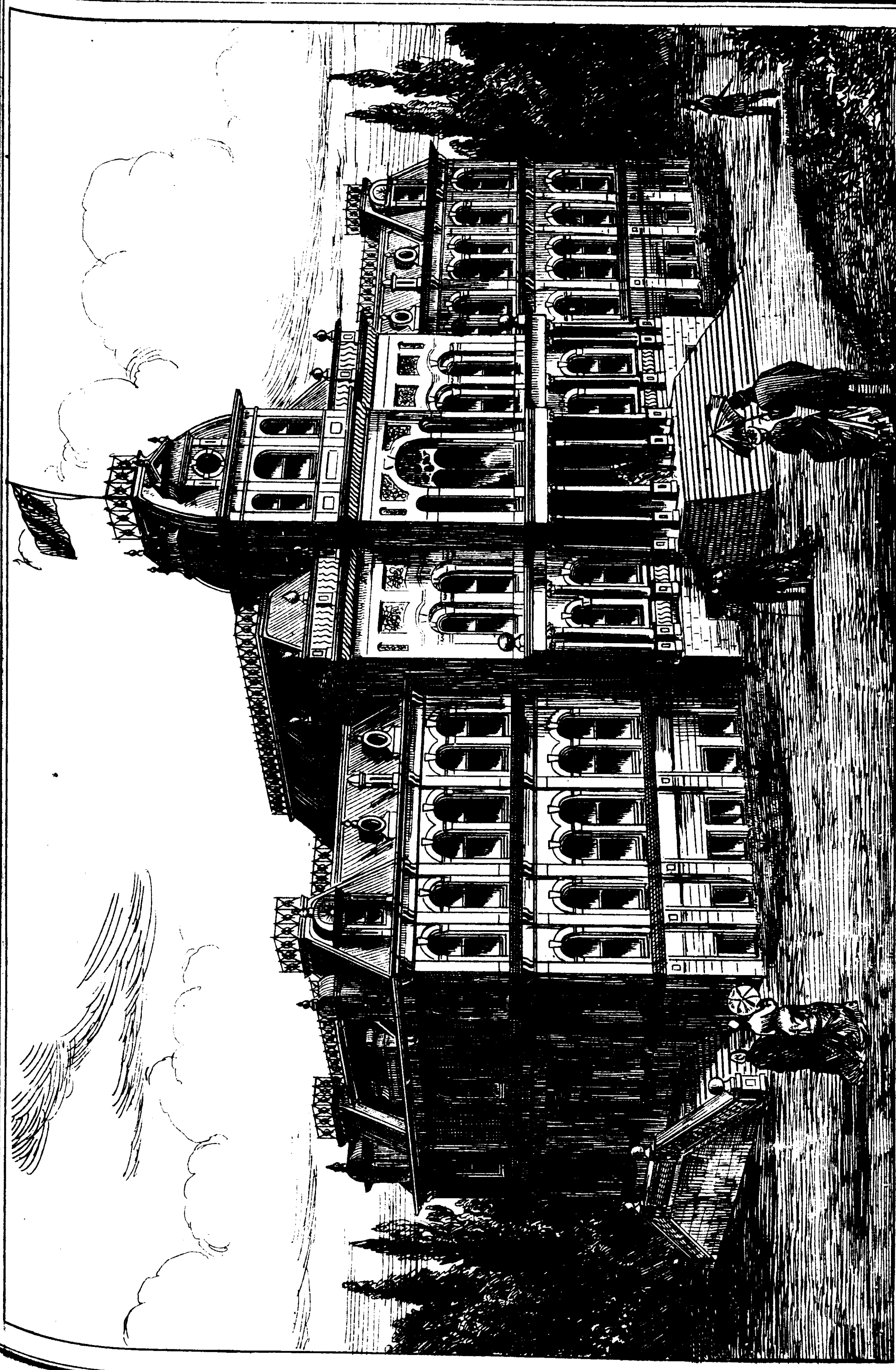


Fig. 4.

saw into very delicate points, and open and mould them so as to give the work a more open and light, as well as a more ornamental appearance. The cutters have double cutting edges, and cut as well when revolving one way as the other.—*Scientific American.*



NEW COURT HOUSE, HAMILTON.

Painter's Work.

Compo.—One pound of glue must be dissolved in one gallon of water. In another kettle boil together 2 lbs. of rosin, 1 gill of Venice turpentine, and 1 pint of linseed oil; mix together in one kettle, and boil and stir till the water has evaporated. Turn the whole into a tub of finely rolled whitening, and work it until it is of the consistency of dough.

Another Receipt.—Boil 7 lbs. of best glue in 7 half-pints of water. Melt 3 lbs. of white resin in 3 pints of raw linseed oil. When the above has been well boiled, put them into a large vessel and simmer them for half-an-hour, stirring the mixture and taking care that it does not boil over. The whole must then be turned into a box of whitening rolled and sifted, and mix till it is of the consistency of dough.

Gold Ink.—24 leaves gold, ½ oz. bronze gold, 30 drops spirits of wine, 30 grains honey, 4 drams gum arabic, 4 ozs. rain water. The gold must be rubbed with the gum and honey, and the whole mixed with water, and the spirit added.

Gold and silver inks used for illumination, are simply the metals powdered very fine, and mixed in weak gum water. Gold leaf ground with honey and mixed with thin gum, will be found to work well for illuminations.

Gilder's Ormolu.—Quarter pint spirits of wine, ½ oz. garnet shellac, 1 dram red saunders wood, ½ dram turmeric.

Brush Polish.—The following receipt must be used warm, and laid on with a brush. If the article to be polished be held to the fire before the application, a better polish will be the result. 2 ozs. shellac, 2 ozs. white resin, dissolved in one pint of spirits of wine will be found to answer well for carved work, or Oxford frames.

French Polish Reviver.—Half pint linseed oil, 1 oz. spirits of camphor, 2 ozs. vinegar, ½ oz. butter of antimony, ½ oz. spirits of hartshorn.

Another.—1 lb. naptha, 4 ozs. shellac, ½ oz. oxalic acid. Let it stand till dissolved, and add 3 ozs. linseed oil.

To Clean Marble.—Mix with ½ pint soap lees ½ gill turpentine, sufficient pipe clay and bullock's gall to make the whole into a rather thick paste. Apply it to the marble with a soft brush, and after a day or two, when quite dry, rub it off with a soft rag. Apply this a second or third time till the marble is quite clean.

Gold Varnish.—16 parts shellac, 3 parts gum sandrach, 3 parts mastic, 1 part crocus, 2 parts gum gamboge, and 144 parts alcohol.

Another.—8 parts gum seedlac, 8 parts sandrach, 8 parts mastic, 2 parts gamboge, 1 part dragon's blood, 6 parts white turpentine, 4 turmeric, and 120 alcohol.

Linseed Oil Varnish.—Take 8 lbs. linseed oil, and boil for one hour, then add 1 lb. best resin, previously powdered, and stir the mixture until the resin is perfectly dissolved. Now add ½ lb. turpentine, let the whole cool, and it is ready for use.

Black Varnish.—Dissolve in a glazed earthern vessel a small quantity of colophonium or boiled turpentine until it becomes black and friable, and gradually throw into the mixture three times as much amber finely pulverized, adding from time to time a little spirit or oil of turpentine. When the amber is dissolved besprinkle the mixture with the same quantity of sarcocolla gum, continually stirring the whole, and add spirits of wine until the composition becomes fluid; then strain it through a piece of hair cloth, pressing it between two boards. The varnish, when mixed with ivory black, should be applied in a warm place.

Colourless Varnish.—Dissolve 8 ozs. gum sandrach and 2 ozs. Venice turpentine in 30 ozs. alcohol by a gentle heat. To make a harder varnish of a reddish cast, dissolve 5 ozs. shellac and 1 oz. turpentine in 32 ozs. alcohol by a very gentle heat.

Cabinet Maker's Varnish.—Half oz. gum mastic, ½ oz. gum sandrach, 1½ ozs. gum shellac, and 20 ozs. spirits of wine. The two first should be dissolved in the spirits and afterward the shellac, and pour off the clear liquid for use.

Parisian Wood Varnish.—To prepare a good varnish for fancy woods, dissolve one part of good shellac in three to four parts of alcohol of 92 per cent. in a water-bath, and cautiously add distilled water until a curdy mass separates out, which is collected and pressed between linen; the liquor is filtered through paper, all the alcohol removed by distillation from the water-bath, and the resin removed and dried at 100 degrees Centigrade, until it ceases to lose weight. It is then dissolved in double its weight of alcohol, of at least 96 per cent., and the solution perfumed with lavender oil.

Impervious Varnish.—The Chinese apply to chests of tea, tobacco, sugar, coffee, &c., a varnish made of freshly-drawn blood, a little alum, and four parts of powdered slaked lime. One, two, or three coats of this mixture applied while viscid, renders the packages so impervious to moisture that zinc-foil, &c., becomes superfluous.

Varnishes.—In accordance with the nature of the solvent, varnishes are called spirit varnishes, turpentine or volatile oil varnishes, or fat oil varnishes. The first are those whose solvent is ether, chloroform, &c., rarely, but more commonly spirits of wine or wood spirit, dry off rapidly. These are very thin in coat when dry, and are best suited for paper, fans, or any very fine work, requiring perfect transparency in the varnishes. Volatile oil varnishes, in which the solvents are spirits of turpentine, or coal naptha, or the like, are those mostly employed by the oil painter. What is called "French varnishing," now so much employed upon the wood of furniture, &c., consists in the application of alternate films of lac varnish and of linseed oil, with constant and sufficient friction to polish the compound film of spirito-fat oil varnish, as soon as it has become thick enough to afford a glossy surface, the total thickness being exceedingly small. The method of varnishing employed by the carriage builder for his finest work is the very opposite of this. Over his last coat of paint he lays on coat after coat of copal or dammar varnish, until he has got a considerable thickness, often nearly one-tenth of an inch. When this to its full depth has got hard and perfectly vitreous in the warmth of the "varnishing room," the whole surface is literally ground off with pumice-stone and water until a perfect form, as to contour, and perfect superficies, have been procured, when the glossy face of the varnish is then polished by putty-powder, chamois skins, the hand, &c., just as a plate of looking-glass is polished.

Brushes for Varnishing.—Varnish brushes should be made of long white hairs, have a good spring, and be of the best quality. They should be worn flat, sharp, and thin at the point, as they will lay on the varnish so much more regularly. No oil brush should be put into the varnish; if so, they should be well washed first in turpentine, and well squeezed out. It is important to pay a little attention to brushes when not in use, and oil varnish brushes should be *suspended* in varnish of the same sort as used, care being taken that the varnish covers the hairs of the brush up to the binding or the tin. The advantage is that they are always clean, pliable, and straight. If brushes are kept in turpentine they become hard and harsh, and the turpentine left in the brush will cause the work to look cloudy or streaked.

A Spirit Varnish.—Take 1 gallon of alcohol, 1 lb. of gum sandarac, ½ lb. of gum mastic, 2 lbs. of best white resin, and 3 lbs. of gum benzoin; cut the gums cold. When they are thoroughly dissolved, strain the mixture through fine muslin, and bottle for use; keep the bottle tightly corked. This is a beautiful varnish for violins and other musical instruments of wood, and for fancy articles, such as those of inlaid work. It is also well adapted for panel-work, and all kinds of cabinet furniture. There is required only one flowing coat, and it produces a very fine, mirror-like surface. Apply this varnish with a flat camel's hair or sable brush. In an hour after application, the surface is perfectly dry.

French Polish Receipts.—1. 1 pint of naptha, 3½ oz. of orange shellac, and ½ oz. of aleme. Darken with red sanders wood.—2. To 1 pint of spirits of wine, add ½ oz. of gum shellac, ½ oz. of seed lac, and ½ oz. of gum sandarac; submit the whole to a gentle heat, frequently shaking it, till the various gums are dissolved, when it is fit for use.—3. Shellac 6 ozs., naptha 1 quart, sandarac 1 oz., and benzoin ¾ oz.—4. Shellac 3 ozs., gum mastic pulverized ½ oz., and methylated spirits of wine 1 pint added; let it stand till dissolved.—5. Shellac 12 ozs., gum elima 2 ozs., gum copal 3 ozs., and spirits of wine 1 gallon; dissolve.—6. The following must be well mixed and dissolved: Pale shellac 2¼ lbs., mastic 3 ozs., sandarac 3 ozs., and spirits of wine 1 gallon. After the above is dissolved, add 1 pint of copal varnish, 1¼ ozs. of shellac, ½ oz. of gum juniper, ½ oz. of benzoin, and ½ pint of methylated alcohol.—7. Gum mastic, seedlac, sandarac, shellac, and gum arabic, 1 oz. each; pulverize and add ¼ oz. of virgin wax. Dissolve in 1 quart of rectified spirits of wine.

Oak Varnish.—Pale clear resin 3½ lbs. and oil of turpentine 1 gallon dissolved. Lampblack hardened will darken the colour.

The following receipts for staining were communicated to the *Furniture Gazette* by a practical workman.

Ebonized Black for Ebonizing Moulding Frames, &c.—Take 1 gallon of strong vinegar, 2 lbs. of extract of logwood, ½ lb. of green copperas, ½ lb. of China blue, and 2 ozs. of nut-gall. Put these in an iron pot and boil them over a slow fire, till they are well dissolved. When cool the mixture is ready for use.

Add to the above ½ pint of iron rust, obtained by steeping iron filings in strong vinegar. The above makes a perfect jet-black, equal to the best black ebony, and the receipt is a valuable one.

A Cleansing and Renovating Polish.—Take of olive oil 1 lb., of rectified oil of amber 1 lb., spirits of turpentine 1 lb., oil of lavender 1 oz., and tincture of alkanet root ½ oz. Saturate a piece of cotton batting with this polish, apply it to the wood, then, with soft and dry cotton rags, rub well and wipe off dry. This will make old furniture, in private dwellings or that which has been shop-worn in warerooms, look as well as when first finished. The articles should be put into a jar or jug, well mixed and afterwards kept tightly corked. This is a valuable receipt, and not known, he believes, outside of the writer's practice.

A Cheap but Valuable Stain for the Sap of Black Walnut.—Take 1 gallon of strong vinegar, 1 lb. dry burnt umber, ½ lb. fine rosepink, ½ lb. dry burnt vandyke brown. Put them into a jug and mix them well; let the mixture stand one day and it will then be ready for use. Apply this stain to the sap with a piece of fine sponge; it will dry in half an hour. The whole piece is then ready for the filling process. When the work is completed, the stained part cannot be detected even by those who have performed the job. This receipt is of value, as by it wood of poor quality and mostly of sap can be used with good effect.

A Walnut Stain to be used on Pine and Whitewood.—Take 1 gallon of very thin sized shellac; add 1 lb. of dry burnt umber, 1 lb. of dry burnt sienna, and ¼ lb. of lampblack. Put these articles into a jug and shake frequently until they are mixed. Apply one coat with a brush. When the work is dry, sand-paper down with fine paper, and apply one coat of shellac or cheap varnish. It will then be a good imitation of solid walnut, and will be adapted for the backboards of mirror frames, for the backside and inside of case-work, and for similar work.

A Rosewood Stain of a very Bright Shade.—Take 1 gallon of alcohol, 1½ lbs. of cam-wood, ½ lb. red sanders, 1 lb. of extract of logwood, and 2 ozs. of aquafortis. When dissolved, it is ready for use. This makes a very bright ground. It should be applied in three coats over the whole surface. When it is dry, sand-paper down to a very smooth surface, using for the purpose a very fine paper. The graining is then to be done with iron rust, and the shading with asphaltum, thinned with spirits of turpentine. When the shading is dry, apply one thin coat of shellac, and when this is dry, sand-paper down, as before, with fine paper. The work is then ready for varnishing.

A Satinwood Stain for the Inside of Drawers.—Take 1 quart of alcohol, 3 ozs. of ground turmeric, 1½ ozs. of powdered gamboge. When this mixture has been steeped to its full strength, strain through fine muslin. It is then ready for use. Apply with a piece of fine sponge, giving the work two coats. When it is dry, sand-paper down very fine. It is then ready for varnish or French polish, and makes an excellent imitation of the most beautiful satinwood.

A Cheap Black Stain for Pine or Whitewood.—Take 1 gallon of water, 1 lb. of logwood chips, ½ lb. of black copperas, ½ lb. of extract of logwood, ½ lb. of indigo blue, and 2 ozs. of lampblack. Put these into an iron pot and boil them over a slow fire. When the mixture is cool, strain it through a cloth, and add ½ oz. of nut-gall. It is then ready for use. This is a very good black for all kinds of cheap work.

COACH-PAINTING.

To be a successful car-painter requires the closest attention, the most thorough application, and the most constant watching, and even then "deviltries" will appear which baffle the skill, experience, and patience of the most practical and amiable of the craft. Many, however, of the vexations and annoyances of the paint-shop have been overcome, and a large amount of the heart-rendings, crackings, flakings, and pittings are found to be due more frequently to want of knowledge, attention, and care, than to inferior material. While we admit the bad results caused by the use of such material, sudden changes in the weather, &c., there are at the same time defects and imperfections to be seen on our cars that can only be designated as careless blunders. An interchange of views formed by careful observation has done much, and will do more, to improve the character of our work. Allow me then to give as briefly as possible the method I at present pursue, not with the idea of presenting anything new or startling, but to draw from others any experience that may differ from my own.

The Priming.—For priming I use keg lead mixed with the best raw linseed oil. To a pint of oil I add a tablespoonful of Japan size. In mixing care should be taken not to have it too thick, and to be sparing in the use of Japan, the excessive use of which tends to lessen elasticity as well as durability. Some painters use boiled oil in priming to avoid the greasy character of raw oil, but my objection to the former is that it is less penetrating, and that it tends to congeal on the surface. The best method of preparing raw oil for priming that I have ever used is as follows:—Take 1 gallon of oil, put ½ lb. litharge into it, place near the stove, and shake three or four times a day for a few days, and then let it settle and run off. This improves its drying properties and frees it from grease. No gold size is used with it. Before applying, all nail holes, crevices, and beads should be properly filled, and then it should be laid on regularly and evenly, leaving no fat edges.

After the work has stood from four to six days, or longer if possible, it is then ready for the second coat, which is the same as the priming, only a little heavier. The same care should be taken to lay it on evenly and fill all crevices and holes. I prefer puttying after the second coat is on, as the holes are more likely to be filled, which is necessary for the putty to adhere; a less body of putty is also required, and therefore is less likely to swell, which is a source of trouble very often when the work is nearly completed. As a precaution against this, some painters have the holes soaked with warm water before the cars leave the erecting shop.

The Rough Stuff.—There is no end of receipts for rough stuff, but the kind I have used with great satisfaction for some time is composed of 8 lb. mineral, 3 lb. dry white lead, 1 lb. tub lead, 2 parts gold size; 1 part rubbing varnish, and thin with turps. The laying on of this preparation is frequently deemed unworthy of the care usually bestowed on painting. But this is a mistake, as all the principles as respects the laying on of paint should be strictly followed in the laying on of rough stuff. A large amount of time is saved by not applying it to the battens, and by leaving about ¾ of an each diagonally at the corners of the panels. One coat is sufficient except on hard wood, which should have at least two coats. When such wood is very open grained, I prefer knifing it before rough stuffing, using tub lead with a very little turps and Japan. For rubbing rough stuff, I have used different kinds of stone, but have settled down on picked pumice, which is cheaper, and at least as good as any other.

At this stage of the work the car body should be carefully examined, and if any imperfections are found, now is the time to fix them. After thoroughly sand-papering, the work is ready for colouring.

The Putty.—The hard putty I use is composed of dry white lead and whiting in equal parts, mixed with Japan gold size and a very small quantity of raw oil or a little keg lead. I have found the whiting makes the putty less liable to swell; and let me say here that very frequently the painter is blamed for this, when the actual cause is the shrinkage of the wood. The hole or crack should be completely filled, and the putty may even project a little so that it may be rubbed down to the exact level. Very close attention must be given to this part of the work, so that little or no puttying may be required after the rough stuff has been surfaced.

The putty now being levelled down and the whole body sand-papered, the car is ready for the third coat. This is made with tub lead reduced with "turps," and a small quantity of Japan gold size laid on with the usual care. In order to secure a good job these priming coats must be perfectly dry. After three days the rough stuff may be put on.

Necessity of a Good Foundation.—In painting, as in most other things, a good foundation is absolutely necessary, and to secure this everything depends upon the quality and mixing of the material, and also upon the handling of it. The priming of a car is regarded by some painters as a simple matter, and as a matter of economy this preliminary work is often placed in the hands of inexperienced or low-priced workmen. This is a false step at the start, and when once taken we have to hobble through the whole job. In every part of the work there is a definite object to be accomplished. The object in priming is to fill the pores of the wood. The prime must, therefore, be cohesive and have a proper elasticity. The thinners used should enter the pores without congealing on the surface, thus insuring permanency.

FINISHING.—The car is now ready for the finishing coats of varnish. First of all it has to be carefully washed down with cold water to clean off any soiling that may have got on during the striping and ornamenting. The cleaning must be done with brush, sponge, and chamois, and so thoroughly as to remove the smallest particles from mouldings, &c., as the varnish brush is sure to find them and bring them to the surface. In my experience there are comparatively few, even of good workmen, who can varnish a car properly. Some are so afraid of sagging that they put the varnish on sparingly, while others, with the greatest ease and safety, will put a third more on the body without the least tendency to sag—and then again the work of some is much more even and regularly flown than that of others using the same material and on the same body. On the finishing coats as much varnish should be put as they will safely carry. For some time I have abandoned rubbing between the coats. As a matter of beauty, I would prefer a slight rubbing of the first coat, but I willingly sacrifice this advantage to secure what is of more importance—namely, economy and durability. Instead of rubbing before the last coat of varnish is applied, the previous coat must be thoroughly hard and washed down with cold water. Then by using every precaution to get rid of dust, and with care and proper handling, the last coat should stand out, and the entire job reflect credit on the painter and also on the vendors of the materials used in the work.

COLOURING.—The colour on the Michigan Central Railroad cars consists of golden ochre ground heavy in oil along with medium chrome ground in turps and Japan, and brought to the proper consistency with turps. To finish a car properly with this colour, four coats are required, and from first to last there cannot be too much care taken in laying it on in order to secure a solid job and lose nothing of what has preceded. The colour should be worked quickly, put on sparingly, brushed out well and laid off evenly. I would recommend a flat sable brush as the best and most economical for laying colour.

Very often the labour expended in bringing a car up to the point of colouring is completely lost by the mixing of the colour, or by the manner in which it is laid. I make no change in the formula of these coats, and do not use any varnish in last coat. The work should be sand-papered and carefully dusted off after each coat, and one day's time at least should intervene between the coats.

STRIPING AND GILDING.—Striping colours are ground heavy in boiled oil with a little Japan gold size and thinned with turps. Furnish each man with a gauge, divide the car into sections, and let each finish his allotted portion. Emulation is thus excited, and each man is responsible only for his own proper work, with no risk of blame that is undeserved. For gilding, I find that a quick size is the best. I use Noble and Hoare's gold size with about one-third their wearing body varnish.

VARNISHING.—The car is now ready for varnishing. For the first coat I use an outside rubbing varnish, which can be rubbed down very close in four days and washed clean. This forms a beautiful surface for striping and ornamenting. The men who do the striping should be so arranged that each may work on his specialty, as this secures better work by exciting a greater desire to excel.

HINTS ON THE USE OF PLASTER OF PARIS.

The plaster may be made to "set" very quickly by mixing it in warm water to which a little sulphate of potash has been added. Plaster-of-Paris casts, soaked in melted paraffine, may be readily cut or turned in a lathe. They may be rendered very hard and tough by soaking them in warm glue size until thoroughly saturated, and allowing them to dry.

Plaster of Paris mixed with equal parts of powdered pumice stone makes a fine mold for casting fusible metals; the same mixture is useful for encasing articles to be soldered or brazed.

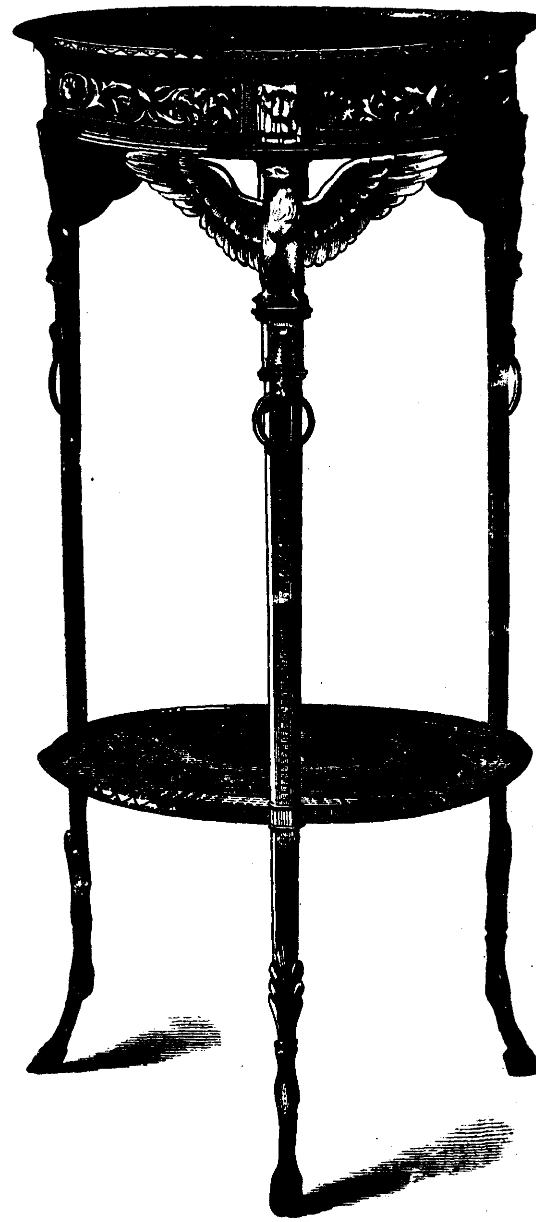
Casts of plaster of Paris may be made to imitate fine bronzes by giving them two or three coats of shellac varnish, and when dry applying a coat of mastic varnish, and dusting on fine bronze powder when the mastic varnish becomes sticky.

Rat-holes may be effectually stopped with broken glass and plaster of Paris.

The best method of mixing plaster of Paris is to sprinkle it into the water, using rather more water than is required for the batter; when the plaster settles pour off the surplus water and stir carefully. Air bubbles are avoided in this way.—*Boston Journal of Chemistry.*

A HANGING CABINET.

A new arrangement for fastening the feet of lounges without glue.



ORNAMENTAL CAST IRON TABLE.

EXAMPLES OF FRENCH WOOD CARVINGS.

Health and Home.

IS FAT INJURIOUS ?

Fats are very important elements of our food ; still, goose oil, lard, tallow, train oil, fish oil, and such varieties of diet, are wisely eschewed by all except lumbermen, and those whose physical labor is very great, and who are almost constantly exposed to cold. While, therefore, the student and civilized worker wisely eschews the coarser forms of fat, he should not ignore it in some more refined and delicate form. He should instead use such as are most suitable to his taste and needs. The brain is a great consumer of fat, combined with phosphorus. No phosphorus—no thought, is a modern phrase, expressing the importance of phosphorus in mental action. As yet we are in the infancy of knowledge on this subject, but it may be predicted that when we know the whole truth, the phrase will be something like this: "No phosphorized fat, no thought." There is always some fat in most of our foods. The special forms best to make up any deficiency that may be in them are no doubt to be found in good butter and cream. There are, of course, instances in which they will not be tolerated, but these are exceptions. Fat is not digested in the stomach, but by the pancreatic juice in the intestines, nature having provided a special juice to form it into an emulsion so it may be absorbed. In this state every atom of fat is so small that it requires a miscroscope to detect it, and in this state it may easily be passed through the walls of the intestines and carried into the circulation. We need no better evidence of the need of fat than this careful provision for its digestion in the system. The symptoms which attend a non-use of fats in some form are coldness of the extremities, a tendency to indigestion, lack of nervous energy and power to think. Emaciation, diminished muscular power, and a tendency to consumption.

It may be true that many persons suffer from an inability to digest fats, and that sometimes they obstruct the liver and make much trouble. In all such cases it would be advisable to use them wisely and judiciously, but rarely to avoid them altogether, except, perhaps, in corpulence, where they are best used in great moderation. Lean people should use fats rather more freely than fat ones. The amount of fat necessary for a healthy working person is about three ounces daily. Persons with extraordinary working power require more than this. The starch in our food is to a certain extent a substitute for fat, and may be converted into it.—"*Eating for Strength.*"

Mechanics.

WOOD FOR CLOCK PENDULUMS.

An interesting discussion recently took place at a meeting of London clock-makers on compensation pendulums. The general judgment seemed to be in favor of plain wooden pendulums for all sorts of timepieces. One speaker said that wooden pendulum rods were generally in use for turret and church clocks, and also in regulators. Another concurred in that statement, and he thought that if wooden pendulums were good for church clocks, they might usefully be adopted for bracket clocks. He had accordingly altered a very old family clock of that description, and of the best London make, by substituting a wooden for a brass pendulum, with very decided advantage. It might possibly be worth while to make a similar alteration generally; brass, being a cheaper and prettier material, having probably been used by the makers of bracket clocks without consideration. A third maker never used anything but wood when he could help it for railway, church or turret clocks. Another speaker considered that one of the a vantages in the use of wood for pendulums might be that, in a fa.. of temperature, when the rod would be shortened, the hygroscop.c property of the wood would come into play, which would tend to lengthen it, and so cause a natural compensation by the thermometric and hygroscopic properties of the wood acting in opposite directions. In some climates that certainly might be the case, though in others they would work together, when the effect would be to increase the error. It was stated that a wooden pendulum with a leaden bob had been fixed to a regulator clock in one of the leading shops, and was keeping excellent time. It was a very simple form of pendulum, and might be made very economically. Further testimony was borne to that form of pendulum. Dr. Mann had used one in Natal, which was simply a rod of varnished wood supporting a cylindrical bob of lead. It was, of course, subjected there to great and rapid changes in the atmospheric pressure and to diversities of heat, but it worked excellently for many years. Subsequently it was replaced by one of Fordsham's best steel pendulums, and though there was some improvement, it was much slighter than might have been expected. In short, it was about as good a pendulum as could be conceived.

Other Methods to Temper Case Springs.—Having fitted the spring into the case according to your liking, temper it hard by heating and plunging into water. Next polish the small end so that you may be able to see when the color changes; lay it on a piece of copper or brass plate, and hold it over your lamp, with the blaze directly under the largest part of the spring. Watch the polished part of the steel closely, and when you see it turn blue, remove the plate from the lamp, letting all cool gradually together. When cool enough to handle, polish the end of the spring again, place it on the plate, and hold it over the lamp as before. The third bluing of the polished end will leave the spring in proper temper. Any st el article to which you desire to give a spring temper may be treated in the same way.

Another process, said to be good, is to temper the spring as in the first instance; then put it into a small iron ladle, cover it with linseed oil, and hold over a lamp till the oil takes fire. Remove the ladle, but let the oil continue to burn until nearly all consumed; when blown out, recover with oil, and hold over the lamp as before. The third burning out of the oil will leave the spring in the right temper.

Warning to Locomotive Engineers.—Drs. Charles M. Cresson and Robert E. Rogers, of this city, says the Philadelphia *Ledger*, well known as experts in chemistry and dynamics, were appointed by the Reading Railroad Company to inquire into and report upon the causes of the recent explosion of the boiler of the express locomotive "Gem," at Mahanoy City, by which five lives were lost. Their report, which is designed to cover the whole scope of a most careful investigation, is not yet made public, but they have arrived at the following specific conclusion, which we give in their own language: "We are, therefore, of the opinion that the explosion of the boiler of the locomotive "Gem," was produced by the projection of foam upon the heated crown bars of the furnace, caused by suddenly and widely opening the safety-valve at a time when the water had been permitted to get so low as to overheat the crown of the furnace." This is an important matter that should be carefully noted by locomotive and other engineers.

Horse-Shoe Nails Abroad.—An observing traveller finds much to interest him in the minor economies of a strange people, and in noticing how differently they do things from the methods he has been accustomed to at home. A friend has presented us with a couple of horse-shoe nails, made in Greece, of the kinds in general use in that country; they are made by hand, and while of the rudest shape, are from the very best Swedish iron. They were sent to this country to ascertain if some of our nail-making machines could be adapted to turn out a similar product. The left-hand and middle engraving show these Grecian nails, while that at the right-hand represents a nail which the writer brought home many years ago from Mexico, and which, until the Grecian product came to hand, he supposed was as rude as it was possible for a nail to be. In the Mexican shoe there is a square hole with sides beveled, into which the lower part of the head of the nail fits snugly, and a horse shod in that manner is protected against slipping on the smooth rocks which in many portions of that country he is often obliged to travel upon.

To Draw the Temper from Delicate Steel Pieces Without Springing Them.—Place the articles from which you desire to draw the temper into a common iron clock key. Fill around it with brass or iron filings, and then plug up the open end with a steel, iron, or brass plug, made to fit closely. Take the handle of the key with your pliers and hold its pipe into the blaze of a lamp till near hot, then let it cool gradually. When sufficiently cool to handle, remove the plug, and you will find the article with its temper fully drawn, but in all other respects just as it was before.

You will understand the reason for having the article thus plugged up while passing it through the heating and cooling process, when I tell you that springing always results from the action of changeable currents of atmosphere. The temper may be drawn from cylinders, staffs, pinions, or any other delicate pieces, by this mode, with perfect safety.

Hints for Molders.—To perfectly accomplish the running in of the metal in molding, the following rules have been laid down by a recent writer on the subject: Choose if possible the thickest part of the casting for the runner, and if the casting is deep, run in the metal at the bottom; where the casting has a flange in the form of a pipe, it is generally preferred to run the metal in at the flange; when the casting is thin and has many branches, or when it is of great length, it is advisable to run in the metal in the center; care should be taken to choose a place in the mold, so that the mold will have no tendency to wash any part away in its first rush; and the metal should not be allowed to fall from any hight upon a weak part of the mold.

Cooling Hot Journals.—Von Heeren proposes a method of cooling hot journals by a mixture of sulphur and oil or grease. The fine metal dust formed when a journal runs hot, and which strongly acts upon both journals and bearing, forms a sulphide of sulphur. This compound, which grows soft and greasy, does not cause any appreciable amount of friction. It has been very successfully used by the steamers of the North German Lloyds. —*Iron Age.*

To Temper Clicks, Ratchets, &c.—Clicks, ratchets, or other steel articles requiring a similar degree of hardness, should be tempered in mercurial ointment. The process consists in simply heating to a cherry red and plunging into the ointment. No other mode will combine toughness and hardness to such an extent.

To Draw the Temper from part of a Small Steel Article.—Hold the part from which you wish to draw the temper with a pair of tweezers, and with your blow-pipe direct the flame upon them—not the article—till sufficient heat is communicated to the article to produce the desired effect.

A softer solder than is used for ordinary brass work is composed of equal parts of zinz and copper. A very hard but fusible solder is composed of two parts zinc and one part copper. This solder is so hard and brittle that it can be easily crumbled in a mortar when cold.

Oil Paint.—A writer to the *English Mechanic* says: The cheapest and best solution that I know of I accidentally discovered, and it may be worth while to tell how, though very likely some may know of it. In trying experiments for preserving copying some old letters, amongst others I used successfully a solution of one table-spoonful of vinegar and one ounce of washing soda to a half pint of water. A little of this was spilt on the painted window-sill and in wiping it up the paint came entirely off, leaving the bare board quite clean. Try it; a gallon will not cost 50 cents.

Cabinet-Makers and Carvers' Receipts.

To Transfer Engravings from Paper to Wood.—The following is an extract from an article entitled "Pictures and Devices upon Wood," in an old number of the *Penny Magazine*:—"First prepare carefully a panel of sycamore, horse-chestnut, satinwood, maple, or other kind of wood. When the surface is perfectly smooth, it is coated with a layer of hot glue, which when dry is rubbed with glass-paper to render the surface uniform. It is then successively coated with spirit varnish five or six times, each coat being dry before the next is applied. The print is laid on a smooth table, face downwards, the back is moistened with water, the surplus water being removed by two sheets of blotting-paper, between which the print is placed; while the print is moist another layer of varnish is applied to the wood, the print is immediately laid on, its face downwards, and carefully pressed. It is then left until dry; when dry the back of the print is moistened, and the fingers are rubbed slightly backwards and forwards till the paper comes off in small rolled fragments. When dry, another coating of varnish is laid on, and the surface polished with Dutch-rush steeped three or four days in olive oil, the oil is wiped off with a soft cloth, and any remaining portion is absorbed by a little powdered starch carefully wiped off afterwards. Three or four layers of varnish are then applied, and the surface is lastly polished with a fine woollen cloth dipped in a little powdered whiting or chalk; the print or impression then presents itself as if on the surface of the wood."

Dyed Veneers.—Some German cabinet-makers, after numerous experiments, have perfected a process for dying veneers through and through. The veneers are first soaked for twenty-four hours in a solution of caustic soda, and then boiled therein for half an hour. They are then washed with water until all the alkali is romoved, when they are ready to receive the dye. This treatment with soda effects a general desintegration of the wood, whereby it becomes, in the moist state, elastic and leather-like, and prepared to absorb the colour. Veneers thus treated, if left for twenty-four hours in a hot decoction of log-wood, and, after superficial dying, immersed for twenty-four hours more in a hot solution of copperas, becomes of a beautiful and permanent black throughout. A solution of picric acid in water, with the addition of ammonia, gives a yellow colour, not in the least affected by subsequent varnishing. Coralline dissolved in hot water, to which a little caustic soda and one-fifth its volume of soluble glass have been added, produce the colour of different shades, dependent on the amount of coralline taken. After dyeing, they are dried between sheets of paper and subjected to pressure to retain their shape.

French Varnish for Cabinet Work.—Take of shellac 1½ ozs.; gum mastic and gum sandarac, of each ½ oz.; spirit of wine by weight 20 ozs. The gums to be first dissolved in the spirit, and lastly the shellac. This may be best effected by means of the water-bath. Place a loosely corked bottle containing the mixture in a vessel of warm water of a temperature below the boiling point, and let it remain until the gums are dissolved. Should evaporation take place, an equal quantity to the spirit of wine so lost must be replaced till the mixture settles, then pour off the clear liquid for use, leaving the impurities behind; but do not filter it. Greater hardness may be given to the varnish by increasing the quantity of shellac, which may be done to the amount of one-twelfth of the lac to eleven-twelfths of the spirit. But in this latter proportion the varnish loses its transparency in some degree, and must be laid on in very small quantities at a time.

To Cut Steel Plate for Scrapers.—Every workman knows that part of the blade of a broken saw is the best scraper he can use; but as it is very hard it is difficult to be cut into the form required for a scraper. As it is very tedious to cut it with a file, the best, and at the same time the most expeditious, it to mark out the size you wish, and place the piece of the blade or steel plate in a vice whose chaps shut very close, placing the mark even with the face of the vice, and the part of the plate that is to be cut to waste above the vice. Then with a cold chisel or a common steel firmer that has its basil broken off, holding it close to the vice and rather inclined upwards, begin at one end of the steel plate, and with a sharp blow of the hammer it will cut; keep going on by degrees, and you will, with a great deal of ease, cut it to the shape required. You have only then to grind the edges of your scraper level, and rub it afterwards on your Turkey stone, and it is complete.

Polishing Fretwork.—First sand-paper the wood with coarse sand-paper and fine glass-paper, taking care not to rub across the grain. When the wood is perfectly smooth and free from flaws, it should be well oiled, by taking a piece of cotton wool and folding it upon a piece of linen, which should be dipped in oil, and then rubbed well into the wood. This should be done several times, and allowed to dry. Another wad should then be made, and the cotton wool inside it dipped in French polish (to be had at any Italian warehouse) and well rubbed in; the hand in rubbing it should be moved in circles, and not up and down the grain; directly the wad feels sticking on the wood, the oil wad should be slightly rubbed over the place and then allowed to dry; and then, when dry, begin again with the polish. When a good polish has been obtained on the wood, spirits of wine should be rubbed in to prevent its losing its brilliancy.—*Cabinet Maker.*

A Very Simple Pantagraph.—Schnaus suggests the use of a fine rubber cord, about 15 inches long, supplied with a loop at each end, and having on it a small white bead, sliding upon it with gentle friction. By securing one end to the table by a pin, and passing a pencil through the other end, and drawing its point over the paper with the right hand keeping the string stretched, and causing the bead to describe the outline of a simple drawing placed beneath it, a tolerably good copy of the drawing will be produced, bearing any desired proportion to the original, according to the position given to the bead on the string; thus if the bead is in the centre of the cord, the drawing will be double the size of the original. The best results are only obtainable after some practice, and by employing a finer point than a bead.

Protection of Wood Carvings.—Worm-eaten wood may be saved from further ravages by fumigating it with benzine, whereby the worm is destroyed. Another way is to saturate the wood with a strong solution of corrosive sublimate—a process which may be advantageously employed to protect carvings in wood. But as sublimate destroys its colour, it will be necessary to restore the latter by ammonia, and then by a very dilute solution of hydrochloric acid. The holes made by the worm may then be injected with gum and gelatine; and a varnish of resin, dissolved in spirits of wine, should afterwards be applied to the surface.

Ebony.—Of this wood there are several varieties in the market, the only one servicable to the carver being one with a close and even grain, so close indeed, that under the gouge it appears to have no fibre whatever. The hardness renders it extremely difficult to work, and for this reason ebony carvings are of great value. The great defect which this wood has, is its tendency to exfoliate, and to split. An imitation ebony is sometimes offered, which is made by soaking pear-wood in an iron and tanning dye-beck for a week or more. The colour penetrates to the very heart of the wood, so that the cut is as black as ebony.—*English Mechanic.*

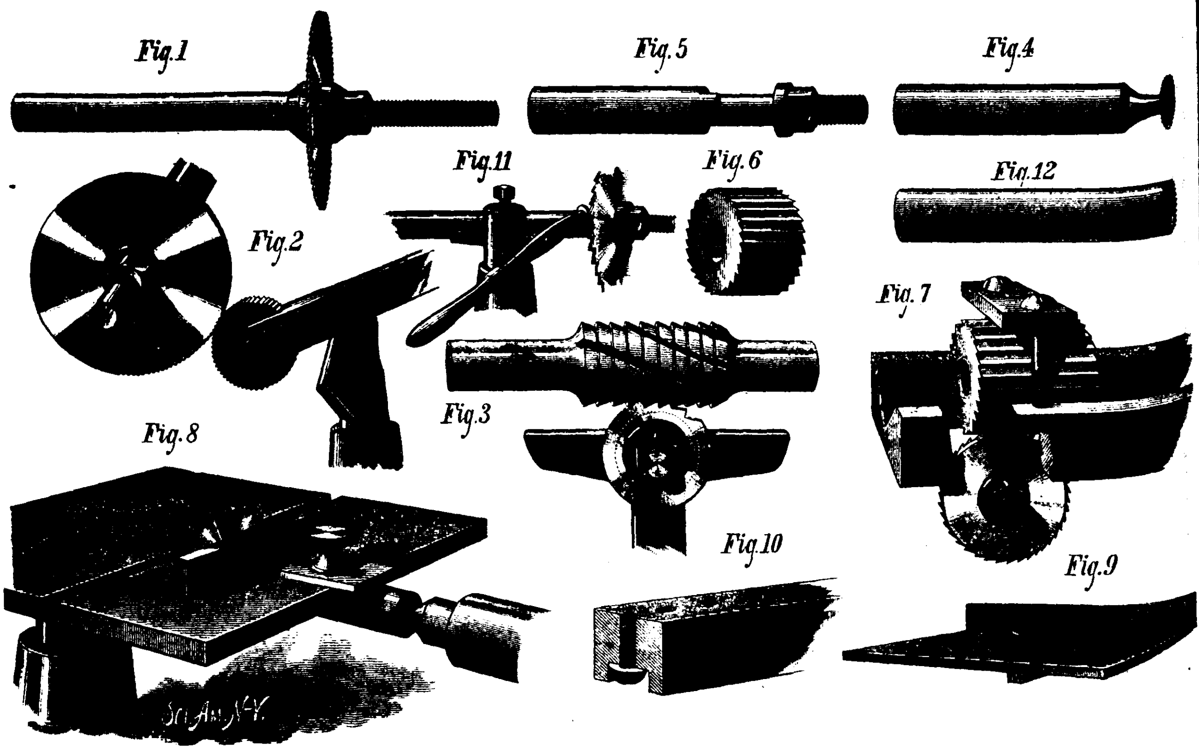
A Satinwood Stain for the Inside of Drawers.—Take 1 quart of alcohol, 3 ozs. of ground turmeric, 1½ ozs. of powdered gamboge. When the mixture has been steeped to its full strength, strain through fine muslin. It is then ready for use. Apply with a piece of fine sponge, giving the work two coats. When it is dry, sand-paper down very fine. It is then ready for varnish or French polish, and makes an excellent imitation of the most beautiful satinwood.

A Cheap Black Stain for Pine or Whitewood.—Take 1 gallon of water, 1 lb. of logwood chips, ½ lb. of black copperas, ½ lb. of extract of logwood, ½ lb. of indigo blue, and 2 ozs. of lampblack. Put these into an iron pot and boil them over a slow fire. When the mixture is cool, strain it through a cloth, and add ¼ oz. of nut-gall. It is then ready for use. This is a very good black for all kinds of cheap work.

A Crimson Spirit Stain.—Take one quart of alcohol, 3 ozs. of Brazil-wood, ½ oz. of dragon's-blood, ½ oz. of cochineal, and 1 oz. of saffron. Steep to full strength and strain. It is a beautiful stain for violins and other wooden musical instruments, work-boxes, and fancy articles.

To Stain Box-wood Brown.—Hold your work to the fire that it may receive a gentle warmth, then take aquafortis, and with a feather or brush, pass over the work till you find it change to a fine brown (always keeping it near the fire); you may then oil and polish it.

Transparent Gum.—A little glycerine added to gum or glue is a great improvement, as it prevents the gum or glue becoming brittle. It also prevents gummed labels from having a tendency to curl up when being written on.



ROTARY CUTTERS.

AMATEUR MECHANICS.

ROTARY CUTTERS.

The saving of files, time, materials, and patience, by the employment of such rotary cutters as may be profitably used in connection with a foot lathe, can hardly be appreciated by one who has never attempted to use this class of tools. It is astonishing how much very hard labor may be saved by means of a small circular saw like that shown in Fig. 1. This tool, like many others described in this series of articles, can, in most instances, be purchased cheaper than it can be made, and the chances are in favor of its being a more perfect article. However, it is not so difficult to make as one might suppose. A piece of sheet steel may be chucked upon the face plate or on a wooden block attached to the face plate, where it may be bored to fit the saw mandrel, and cut in circular form by means of a suitable hand tool. It may then be placed upon the mandrel and turned true, and it is well enough to make it a little thinner in the middle than at the periphery.

There are several methods of forming the teeth on a circular saw. It may be spaced and filed, or it may be knurled, as shown in Fig. 2, and then filed, leaving every third or fourth tooth formed by the knurl; or it may, for some purposes, be knurled and not filed at all. Another way of forming the teeth is to employ a hub, something like that used in making chasers, as shown in Fig. 3; the difference between this hub and the other one referred to, is that the thread has one straight side corresponding with the radial side of the tooth. The blank from which the saw is made is placed on a stud projecting from a handle made specially for the purpose, and having a rounded end which supports the edge of the blank, as the teeth are formed by the cutters on the hub.

The saw, after the teeth are formed, may be hardened and tempered by heating it slowly until it attains a cherry red and plunging it straight down edgewise into cool, clean water. On removing it from the water it should be dried, and cleaned with a piece of emery paper, and its temper drawn to a purple, over a Bunsen gas flame, over the flame of an alcohol lamp, or over a hot plate of iron. The small saw shown in Fig. 4 is easily made from a rod of fine steel. It is very useful for slitting sheet brass and tubes, slotting small shafts, nicking screws, etc. Being quite small it has the advantage of having few teeth to keep in order, and it may be made harder than those of larger diameter. A series of them, varying in diameter from one eighth to three eighths of an inch, and varying considerably in thickness, will be found very convenient.

These cutters or saws, with the exception of the smaller one, may be used to the best advantage in connection with a saw table, like that shown in Fig. 8. This is a plain iron table having a longitudinal groove in its face to receive the guiding rib of the carriage, shown in Fig. 9, and a transverse groove running half way across, to receive a slitting gauge, as shown in Fig. 8. The table is supported by a standard or shank which fits into the tool-rest socket. The saw mandrel is supported between the centers of the lathe, and the saw projects more or less through a slot formed in the table. The gauge serves to guide the work to be slotted, and other kinds of work may be placed on or against the carriage shown in Fig. 9.

It is a very simple matter to arrange guiding pieces for cutting at any angle, and the saw table may be used for either metal or wood. The saws for wood differ from those used for metal; the latter are filed straight, the former diagonally or fleaming. Among the many uses to which metal saws may be applied we mention the slitting of sheet metals, splitting wires and rods, slotting and grooving, nicking screws, etc. Fig. 10 shows a holder for receiving screws to be nicked. It is used in connection with the saw-table, and is moved over the saw against the gauge.

To facilitate the removal of the screws the holder may be split longitudinally and hinged together. Another method of nicking screws is illustrated by Fig. 11. A simple lever, fulcrumed on a bar held by the tool post, is drilled and tapped in the end to receive the screw. After adjusting the tool all that is required is to insert the screw and press down the handle so as to bring the screw head into contact with the saw.

Where a lathe is provided with an engine rest, the cutter shown in Fig. 6, mounted on the mandrel shown in Fig. 5, is very useful; it is used by clamping the work to the slide rest and moving it under the cutter by working the slide rest screw.

To make a cutter of this kind is more difficult than to make a saw, and to do it readily a milling machine would be required; it may be done, however, on a plain foot lathe by employing a V-shaped cutter and using a holder (Fig. 7) having an angular groove for receiving the cylinder on which the cutting edges are formed. The blank can be spaced with sufficient accuracy, by means of a fine pair of dividers, and after the first groove is cut there will be no difficulty in getting the rest sufficiently accurate, as a nib inserted in the side of the guide enters the first groove and all of the others in succession and regulates the spacing.

One of the best applications of this tool is shown in the small engraving. In this case a table similar to the saw-table before described is supported in a vertical position, and arranged at right angles with the cutter mandrel. The mandrel is of the same diameter as the cutter, and serves as a guide to the pattern which carries the work to be operated upon. The principal use of this contrivance is to shape the edges of curved or irregular metal work. The casting to be finished is fastened—by cement if small, and by clamps if large—to a pattern having exactly the shape required in the finished work.

By moving the pattern in contact with the table and the mandrel, while the latter revolves, the edges of the work will be shaped and finished at the same time. By substituting a conical cutter for the cylindrical one, the work may be beveled; by using both, the edge may be made smooth and square, while the corner is beveled.

The tool shown in Fig. 12 might properly be called a barrel saw. It is made by drilling in the end of a steel rod and forming the teeth with a file. To avoid cracking in tempering a small hole should be drilled through the side near the bottom of the larger hole. To insure the free working of the tool it should be turned so that its cutting edge will be rather thicker than the portion behind it. This tool should be made in various sizes.

Tools for gear cutting and also cutters for wood have not been mentioned in this paper, as they are proper subjects for separate treatment.—*Scientific American.*

MACHINERY FOR MAKING SAND MOULDS.

Improvements in the method of making sand moulds for metal casting have been recently patented by Messrs. W. Aikin and W. W. Drummond, foundrymen, of Louisville, Kentucky. Their invention is intended for use in making moulds in sand for castings in metal, and especially in making moulds for matched work by compression. They connect a follower plate made in sections with mechanism which actuates the portion of the follower carrying the patterns simultaneously with the intermediate sections of the follower plate in rising to force the pattern into the sand, but in the reverse movement first withdraws the pattern, leaving the intermediate section of the follower plate in contact with and

FIG. 1.

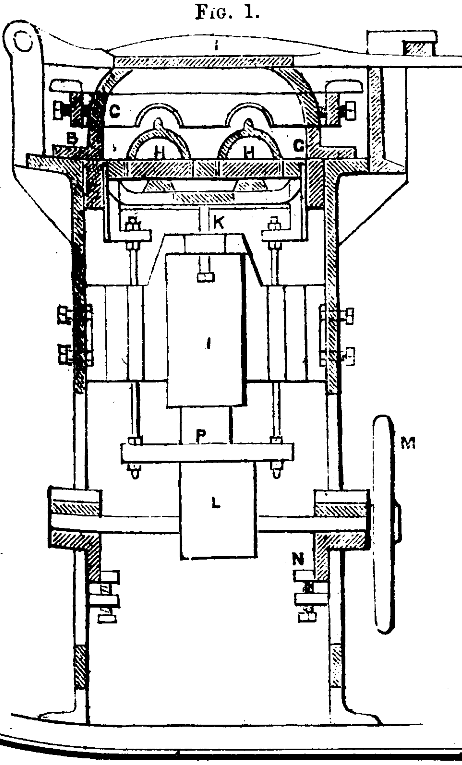
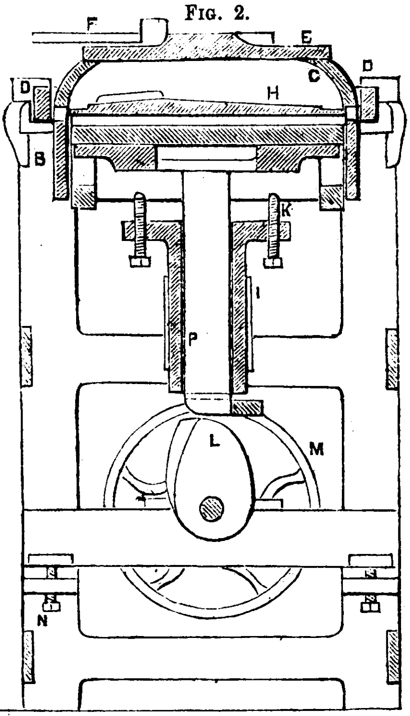


FIG. 2.



supporting the sand until the patterns have been withdrawn; the followers are withdrawn also, leaving the sand in the flask with the pattern duly moulded therein. In the drawings Fig. 1 is a vertical section of the machine, and Fig. 2 a similar section on a plane at right angles to that of Fig. 1. The frame of the machine carries on the top a box, B, open at the top and bottom, which box is intended to contain and gauge the quantity of sand resting upon the follower, which is made in sections, G, H, and also serving as a guider for the follower, which is made to rise and fall, compressing the sand into the section C of the flask, which rests upon the upper edge of the box B. D is the frame, in which the flask is held by adjusting screws. Double steady pins serve to hold the half-flask on the box B, and also to confine sections of the flask when the moulds are completed, part engaging lugs on the box B, and part engaging eyes on the other half of the flask frame. The lid, E, attached to a swinging arm, F, is intended to close the top of the flask, and may be secured in place by a latch, screw, or hook. The followers are formed by sections G and H, the latter having the half-pattern fitted and fastened to its upper face. The form of the section H is adapted to the outline of the pattern, and the sections G G are formed to close the space between the sections H, and between the latter and the sides of the flask. These sections G and H form a plunger for forcing the sand into the flask, but they are moved independently when the mould having been formed they are withdrawn. The sections G are attached to a cross head so formed as to support them independently of the supports of sections H. Rods passing through holes in the stationary guide I, actuate the sections G, being operated by the yoke embracing the piston, P, but capable of moving independently of it. The sections H carrying the patterns are attached to an independent cross head underlying the cross head so as to permit the pattern to be withdrawn from the sand while the latter is sustained by the sections, G, of the follower. These movements are provided for by the double cam, L, the surfaces of which are so formed as to lift the yoke and plunger, P, simultaneously, then allow the latter to descend first, so as to withdraw the patterns from the sand while it is still supported by the intermediate plates of the follower, which are then withdrawn, leaving the mould complete. Temper screws, K, passing through the guide, I, regulate the distance to which the cross head can fall, and thereby determine the quantity of sand which the box B will contain. The cam is actuated by the wheel, M, the shaft of which is hung in bearings that are vertically adjustable on the main frame at N by means of screws, so as to adjust the cams to the plungers. Some modifications of the apparatus are described by the inventors, who have also devised a feed apparatus, or hopper, for measuring off the quantity of sand and automatically locking and unlocking the bottom, as required by the motions of the machine.—*English Mechanic.*

NEW ALLEGED DISCOVERIES IN PETROLEUM.

The *Oil and Drug Reporter* has been shown specimens of what were claimed to be *saponified petroleum.* These specimens were shown in different forms—as emulsion, paste and cake. "Upon a close inspection," says the *Reporter*, "they appeared to be perfect specimens of saponification, and we were assured that no oleaginous matter, except petroleum oil, was introduced in their composition. These seemed to be a practical contradiction of the theory that petroleum oil cannot be saponified in the very nature of things. Such has been our impression, not from actual experiment, but based upon the statement of experts, who insist that petroleum can be rendered miscible only, and we know that it has been tested by various parties with great care and persistence. We confess our incredulity in the matter, but it is not safe in these days of discovery to doubt the solution of any scientific problem, and we can only say that we hope the enthusiastic author of this long-sought consummation is not deceiving himself. They are claimed to be applicable to the purposes of scouring and finishing in textile manufactures; to domestic and toilet articles, and by reason of their antiseptic and healing properties, to medicinal preparations. But this is not all. We are assured by the same gentleman that he had eliminated an aniline black from petroleum, which was at once dense, brilliant and permanent; air and exposure to light serving to intensify and make it more firm. This, too, if it shall be assured, will prove another great achievement in industrial art."

In connection with the above, Maj. Henry Howell, of Sarnia, Canada, claims to have discovered a new process of refining petroleum without the agency of heat. A sample manufactured from American petroleum of 45 gravity is stated to be a very brilliant and white oil of 48 gravity and 122 fire test. The yield from the crude was 93%. But the most extraordinary claim for this process is not merely that the means used are entirely mechanical, but also that there is no production of gasoline or benzine, and the entire product is standard white illuminating oil, superior to the oil refined under old methods. This new process, if what is claimed for it be true, is just precisely what the producers have been looking for. But how the lighter parts of crude petroleum can, by a mere mechanical process, be retained so as to stand a fire test of 122°, is something truly wonderful, and is simply equivalent to a mechanical decomposition of a chemical compound.

THIS WILL PAY.

ANCIENT LETTERS IN MODERN TATTOOING.

At a recent meeting of the British Anthropological Institute Mr. Park Harrison read a paper on some characters which are still in use as tattoo marks by the Motu, a people located in the southestern peninsula of New Guinea, and described by the Rev. Dr. Turner as a race superior to the Papuans, from whom they differ both in color and customs. About half of the more distinctive forms tattooed on a Motu girl, carefully copied by Dr. Turner, correspond with letters in the Asoka inscriptions in India, which are believed to be allied to Phœnician, while several others resemble letters admittedly derived from the same stock, but independently acquired. The marks are mostly arranged in groups of three; on the right arm, however, nine or ten are apparently connected by a line running above them all. The characters are twenty-three in number, and are formed of straight lines in the following combinations, viz.: five of 2 lines, nine of 3 lines, five of 4 lines, and three of 5 lines, much in the same proportion as in the Rejang and Lampong alphabets of Sumatra, the letters of the former of which have been shown to be identical with Phœnician characters reversed. Archaic forms of letters have also been met with in several islands of the Indian Archipelago and Melanesia, but are now without meaning. The Motu characters are used simply for ornament or as charms. As an example of the use of letters for tattoo marks, the case of the Austrian subject was cited, who, having been taken prisoner in Burmah, a few years ago, was there tattooed with letters and other patterns. Besides the characters on the Motu girl, there were various pictures, or hieroglyphics, consisting of eyes and eyebrows, a lunar crescent, and other forms.

BRAIN WORK AND SKULL GROWTH.

The London *Medical Record* sums up as follows the results of some very interesting measurements of heads by two French physicians, Messrs. Lacassagne and Cliquet:

Having the patients, doctors, attendants, and officers of the Val de Grace at their disposal, they measured the heads of 190 doctors of medicine, 133 soldiers who had received an elementary instruction, 90 soldiers who could neither read nor write, and 91 soldiers who were prisoners. The instrument used was the same which hatters employ in measuring the heads of their customers; it is called the conformator, and gives a very correct idea of the proportions and dimensions of the heads in question. The results were in favor of the doctors; the frontal diameter was also much more considerable than that of the soldiers, etc. Nor are both halves of the head symmetrically developed: in students, the left frontal region is more developed than the right; in illiterate individuals, the right occipital region is larger than the left. The authors have derived the following conclusions from their experiments: 1. The heads of students who have worked much with their brains are much more developed than those of illiterate individuals, or such as have allowed their brains to remain inactive. 2. In students the frontal region is more developed than the occipital region, or, if there should be any difference in favor of the latter, it is very small; while in illiterate people the latter region is the largest.

WOMEN INVENTORS.

The question is often asked us: Do the inventions of women ever amount to anything? From our long experience with inventors of both sexes, we conclude that a larger proportion of inventions patented by women prove useful and profitable than those of the sterner sex. We see by the New York *Sun* that the Metropolitan Elevated Railway Company has selected a device, from the many that have been under consideration, for lessening the noise of the trains, and that it is the invention of a Mrs. Walton, of this city. The plan consists of boxing the rails in a mixture of sand, tar, and cotton, and has been under test for two months on several blocks of the road in Sixth avenue. The ringing of the wheels on the rails, which makes a large part of the objectionable sound, is considerably deadened. She gets, according to the *Sun*, $10,000 for the use of the invention on the Metropolitan line, and the company is to control its adoption on other roads, paying her a royalty.

TOBACCO SMOKE.—The authorities of several German cities, says *Chambers' Journal*, have been seriously considering the evils resulting from smoking, now so generally practiced by boys. In certain towns, the police have been ordered to forbid all boys under 16 to smoke in the streets, and a punishment by fine or imprisonment is meted to offenders. It has been the testimony of several eminent physicians that the too general and excessive use of tobacco is the main cause of color blindness, now occasioning such great anxiety from its influence upon railway and other accidents, and also upon military efficiency.

SIXPENNY PHONOGRAPHS.

(*See page 216.*)

When a great scientific discovery or invention is announced to the world, such, for example, as the telephone of Professor Graham Bell, the microphone of Professor Hughes, or the phonograph of Mr. Edison, it is pretty certain in a short time to be followed first by spurious and unauthorised imitations, which, if the invention be protected, are nothing more or less than direct infringements of the patent, and after that by highly interesting modifications of the apparatus either for the extension of the principle, developing further physical facts, or to analyse those already discovered ; or else for the reduction of the instrument to its simplest possible form, so as to place in the hands of the teacher as well as in those of the million a scientific toy which can illustrate and render familiar the principle which lies at the base of the more important and typical apparatus.

There are few who can have failed to see that both the telephone and the microphone have gone through both these stages; and the phonograph, after having been imitated by amateurs and copied by unlicensed manufacturers, has led to the very beautiful analytical and synthetical apparatus of Mr. Stroh, and has quite recently reappeared as a curious and most interesting scientific toy, and one which we would hesitate to say could not be made applicable to some useful purposes.

The very simple apparatus which we illustrate below is a speaking phonograph that can be made and sold for sixpence or even less, and yet leave a profit to the manufacturer. It is the invention of M. Lambrigot, an inspector of telegraphs at Albi, in the Department of Tarn, in the south of France, and has been brought to this country by M. Hospitalier, whose name is well known in connection with physical and electrical science.

The whole apparatus which is represented in Fig. 1, consists, first, of a hollow cone of pasteboard about 1½ in. in diameter, whose apex is connected to the centre of a similar sized pasteboard disc by means of a lead wire about 16 in. long; and, second, of a small board or tablet, on which is fixed one, or a larger number of short lengths of lead wire, each of which bears upon its upper surface a phonographic embossed record corresponding to a certain word or sentence, by which it was originally produced by a process to be described further on.

To those who are familiar with the construction of the phonograph in the form in which it was first shown in this country, it would appear necessary in order to reproduce the sounds recorded on the tablet, for the edge of the disc to be held in an annular frame so as to convert it into a diaphragm, and for its centre to be thrown into vibration by means of a point or style projecting from it and drawn over the undulatory surface of the record. But the method of using the apparatus is far simpler than that; all that is necessary is to hold the paper cone against the ear with one hand and with the other to take hold of the cardboard disc, drawing its edge along the record with a steady scraping motion, and the mechanical vibrations thus set up in the disc being communicated by the wire to the conical ear-piece which serves as a resonator and concentrator, produce in the organs of hearing the sensation of the articulate sound by which the markings on the leaden record were originally produced. We should have thought that a stout thread or a lighter wire would have formed a more efficient as well as a cheaper connection for the purpose than the lead wire, but we are informed that M. Lambrigot has found the lead to answer the purpose better than anything else; it does not require to be kept stretched between the cone and the disc, and being of a very inelastic nature it does not spring about and produce disturbing sounds by clashing against itself or against neighbouring objects. Again, it would naturally be expected that the ear-piece would be more perfectly adapted to its purpose if it were in the form of that used in the ordinary thread telephone, that is to say if it consisted of a cylindrical cardboard box closed at one end with a stretched paper diaphragm, to the centre of which the connecting wire were attached, but simple as it is, this would undoubtedly be a more complex form of construction than the cardboard cones, and would be far more liable to be destroyed by the weight of the connecting wire. The employment of cardboard as the material of which the principal parts of the apparatus are constructed is, in the case of the cone, for cheapness, and in that of the disc partly for cheapness, but chiefly to protect the markings on the lead record from being destroyed, as they soon would be if a harder material than card were employed.

The most interesting point connected with this very simple apparatus is the method by which the leaden records are produced, which is as follows :—The upper surface of a rectangular prism of glass, or other hard and rigid material, is thickly coated with stearine wax, which is then scraped into a convex form, as shown in the diagram Fig. 2, in which *a* represents the glass bar and *b* the convex coating of stearine. This bar is then fixed into a simple phonographic instrument, which, by means of a screw or other mechanical contrivance, traverses it at a suitable speed below a diaphragm. This diaphragm is rigidly held around its circumference by an annular framework (not shown in the diagram), and is in every respect exactly similar to the diaphragm of an ordinary phonograph. To the centre of this diaphragm is attached a thin flat plate, whose lower end is cut out to a concave curve to fit the convex surface of the stearine *b*. When all is properly adjusted, and the temperature is so arranged as to give to the stearine surface the proper degree of hardness to insure the best results, the handle of the instrument is turned, and at the same time words are spoken against the diaphragm, which immediately set up in it vibrations, which are communicated to the plate or style. While this is moving up and down, following the vibrations of the diaphragm caused by the voice, the stearine coating of the bar *a b* is steadily drawn in the direction of the arrow below the vibrating bar, receiving from it a phonogram similar to that produced on the tinfoil of an ordinary phonograph.

The stearine bar is then coated with a fine surface of plumbago so as to give to it an electrically conducting surface, and it is then electro-plated with copper by the ordinary process. Out of the copper coating so formed the stearine is removed, and a rigid backing of lead or other metal having been run over the outside convex surface of the copper, a firm copper-lined matrix or mould is formed, the whole presenting the appearance shown in Fig. 3, and consisting of a rectangular block having along the centre of one of its sides a semi-cylindrical groove *o* of copper which bears upon its surface certain raised striations corresponding to the depressions which were made by the diaphragm on the surface of the stearine. Into this groove is laid a piece of lead wire of about 3 or 4 millimetres in diameter, and the two being put into a press and squeezed together the surface of the lead wire receives a permanent impression which is an exact reproduction of the original impression made upon the stearine bar. From one copper matrix a very large number of lead impressions may be made, and we are told that the whole process can be gone through and lead wires, each containing the record of a short sentence, can be made and sold with a profit for one halfpenny each.

It is an interesting fact that if a small stick of wood, such as the stem of a common match, be substituted for the disc shown in Fig. 1, and its end be drawn along the copper groove of one of the matrix moulds shown in Fig. 3, articulate speech is communicated equally well to the ear-piece, although the motion of the point is the reverse of that of the disc; and this bears a very close analogy to the fact that in the ordinary Bell telephone a message is transmitted with equal distinctness whether the poles of the receiving instrument be reversed or not.

We have had an opportunity of testing this simple little instrument, and the words come out of it with remarkable distinctness, though of course with but feeble power; and among the following words, all of which we have heard it utter, some were unmistakably clear: "Mon cher ami," "Louis Quatorze," "Victor Hugo," "La République," "Octavie," "Bonjour," "Lambrigot," "Miserable," and "Miracle," and it is a curious fact that while in the phonograph the words "Phonograph" and "How do you do?" come out with exceptional distinctness, so in this instrument the words "Bonjour," and the name of the inventor, "Lambrigot," are the clearest of those we have heard.

It is only fair to Mr. Edison, the inventor of the phonograph itself, to point out that the plan of producing a phonogram on a stearine surface, and afterwards reproducing it in copper by the process of electrolysis, was suggested by him long ago, but we do not understand that M. Lambrigot claims any novelty for that portion of the invention, but more especially for having produced a little instrument at the cost of a few pence, which can demonstrate the action of the phonograph and illustrate some of the most beautiful phenomena connected with the science of acoustics. We must congratulate M. Lambrigot on his success, and upon the very beautiful methods by which he has brought it about, and we hope before long his very interesting little instruments may find their way in large numbers to this country, for it is by the cheapest and simplest apparatus that some the greatest discoveries of science are made, not on account of any intrinsic merit in cheapness, but because popular instruments, accessible to thousands, often give to individuals a first taste for scientific investigation, starting them on a research which may lead to great things, and out of the multitude of workers which such inventions instigate, some discoveries are well-nigh certain to be made.

Fig. 1.

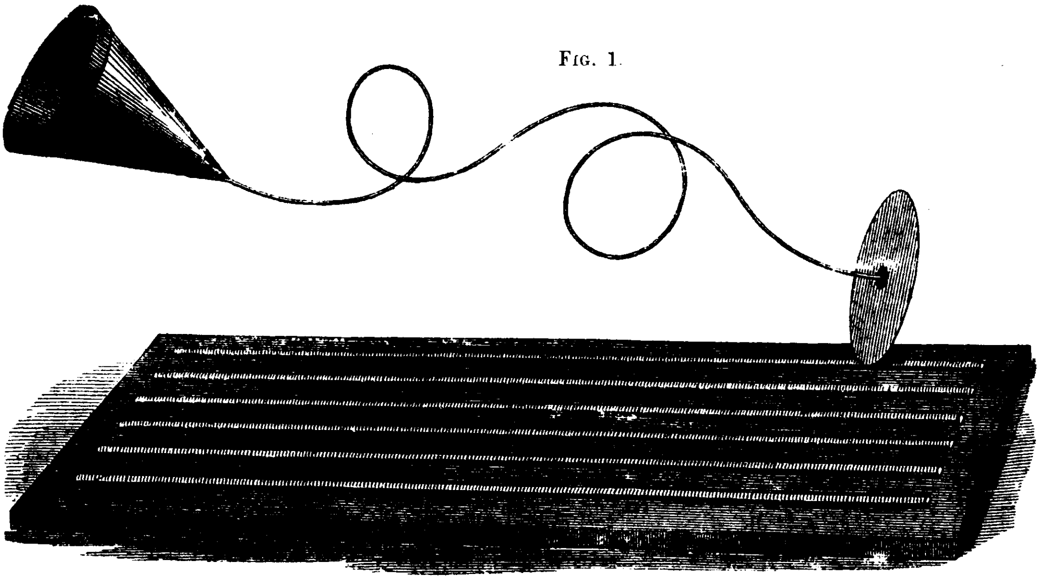


Fig. 2.

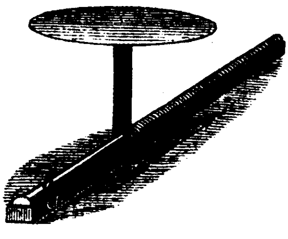
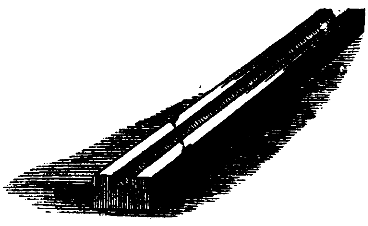


Fig. 3.



SIXPENNY PHONOGRAPH.

IMPROVED MILLSTONE VENTILATOR.

The illustrations, Fig. 1 and 2, illustrate the invention of Mr. Herman F. Stinde, of Steeleville, Ill., the object of which is to ventilate millstones, to obviate the heating which usually occurs so that the stones in operation or during grinding can be kept cooler and a higher speed be maintained ; also to produce a better quality and larger quantity of product. The millstones and casing require no special arrangement ; the device can be attached to those of usual construction. Fig. 1 is a perspective view of the ventilator, looking slightly from below, and shows clearly its shape and construction, and fitting to the eye of the runner stone. Fig. 2 is a section of the runner stone *A*, *B* representing the air-conveyor of ventilator, having internal ducts, chambers or passages *b*, *b*, *b*, *b*, that during the operation of grinding produce the required ventilation between the stones. The feed-tube enters the centre opening, *C*, in the ventilator, so as to properly discharge the grain in and through the eye in the usual manner. The air is first caught or drawn into the eye of the runner. This result is secured by the series of ducts that constitute the top part of the ventilator, which revolves with the stone, catching the air, causing it to enter each of the ducts during the revolution of the runner. The air after entering the ducts is carried through their spiral continuation, discharged at the bottom of the ventilator, passes out from the eye of the runner and out between the stones in the manner and direction indicated by the arrows. The runner stone is also provided with wings or flanges, *E*, that project upward from the top face of the stone and are placed in a direction tangential to the eye of the runner. During operation the wings cause the cold air to be directed from the centre toward the periphery of the runner, supplying cold air between the skirt (periphery) and the inclosing curb. The escape for the entered air between the stones and the curb discharges or finds its outlet through the usual meal-spout, but Mr. Stinde prefers by means of an extra spout leading to a setting-chamber, to direct the air-discharge in an upward direction, in order that the flour-dust can settle or be collected in the settling chamber. Here Mr. Stinde would call attention to a prime factor for the prevention of flour-dust explosions, inasmuch as his invention prevents the heating which the meal usually incurs in grinding, and necessarily adding to the danger of such accidents. Our space does not admit of further description of this invention.

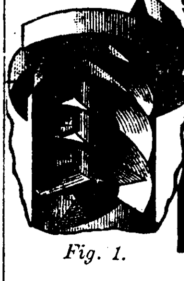


Fig. 1.

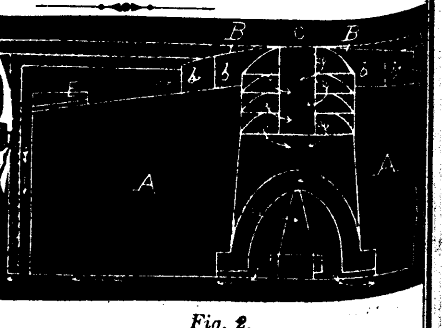
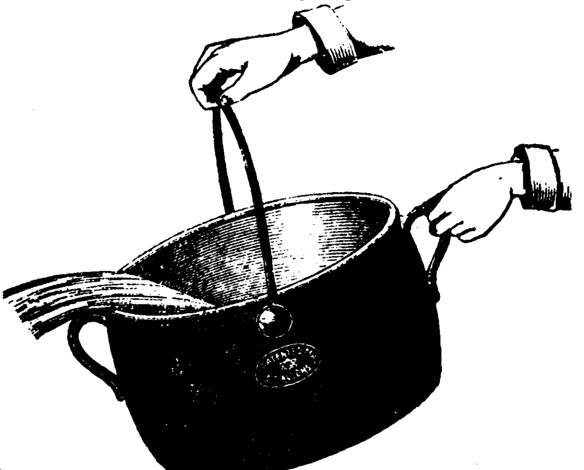


Fig. 2.

MILLSTONE VENTILATOR.

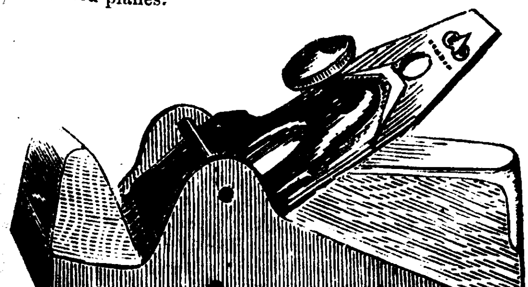
NEW CROSS-POT BAIL OVAL POT.

Messrs. T. and C. Clark & Co., of the Shakespeare Foundry, Wolverhampton, are now bringing into the market a most acceptable invention for domestic purposes, namely, a newly-patented stop bail-handle for oval and other pots. As will be seen from our illustration, the handles of this new cooking utensil are so fixed that when the bail is not needed it is not in the way, while the jug handles at each end will do duty in the place of bow handles. This is a great advantage, since the objection to the ordinary bow handles has always been that when they are riveted to the body the rivets are liable to rust. The bail is so constructed that in the emptying process the vessel is stopped at just half-way instead of its top edge falling on the hand of the person using it, so that there is no risk or danger of persons pouring hot water out of the pot being scalded or burnt. Another advantage this cross-stop bail oval pot possesses over the long bail is, that when a steamer—now much used for cooking turkeys and hams—is put on it, the jug handles can be used to move the pot about with. The makers have recently added to their potato steamer a tinned fish strainer, which supplies a new use for these improved oval cooking pots, namely, that of a fish-kettle—an article only to be found in the best of furnished houses. The general utility of the oval pot just described will be obvious to ironmongers, as it will save them the labor and trouble of keeping a stock of two kinds of pots, one for the open fire, and the other for the cooking range.



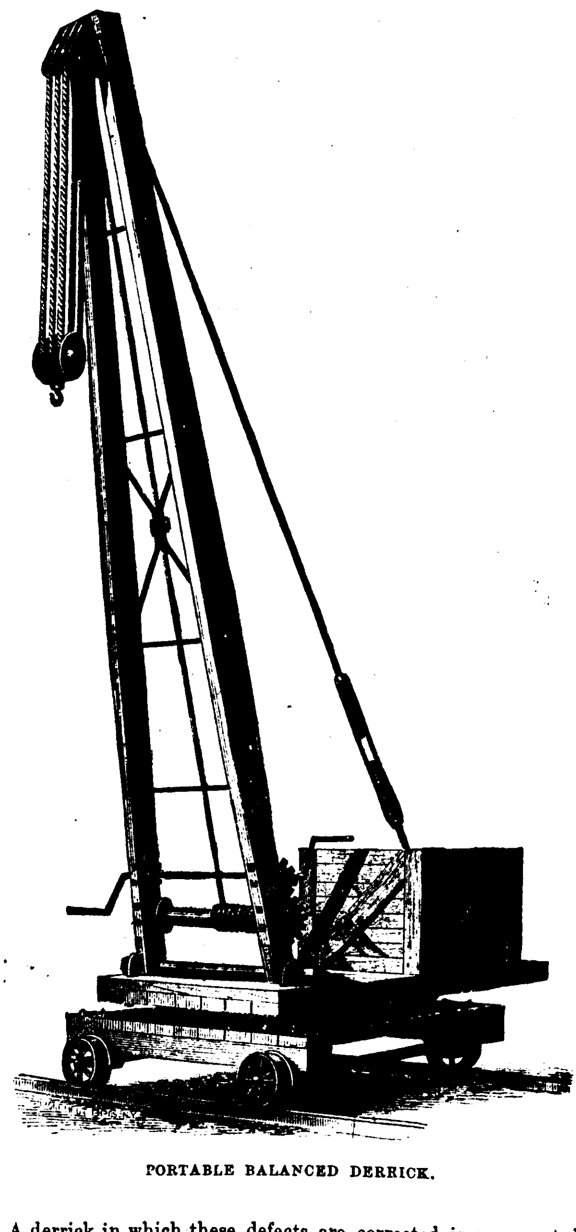
CHEAP SMOOTHING PLANE.

The subjoined illustration shows a new pattern iron smoothing plane, manufactured by Mr. E. Preston, of Birmingham, for which he has found a ready sale. We are not surprised at this, for it seems a really strong and well-made tool, specially designed to meet the wants of joiners, carpenters, and wheelwrights who do not care to go to the price of the more costly wrought iron planes. Considering that about two-thirds of the composite plane is made of iron and steel, the article is comparatively light, and we are assured that it will do its work equally as well as the higher priced planes.



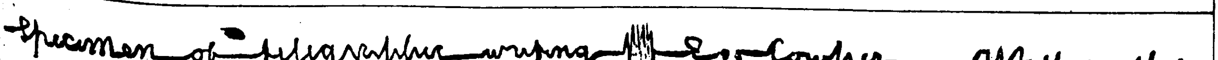
PORTABLE BALANCED DERRICK.

Almost every one is acquainted with the common derricks used for hoisting building material for the erection of fronts of houses; they are still of primitive construction, troublesome to move about, and the ropes intended to keep them in position are inconvenient, as they always require an attachment by back guys to a kind of anchorage in the rear; but the principal inconvenience is that the material has to be brought just in front of them, as they can only lift, but are incapable of sideward transportation.



PORTABLE BALANCED DERRICK.

A derrick in which these defects are corrected is represented in the adjoined engraving. It is the invention of Mr. Frank Lyons, who recently obtained a United States patent for the same. The first improvement is that it stands on a second lower platform, which is supported by wheels running on rails laid down for temporary use. By this arrangement it is easily moved about sideways, even while a load is hanging on it. The second improvement is that the ropes supporting it in position, or the



THE WRITING TELEGRAHH.

back guys, are not attached to an immovable anchorage in the rear, but to the end of the upper platform which carries the frame ; on the other end of this platform a counterpoise keeps it in position, while this counterpoise can be increased at will, if, during the raising of a load, it is found that there is a tendency of the rear end of the platform to be lifted. This way of steadying the derrick possesses the advantage of securing a free motion in all directions, and makes it possible to apply the third and most important improvement, which is that the platform-car supporting the frame has on its top a circular rail with a set of rollers, of which the axes are placed like the radii of a circle, and on the top of which another circular rail turns easily. This latter rail is attached to the upper platform of the derrick, carrying the beam, counterpoise, etc., and thus the whole arrangement can be turned on its axis, and, for instance, a stone lying behind the derrick, be lifted, brought forward, and carried to its place of deposit.

It will thus be seen that this derrick can not only be moved from right to left with the greatest ease, running as it does on a straight track, but also that it can turn around on its circular track between the two platforms, and so its usefulness, convenience, and labor-saving properties are evident, as it renders it possible to largely diminish the labor of handling the material.

There is a turn-buckle in the guy rods, intended to lengthen or shorten them, and thus change the angle under which the frame or legs can be placed.

The steadiness is secured by having all the supporting parts as low as possible, so that even the upper platform is little above the ground, while every part is made very strong, substantial, and of the best material.

This balanced derrick is also made on a larger scale, in which case steam-power is employed to do the hoisting. In this case the hoisting engine and boiler are placed on the rear end of the upper platform, and at the same time serve as a counterpoise to the load in front. Of course, in this case the platforms are built larger and heavier, and an extra rail laid down in the middle between the two others, in order to support the lower platform better, and to secure the equal working of the circular rail.

Such a balanced steam derrick is very suitable for building bridges, viaducts, churches, or other large buildings ; to work in quarries, on railroads, docks, stone-works, foundries, and other places where heavy material has to be moved or hoisted. It would be especially useful on docks where a track has been laid lengthwise and the derrick can move about, unload vessels, and deposit the load on the pier or on wagons, or, inversely, to take heavy loads directly from waggons, and, by turning, bring them over the vessel and deposit them in the hold.—*Manufacturer and Builder.*

THE FIRE-PLACE IN SUMMER.

A fire-place, large or small, may not only have its unsightliness covered, but it may be made an attractive and beautiful feature of the room by converting it into a fernery. It is well, to prevent all injury from water, to have a shallow pan or tray made of galvanized iron ; this should fit the floor of the fire-place, extending as far forward upon the hearth as may be desirable, with its edges turned up all around for about two inches. This is the only expense attending it ; all the rest is to be furnished by the woods and fields, and is vastly more easy to those who live in the country than to dwellers in towns—though these, if they have a taste for rambling, will find a way to accomplish it. Moss-covered rocks are preferable ; these are to be disposed in a natural manner ; woods-earth is to fill every crevice between and under the stones, and fill the pan. Bring home ferns of all kinds as soon as they show themselves, taking up good clumps of earth with them. Place the kinds known to be tall-growing at the rear, the smaller in front, disposing them in an informal manner. Then cover all of the earth with sheets and tufts of moss to make a complete carpet of green. If in getting the moss some of the low plants, such as Partridge-berry and the like, are taken up, all the better. If the fire-place admits of it, arrange some kind of shelf or support within the chimney and *above* the opening, upon which may be set pots or fruit cans of Ivy and other vines, which may hang down naturally, or be trained along the mantlepiece. The engraving of an old-fashioned fire-place thus treated will give an idea of the plan. Most ferns love shade, and if supplied with water, will flourish ; when any are found not to like it, replace them by others. The sole care will be watering ; let the soil be moist at all times ; but never *wet* and muddy ; water by sprinkling, as this will keep the plants free of dust and add to their beauty. Those who are fond of such things may not only hide the fire-place, but derive much pleasure from the care of such a fernery.—*American Agriculturist.*

The Love of Beauty.—Everything which surrounds us is an influence. We are surrounded with beautiful things in the world, and it is our duty to make our homes look as beautiful as possible. Everything we have in our houses, every glass and jug, every painted door and table, is an influence, an association, out of which the mind receives its instruction, even more than that which the pedagogue conveys in school. Therefore, art is nothing more nor less than the recognition of the example set us by God. I should be sorry to limit art to a mere canvas and statuary exposition of it. The basis of all good art—of painting, statuary, and architecture, and the ornamentation of domestic vessels—is a constant acknowledgment of the beauty of the external world, out of which can only come good art. The craving for this art is perfectly universal. The savage who carves his spear and war instruments, and paints his body, evinces a leaning towards things that are beautiful. The commonest hind, who cultivates his small plot of land with flowers, is declaring an inward and conscious sense of the beauty alluded to. Therefore, the manufacturer, the designer of every class, and the workman, instead of working from the thought that he is merely catering to a luxurious feeling, should labour rather with the consciousness that he is labouring to cultivate and raise that which in the human mind is a natural instinct. To the designer—and house-painters and architects are among this class—a true sense of art is indispensable ; that he should think for himself, and not be continually reproducing what has been done before. Take the ordinary house painter ; a man thoroughly educated for his business would for $2.00 make a cottage an arena of excellence. Shopfronts and signs, and all these things, are influences. It is impossible to live opposite an ill-painted shop-front without being morally the worse for it. We are continually talking of our inferiority to France and Germany in designs. In these countries every man has received an education in art, from the designer to the lowest kind of workman, to enable him thoroughly to understand and to love the work to be done. These are the men to make work beautiful, and to do justice to the designer.

Spotted Fruit.—*La Science pour Tous* says that Mr. Duchartre presented recently to the Academy of Sciences at Paris a paper by M. Prillieux on the dark spots which appear on the skin of apples and other fruits, giving the results of observations as to whether or not these and the cracking of fruits were due or not to parasitic fungi. He finds that there is "unique" proof that disease is due to the presence of a fungus, which not only penetrates the epiderm, but also the solid tissue of the fruit. The fungus attacks the leaves and branches, as well as the fruit, and thus travels by means of propagation by drafts. And this is the chief reason why it often seems to be confined to one variety of fruit. The name of the small fungus is *Cladosporium dentriticum* of Wallroth. M. Duchartre pays a compliment to the address of the Pomological Association at Chicago, in 1875, by Mr. Thos. Meehan, of Philadelphia, and contends that the observations there noted correspond with the recent researches of M. Prillieux, and which prove, he says, that on both sides of the Atlantic "microscopic fungi clearly exist."

Recuperating the Brain.—An intelligent writer on this subject thinks the use of stimulants to fortify the exhausted brain an unwise measure. The best possible thing, he says, for a man to do when he feels too weak to carry anything through is to go to bed and sleep as long as he can. This is the only recuperation of the brain power, the only actual recuperation of brain force ; because during sleep the brain is in a state of rest, in a condition to receive appropriate particles of nutriment from the blood, which take the place of those which have been consumed by previous labor, since the very act of thinking burns up solid particles, as every turn of the wheel or screw of the steamer is the result of consumption by fire of the fuel in the furnace. The supply of consumed brain substance can only be had from nutritive particles in the blood, which were obtained from the food eaten previously, and the brain is so constituted that it can best receive and appropriate to itself those nutritive particles during the state of rest, of quietness and stillness of sleep.

It is said that the oil that exudes from orange peel when bent between the fingers, will check the progress of carbuncles in their incipient stage. Perhaps the oil may also be useful for other cutaneous eruptions.

ELEVATED RAILWAYS ON A NEW PLAN.

According to the Chicago *Commercial Advertiser*, a plan is on foot in that city for the construction of an elevated railroad on a greatly improved plan. Its advantages over other systems are stated to be very great. It the first place, it is perfectly noiseless; the rattle and roar caused by the usual vibrations and echo produced by the running of trains to and from stations is obviated. Thus the inventor (a Mr. Patterson) has solved the problem which Mr. Edison was working out a year ago. It is impossible for the train to jump the track, no matter what the rate of speed may be, thereby insuring safety to passengers and the public underneath. The trucks and underwork of the car are out of sight, being inclosed by ornamental ironwork the entire length of the road. The steam brakes employed are inclosed, and disagreeable noise by the exhaust is avoided. The steam from the engine is exhausted under a casement and condensed, is not seen or heard, and is noiseless. It is also claimed by Mr. Patterson that the many objections caused by darkness of stories and streets is overcome. It does not cast a shadow as much as an ordinary awning. It is said also that the road can be built much cheaper than any now in use, is more substantial, less objectionable to property owners, and does not occupy more space on the pavement than an ordinary telegraph pole, and so arranged as to carry the telegraph wires, thereby doing away with the poles.

LIFE-TIME OF A LOCOMOTIVE.—The iron horse does not last much longer than the horse of flesh and bones. The ordinary life of a locomotive is 30 years. Some of the smaller parts require renewal every six months; the boiler tubes last five years, and the crank axles six years; tires, boilers and fire boxes from six to seven years; the side frames, axles, and other parts, 30 years. An important advantage is that a broken part can be repaired, and does not condemn the whole locomotive to the junk-shop; while when a horse breaks a leg the whole animal is only worth the flesh, fat and bones, which amounts to a very small sum in this country where horse flesh does not find its way to the butcher's shambles.

BESSEMER STEEL FOR CUTLERY.—The Sheffield correspondent of the *Engineer* states that efforts are being made in the Bessemer trade to bring out special makes of Bessemer steel for cutlery purposes. These makes are now varied to any given temper. Up to this time the greatest obstacle in using Bessemer for cutlery purposes has been the variations of temper—each rod almost varying so as to cause great difficulty in the hardening. This difficulty has been overcome by the making of specialties, which are offered for even less than what is charged for rail ends, $26 in ingots, as against $45 for "cast." It is said that the Bessemer at $26 is considered equal to the "cast" at $60.

ADHESION OF MORTAR.—In building the Pont de Claix, some experimental blocks were joined by mortar which was allowed to harden for three years, when the mortar was broken by an average load of 142,228 pounds per square inch. This experiment seems to show that the adhesion of mortar to stone is only about one-third as great as the cohesion of the mortar itself. The result is noteworthy, as this adhesion is the true measure of the resistance of masonry. Further experiments of a similar kind are desirable, in order to establish formal conclusions.

INCREASE IN THE DEMAND FOR BESSEMER STEEL.—Fourteen years ago there was only one Bessemer steel establishment in the country. Now there are eleven, with an annual production of more than 500,000 tons.

Useful Information.

TO REMOVE GREASE AND PAINT SPOTS.—The *Manufacturer and Builder* gives the following useful hints under the above head: The treatment varies according to the material; white linens stand alkaline lyes, while cotton, especially when colored, does not stand it so well, and wool or silk not at all. To take grease spots out of linen, cotton or wool, first try soapsuds; if these do not take them out perfectly, you may use a potash or soda lye for linens; for wool it is best to use ammonia, or strong soap-suds mixed with ammonia. If the grease spots are produced by the drippings of a stearine candle, which often happens, use strong alcohol; this is also good for silk; but ordinary grease cannot be taken out with alcohol; it is necessary to use ether or benzine, and in any case to rub carefully with a clean rag, so as to remove the dissolved grease. Do not (as we have often noticed some persons do) merely pour some benzine on the grease spot and let it dry up; if you do not rub it out the whole operation is of no use. Silk requires great care, as also does paper, and it requires some experience to become an expert. One method, especially adapted for removing grease spots from light-colored silks and valuable papers, is to cover the spot with pulverized magnesia, chalk, fuller's earth, or pipe clay; lay a paper over it and then press with a hot iron; the heat will liquify the grease and the powder will very readily absorb it. The yoke of an egg and ox bile are also recommended for silk, and soap also when used with care. In regard to varnishes, they are usually soluble either in turpentine or strong alcohol of 95°, and more easily removed than some oil paints. The most obstinate of the latter is zinc white, which, in combination with linseed oil, forms a hard white crust, which, as it resists most the above-mentioned solvents, is very difficult to dissolve out when it has penetrated into the texture, and especially when the material is woolen cloth.

CONSUMPTION OF RUBBER.—The consumption of rubber by our manufacturers continues as large as ever, imports amounting to about 12,000,000 pounds per annum, chiefly from South America. The price ranges from 20 to 50 cents per pound, the cheaper grades coming from Africa and the finest from the valley of the Amazon, where the trees producing it abound over a vast region, one-half of the entire yield going to the United States. The consumption in the manufacture of shoes equals the demand for all other purposes. In the manufacture of rubber from 3% to 10% of sulphur, and various metallic oxides—chiefly lead and zinc—are combined with it; the quantity of the latter depending on the degree of elasticity and other properties required in the article to be manufactured; and to judiciously combine these substances with the rubber in suitable proportions to produce the desired end, as well as in properly vulcanizing it afterwards, requires great experience and skill. A certain degree of honesty on the part of the manufacturer is also essential to abstain from introducing mere adulterating substances into his "compounds," and thus cheapen the product at the expense of its quality.

PROCESS FOR PREPARING SULPHATE OF BARYTA FOR PAINTING.—Pure amorphous sulphate of baryta may be used as a water color, but not as an oil paint. The sulphate gained by precipitation by sulphuric acid of the chloride or some other soluble baryta salt, called "blanc fixe," forms, mixed with linseed oil, a glassy, granular mass. The precipitate obtained by a solution of sulphate behaves similarly, although in an inferior degree. Meissner proposes to dry the precipitate obtained by means of a sulphate, and heating the same as soon as possible after precipitation to a red heat in a muffle. The mass is, while yet glowing, thrown into water. By this sudden change of temperature the sulphate of baryta is altered to a considerable degree. After being dried, ground and levigated with a small quantity of linseed oil, it is mixed readily with the required proportion of the latter, and forms a white paint equal in all respects to white lead. If the paint shall merely serve as a body for different shades of other colors, the latter must be added to the water.—*Deutsche Gewerbe Zeitung.*

COVERING FOR BOILERS, STEAM PIPES, ETC.—A French firm is using a composition for covering boilers, steam pipes, and similar articles, which is certainly cheap and said to be very effectual. The surfaces are covered with sawdust mixed with flour paste. If the paste is not very liquid, the mixture being used in the form of moderately stiff dough, and the surfaces of the boilers or pipes have been well cleaned from grease, the adhesion is perfect and the material is free from cracks. Five layers of this composition are recommended, each about one-fifth of an inch thick. It is said that one-inch of this composition will give better results than double that amount of the materials usually employed. The paste is composed of rough flour without the addition of starch. The mixture can be applied without a trowel, and, if there is much exposure, two or three coatings of tar will render the composition impervious to water. Copper tubes should first be treated to a hot liquid solution of clay, so as to increase the adhesion of the sawdust.

WEAK EYES.—Bathe in soft water that is sufficiently impregnated with spirits of camphor to be discernible to the smell; a teaspoonful of spirits of camphor to a tumbler of water. For inflamed eyes use milk and camphor, adding a little more of the camphor than above.—*Herald of Health.*

IMITATION MARBLE.—A German glass company near Freden, Hanover, make imitation of marble from glass, which, on account of its superior hardness, is preferable for some purposes. They imitate marble tables and floor slabs.

Machine Construction & Drawing.

(From *Collin's Elementary Science Series.*)

(*Continued from page 220.*)

from the column the numbers for the wheel nearest to the one required is very small* and practically inappreciable. The remaining columns contain respectively the numbers for the centres of the faces and for the flanks of the teeth of the wheels given in the first column, for pitches advancing by quarter inches from 1″ to $2\frac{1}{2}$″, and for a pitch of 3″. The numbers for intermediate pitches may be found by direct proportion from those given; thus, for $\frac{1}{2}$″ pitch, by halving those of 1″ pitch; for $3\frac{1}{2}$″ pitch, by doubling those of $1\frac{3}{4}$″ pitch; and so on for other pitches.

69. An example will explain how to use the instrument. In figs. 126 and 127, Plate XV., A is the centre and PC the pitch circle of a wheel of 29 teeth, $1\frac{1}{4}$″ pitch. Fig. 126 is drawn to a scale of $\frac{1}{4}$, and fig. 127 shows a portion of the former figure drawn full size. Let it be required to describe the teeth of the wheel. From A draw any radial line AB cutting the pitch circle in *m*, from *m* set off along the pitch circle *m*D, *m*E, each equal to one half of the pitch; from D, E, draw radial lines DA, EA. For the flank of the tooth place the line CT of the instrument upon the line AD, so that T coincides with D; now look to the table of *centres for the flanks of teeth*, and in the column of $1\frac{1}{4}$″ pitch, opposite 30 teeth (nearest to 29) is the number 21. The point numbered 21, counting from T to A, on the *scale of centres for the flanks of teeth* is the centre required; we will call the point *h*; and from *h* as a centre with a radius *hm* describe the arc *mp*, which is the required flank. To describe the face place the line CT upon AE; in the table of *centres for the faces of teeth* opposite 30 will be found the number 9, counting from T to B; mark off this number from the *scale of centres for the faces of teeth;* we will call the point *k*; from this point as a centre with a radius *km* describe the arc *mn*, which is the required face. By repeating these curves the other side of the tooth can be drawn, and also the remaining teeth. From A as a centre with radius A*h*, A*k*, respectively, describe circles *hq*, *rk*. These circles contain the centres (*h*, *k*) of all the teeth, which are to be described with the radii *hm*, *km*. We will apply the instrument to draw the teeth of a rack and pinion.

70. Rack and Pinion.—Figs. 128, 129, Plate XVI., represent, in elevation and plan, a rack and pinion in gear; the pinion A has 16 teeth, 1″ pitch; B is the rack, the pitch line of which is a tangent to the pitch circle of the pinion at the point *b*. Having drawn the centre lines, describe the pitch circle PC of the pinion, which is 5·091″ or $5\frac{3}{32}$″ diameter, and draw *pl* the pitch line of the rack; divide the circumference of the pitch circle into 16 equal parts, mark off the thickness of each tooth on the pitch circle, one half on each side of the points *s*, *t*, *u*, &c., then mark off the top and the bottom of the teeth from the first list of proportions given in Art. 66, page 51, and describe circles for them, as shown in the top left-hand quadrant of fig. 128. Now divide the pitch line of the rack for the teeth, so that a tooth of the rack shall be in contact with a tooth of the pinion, as at *a*, the pinion being the driver and turning in the direction indicated by the arrow.

To describe the teeth for the pinion, find the points *h* and *k* for the flanks and the faces of the teeth, as in Art. 69, page 54, the numbers being 40 and 6; through *h* and *k* describe circles having P for centre. These circles will contain the centres *h* and *k* for all the teeth; with *hm* and *km* as radii, describe the flanks and the faces of the teeth. In fig. 129 one half of the pinion is in section, as made by a section plane S_1P_1, fig. 128; the other half shows a projection of the teeth. The teeth of the rack are obtained in a manner similar to those of the pinion, as is shown in fig. 130, where *pl* is the pitch line, and where D, *m*′, and E, are points corresponding to D, *m*, and E, in fig. 127; AD and AE are drawn perpendicularly to the pitch line, because *pl* is a straight line. The points

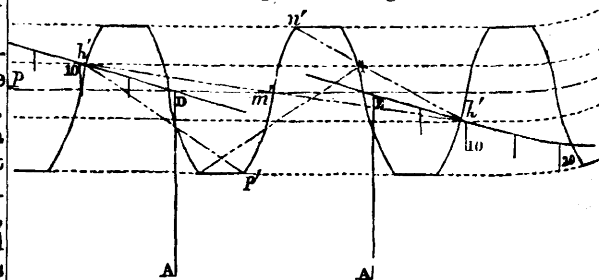


Fig. 130.

h′, *k*′, are obtained from the scales in the same way as for the pinion; the numbers 10 for the flanks and the faces are taken from the bottom line of the tables.

The teeth of the rack in fig. 128 are described in the same manner as those in fig. 130.

71. A Spur Wheel and Pinion in gear is shown in figs. 131, 132, Plate XVII. The pinion A is the driver, and the wheel B the follower; the former turns in the direction indicated by the arrow; the latter will therefore turn in the opposite direction. The teeth are of the same form as those previously described in Art. 69, and the pitch is $1\frac{1}{4}$″; A has 19 teeth, and B has 50 teeth. The diameters of the pitch circles are by equation (3), Art. 50, page 43, for A 7·558″ or $7\frac{9}{16}$″, and for B 19·890″ or $19\frac{7}{8}$″

Having drawn the centre line *ay*, fix upon a point for the centre of one of the wheels, say, E for the pinion A; from E mark off along *ya* E*b* = $\frac{1}{2}$ of $7\frac{9}{16}$″, and from *b* mark off *b*D = $\frac{1}{2}$ of $19\frac{7}{8}$″; through E and D draw the centre lines *dx*, *ez*. From E and D as centres with radius E*b* and D*b* respectively, describe the pitch circles PC, and circles for the top and the bottom of the teeth, taking the proportions for these and also those for W and B from fig. 121, page 52, and the list given in Art. 72. The teeth are to be described as shown in Art. 69; the centres *h* and *k* are taken from the tables of $1\frac{1}{4}$″ pitch, Plate XIV. The numbers for the faces are for A, 8, and for B, 10; which are the numbers for wheels nearest to the required ones. Those for the flanks are taken between 37 and 31 for A, and between 18 and 15 for B, which are the numbers for wheels of 18 and 20 teeth, and 40 and 60 teeth respectively.*

The pinion is solid, with facings on each side 4″ diameter, and $\frac{3}{16}$″ thick; the hole is 2″ diameter, and $3\frac{1}{4}$″ through; the key is $\frac{7}{16}$″ square. The wheel has six arms of a cross-section shown at X, fig. 131, as made by the plane S_1P_1; they are connected to the rim R and the boss K by feathers F, F; on both sides of each arm are

* The error in the curves for a wheel of 3″ pitch is less than $\frac{1}{100}$ of an inch.

* See foot-note to Art. 68,

feathers H, which also join the rim and the boss, the whole being cast together. The boss is 5″ diameter, and 4″ through; the hole is $2\frac{1}{2}$″ diameter, and the key is $\frac{1}{2}$″ square.

72. The proportions of the several parts are as follow:—

The pitch . . .	(=1·25″)	$=p$.
Top of the tooth T		$=p\times$ ·33.
Bottom of the tooth B		$=p\times$ ·42.
Total depth of tooth T+B . . .		$=p\times$ ·75.
Thickness of tooth on pitch line W .		$=p\times$ ·45.
Space between teeth on pitch line S .		$=p\times$ ·55.
Thickness of rim R		$=p\times$ ·45.
Thickness of arms G		$=p\times$ ·45.
Width of feathers F, F . . .		$=p\times$ ·45.
Thickness of feathers H, F . . .		$=p\times$ ·45.
Thickness of boss round shaft K . .		$=p\times$ 1.
Usual width of teeth L		$=p\times$ 2·5.

CHAPTER X

73. The change of rotary or circular motion into reciprocating rectilinear motion by means of the Crank, the Eccentric, and Cams.

The Crank.—In this chapter we shall consider the change of motion as stated above, taking for the first example the crank and connecting-rod, which is the most common arrangement used. The crank consists of an arm AC, fig. 133, Plate XVIII., which turns about a fixed centre C; the end A therefore describes a circle at each revolution of the arm. Attached to A is one end A of a connecting-rod A*a*, while its other end *a* moves in the straight line *ba*CD. In this example we shall consider the crank to be the driver, because then the change is from circular to rectilinear motion; and we shall suppose it to be turning in the direction indicated by the arrow. For every revolution of the crank-arm AC, the end *a* of the connecting-rod moves through the space *bd* + *db*; or, in other words, if the crank starts from the initial position CD and moves in the direction DAB, and *a* starts from *d* moving in the direction *db*, at the same instant that A arrives at B, *a* will arrive at *b*; for the other half revolution B3D of AC, *a* will move from *b* to *d*. The distance *bd* (=BD) is termed the *stroke* of the crank, and is equal to 2AC. A being the centre of the *crank-pin*, the circle DAB is called the *path* of the crank-pin; the length of the path of the crank-pin is nearly 3·1416 times the length of the stroke.

74. Owing to the obliquity of the crank AC, which varies for every new position on each side of BD, except the positions BC, DC, the end *a* of the connecting-rod *a*A does not pass through equal spaces for equal arcs described by the crank. A common problem is to find the position of *a* for any given position of A, and *vice versâ*. By taking a number of positions for A we can find corresponding positions for *a*, and thus show the varying motion of *a* resulting from the regular motion of A. Divide the circumference of the semicircle B3D, fig. 133, into any convenient number of equal parts, say six; and from 1, 2, 3, &c., as centres with a radius equal to the length of the connecting-rod A*a*, describe arcs of circles cutting *bd* in 1, 2, 3, &c.; then the distances between *b*—1, 1—2, 2—3, 3—4, 4—5, 5—*d*, represent the spaces moved through by the end *a* of the connecting-rod for the equal arcs B—1, 1—2, 2—3, 3—4, 4—5, 5—D, described by the crank. The motion of *a* when it is in the position *b* is 0; in passing from *b* to 3 it increases from 0 to its maximum; and from 3 to *d* it decreases to 0; the point *c* marks the middle position of the path of the sliding end *a*. This variable motion of *a*, especially its decreasing at each end of the path, is of great advantage in some kinds of machinery.

75. In the steam-engine the reverse of the motion just described takes place; the sliding piece *a*, connected to the piston-rod of the engine, becomes the driver; the change is therefore from rectilinear to rotary motion.

76. In figs. 134, 135, Plate XVIII., is shown in plan and elevation one form of wrought-iron crank and crank-shaft, the whole being welded together. AC is the crank-arm, A the centre of the crank-pin B, C the centre of the crank-shaft, and D, D, are its bearings. The following are the dimensions:—AC ($\frac{1}{2}$ the stroke) is 7″; the diameter of the crank-shaft is 4″, the bearings are 6″ long and $3\frac{1}{2}$″ diameter; the crank-arms are 4″ wide at *e*, and $2\frac{1}{2}$″ thick at *f*; the distance *g* between the arms is $4\frac{1}{4}$″.

77. The drawing of these figures requires no special notice except for the curves *ab*, fig. 134, which we will now explain. Figs. 136, 137, represent a portion of the former figures, containing the curve *ab* drawn full size, and the mode of obtaining the plan of the curves. If the crank-arms, which are of a rectangular cross-section, were connected to the shaft, leaving angles at E, as AEB, fig. 137, the curved line *ab* would be a straight one *eb*; but for the purpose of strengthening such connections, angles are always avoided when circumstances permit; the angles AEB are *filled-up* leaving the outline, as seen at A, 1, 2, &c., to B, a quadrant of a circle, which is a projection of A′B′, fig. 136. This circular filling-up is continued on each side of A′B′, as shown at A′*a*′, B′*b*′. If we take sections as *kl*, *a*′*p*′, which do not pass through the centre of the shaft C, the plans of *mn*, *a*′*b*′ will not be circular as AB. The general problem will be to find the form of the curve made by such cutting planes. In the present case the cutting plane is represented by the surface *a*′*b*′*p*′, the cut portion of the circular filling-up being *a*′*b*′, of which we are required to show the plan. Divide AB into any number of parts, 1, 2, 3, &c., not necessarily equal parts; and through these points draw lines parallel to AA′ cutting A′B′ in 1, 2, 3, &c.; from C as a centre with radii C1, C2, C3, &c., describe arcs of circles cutting *a*′*b*′ in 1′, 2′, 3′, &c. From these points draw lines parallel to AA′ cutting lines drawn parallel to A*a* from 1, 2, 3, &c., fig. 137; and number the intersections of these lines I, II, III, &c. Through I, II, III, &c., draw the line *ab*, which is the required projection of *a*′*b*′.

78. We have employed the construction just described to find the form of the line joining *ab*; to do this we have divided the portion of the solid between A*a*, B*b*, by a number of vertical planes, which are represented by *q*1, *r*2, *s*3, &c., in fig. 137, and by 11′, 22′, 33′, &c., in fig. 136; the projections of the intersections of these planes with *a*′*b*′ are the points 1′, 2′, 3′, &c., in fig. 137, and I, II, III, &c., in fig. 136, which when joined are the required line. The number of sections to be taken depends upon the degree of accuracy with which the curve is to be delineated. In scale drawings it is not usual to make constructions for such curves as the one described; the draughtsman, by frequent application, knows the form, and makes use of an approximation, which is a good one or otherwise according to his ability to describe the curve accurately.

79. A common form of cast-iron crank is shown in figs. 138, 139, drawn to a scale of $\frac{1}{24}$, the drawing of which

(*To be continued.*)

Scientific.

THE CONSTITUTION OF METEORS.—The Paris Academy, says *Nature*, has just awarded the Lalande medal to M. Stanislas Meunier for his researches into the constitution of meteors. M. Daubree had already shown that there existed a close connection between these falling bodies and the lower strata of our own globe. M. Meunier has carried the same line of research further, and proved that this analogy is not confined alone to mineralogical constitution, but that it extends to the relations which these cosmical materials, disseminated in space, present when compared amongst themselves. The academy considered that M. Meunier had reason to conclude from his experiences that all the masses once belonged to a considerable globe, like this earth, of true geological epochs, and that later it was decomposed into separate fragments, under the action of causes difficult to define exactly, but which have more than once been seen in operation in the sky itself. Such a conclusion, it is remarked, adds greatly to the interest attaching to these "minute stars." The astronomer, once occupied only with their motions and their probable distribution in space, finds himself confronted with a sidereal geology, as he already was under the necessity of having regard to celestial physics, celestial chemistry and celestial mineralogy.

PROF. TYNDALL ON THE ELECTRIC LIGHT.—Prof. Tyndall, who was recently examined before the Parliamentary Select Committee, gave a brief history of the discovery of electricity for lighting purposes, illustrating his description by a series of experiments. Volta's discovery, he said, had the power of producing heat and light, and if his conception was correct it would have been tantamount to the introduction of perpetual motion. The voltaic battery, however, was not an economical mode of producing electricity. In 1820 a Dane named Orsted found that a magnified needle was affected by the proximity of the electric current, proving the analogy existing between electricity and magnetism. Prof. Faraday had also for many years devoted his attention to the subject, with the result of discovering a new magnetic electricity. In the opinion of the witness very extensive improvements in the electric light must be regarded as inevitable, and seeing what had been done by Mr. Edison there was reaso to believe that many of the existing difficulties would eventually be removed. He was afraid that as regarded public illumination, platinum would be found too expensive for general use; nor was he of opinion that the electric light would drive gas out of the field, there being so many uses for the latter.

DEW.—The commonly accepted theory that the phenomenon of dew is produced by the condensation of the moisture of the air by contact with surfaces of a lower temperature, is rejected by Prof. Stockbridge, of the Massachusetts Agricultural College, who defines it to be the vapor of the soil condensed by the cooler air.

A CONVENIENT PLAN FOR WASHING GELATINE EMULSIONS.—In Mr. Bennett's process a rather inconvenient plan of washing the gelatine emulsion is prescribed, and one on which we think we have improved, since by adopting it the emulsion can be washed in an ordinarily lighted room. A bottle by preference having a wide neck is chosen, and a tin canister with a top is procured, into which the bottle can be placed and covered up. In the top a hole is carefully drilled so as just to fit a piece of ¼in. glass tubing, ½in. longer than the canister is high; and about 2 inches from the bottom another hole is bored, and a ¼in. tin tube with a couple of bends at right angles to one another soldered over the hole. The bottle with the emulsion in it is placed in the canister, the glass tube put into the bottle through the hole in the lid, and a piece of india-rubber tubing slipped over the projecting end of the tube till it fits tightly against the lid. The other end of the indiarubber tubing is fitted to the water supply, and the amount of water admitted to the bottle regulated by a clip on the tube or by the tap. We have ourselves used as a reservoir a 4 gallon jar with a bung hole at the bottom, into the bung a piece of glass tubing is inserted as an exit for the water, and the supply is controlled by a clip on the india-rubber tubing. It answered excellently: four times filling washed the emulsion perfectly.—*Photographic Journal.*

CASE-HARDENING IRON.—In order to economize in the more expensive materials for case-hardening cast, wrought, or malleable iron, and to harden only portions of the article in different degrees, if required, Mr. Gracie S. Roberts, of Brooklyn, makes use of an improved method. After polishing the surface, he glues to the portion to be case-hardened a coating of yellow prussiate of potash. A number of coats are given, according to the degree of the case-hardening required. A cheaper material, or simply boneblack is used where a slight effect only is required. When the glue is set hard, the article is packed in powdered charcoal, heated to redness in a quick fire and maintained at that heat for half an hour. Then it is hardened and tempered in the usual manner.

GIGANTIC TREES.—It is well known that America claims to outstrip all the other parts of the world even in the size of its trees. Thus, until lately, a *sequoia* in the neighbourhood of Stockton, in California, estimated to be 325 feet high, enjoyed the reputation of being the tallest tree in the world. But an official of the Forests Department in Victoria (Australia) measured not long since a fallen *Eucalyptus* in Gippsland, and found that it was 435 feet long from the root to the highest point of the branches. But even this is exceeded by another *Eucalyptus* still standing in the Dandenong district in Victoria, which is estimated to be 450 feet from the ground to the top.

EMERY BELTS.—A correspondent of the *Scientific American* says that most users of emery belts and emery wheels do not use glue that is thick enough, fearing it may chill before the sand or emery can be spread. In making an emery wheel or belt, if the cloth has never been glued, it should be sized with glue about as thick as lard oil, and allowed to dry thoroughly before applying the glue which holds the emery. Have the emery heated to 200° F., and coat the belt or wheel with glue about as thick as molasses and roll it in the hot emery. If a wheel or belt thus treated is allowed sufficient time to become thoroughly dry, it will be very serviceable.

THE LOFTIEST BRIDGE IN THE WORLD.—The erection of one of the great towers of the Forth Bridge on the Island of Inchgarvie was commenced on the 4th inst., by the contractor, Mr. Wardell. The towers, of which those on the Inchgarvie are to form the centre support of the bridge, will, when the ironwork is completed, be upwards of 500 feet in height, says the *Leeds Mercury*. It is intended that the construction of the heavy engineering work shall be carried on with expedition. The bridge will be one of the greatest engineering works of modern times.

FERN DYEING AND MOUNTING.—Collect the fern fronds and lay them between dry blotting paper, then have as many pieces of blotting paper as you have fronds, put them under a little pressure and keep them until quite dry, then you may dye them with Judson's dyes until the colour required. Do not attempt to dry them too quickly; they are well worth the extra time when well done.

A POLISH FOR REMOVING STAINS, &C., FROM FURNITURE.—Take ½ pint of alcohol, ¼ oz. pulverized resin, ¼ oz. gum shellac, ½ pint boiled linseed oil. Shake the mixture well and apply with a sponge, brush, or cotton flannel, rubbing well after the application.

CLEANING CARVED WORK.—The feather end of an old quill pen will, by the aid of benzoline, effectually remove the dirt from the interstices of carvings.

A REMEDY FOR WHOOPING COUGH.—Dr. Garth (*Wiener Allgem.*) states that by placing xx. gtt. ol. terebinth. on a handkerchief, holding it before the face, and taking about 40 deep inspirations, to be repeated thrice daily, signal and marked relief, followed by rapid cure in cases of laryngeal catarrh, is the result. In an infant 15 months old, in the convulsive stage of whooping cough, he directed the mother to hold a cloth, moistened as above, before it when awake, and to drop the oil upon its pillow when asleep. The result was markedly beneficial. In 24 hours the frequency and severity of the attacks were notably diminished, and by proper support by aid of stimulants, the improvement was rapid. Subsequently pertussis became epidemic in his vicinity, and he repeatedly used the drug in this way. He gave it to children of all ages, and in any stage of fever. The initial catarrh, the convulsive, and the final catarrhal stages were all decidedly benefited, the spasmodic attacks being in many cases aborted.

TO CHILL CAST IRON VERY HARD.—Use a liquid made as follows: Soft water, 10 gallons; salt, 1 peck; oil vitriol, ½ pint; saltpeter, ½ pound; prussiate of potash, ½ pound; cyanide of potash, ½ pound. Heat the iron a cherry-red and dip as usual, and if wanted harder, repeat the process.

Health and Home.

SOME HINTS IN REGARD TO DIET.

In Dr. Hall's *Journal of Health*, a few years ago, the following statement of the amount of nutriment in various articles of food was given :

"Raw apples, 10 p. c.; boiled beans, 87 p. c.; roasted beef, 26 p. c.; baked bread, 80 p. c.; butter, 96 p. c.; boiled cabbage, 7 p. c.; raw cucumbers, 2 p. c.; boiled fish, 20 p. c.; fresh milk, 7 p. c.; roasted mutton, 30 p. c.; roasted pork, 24 p. c.; roasted poultry, 27 p. c.; boiled potatoes, 13 p. c.; boiled rice, 88 p. c.; sugar, 96 p. c.; boiled turnips, 4 p. c.; roasted veal, 25 p. c.; and boiled venison, 22 p. c."

From this statement of Dr. Hall's a correspondent of the New York *Sun* makes the following deductions :

"The cheapest articles of food, except butter, are the most nourishing. A pint of white beans, costing a few cents, contain the same amount of nutriment as 3½ pounds of prime roasting beef, which is twelve times as expensive. Furthermore, a pound of Indian meal will go as far as a pound of fine flour."

In alluding to the above, the Boston *Journal of Chemistry* says :

"We call it a loose statement, and so are all the statements made in various books in regard to the comparative nourishing qualities of various kinds of food, as they are all based on some false premise ; some, for instance, on the percentage of nitrogen in the food, others on the amount of water in it, &c. The result is an erroneous comparison, and the deductions drawn must be false. Thus in the above table, sugar is 96 p. c., and turnips 4 p. c., making 24 pounds of turnips equivalent to one pound of sugar ; rice 88 p. c., and roasted beef 26 p. c., making one pound of roasted beef not much more nourishing than four ounces of boiled rice. The whole assertion is simply absurd and the table worthless, as every one will maintain who properly attends to the duty of selecting his food judiciously in regard to the wants he feels.

"We deliberately call it a duty to be careful in selecting our food ; we even go further, and call it a crime not to feed well, or to be negligent in our selection, eating or drinking things we dislike, or, what is worse than all, eating when we have no appetite, simply because it is time for meals."

In speaking of a corn diet the same paper remarks .

"Very few constitutions can stand a corn diet. In most cases corn has a tendency to sour on the stomach, and by its continued use chronic dyspepsia and premature death result.

"Man, and especially civilized man, needs a variety of food. The man who does a great deal of brain work requires different food than the man who only works with his muscles, as the one consumes more nervous material, and the other more muscular ; and as different as the chemical composition of the brain and nerves is from that of the muscles, equally different must be the character of the food needed to supply the waste."

KISSING PETS A CAUSE OF SORE THROAT.

A writer in the *British Medical Journal*, in a communication to the editor in regard to the possible cause of the recent outbreak of an epidemic of sore throat at Darmstadt, says : "It is well known that women and children are in the habit of kissing pet cats and dogs, especially when these favorites are ill with discharge from the nose, cough, and sore throat, and even use their pocket handkerchiefs to wipe away the secretion. I have seen this done frequently. As such mistaken sympathy is exceedingly dangerous, I think a notice in the *Journal* to this effect would tend to its discouragement. It is a common saying that, 'There! the cat has got a cold ; now it will go through the house ;' and, as this remark has been repeatedly verified, it shows how careful people should be to avoid contact with such a mode of contagion. I do not affirm that this was the way in which the disease was contracted, either within or without the palace walls, but I feel sure the habit of kissing pets is a source of danger that should be widely known and prevented."

Rest for Headaches.—Dr. Day says, in a late lecture: Whatever be the plan of treatment decided upon, rest is the first principle to inculcate in every severe headache. Rest, which the busy man and the anxious mother cannot obtain so long as they can manage to keep about, is one of the first remedies for every headache, and we should never cease to enforce it. The brain, when excited, as much needs quiet and repose as a fractured limb or an inflamed eye, and it is obvious that the chances of shortening the seizure and arresting the pain will depend on our power to have this carried out effectually. It is a practical lesson to be kept steadily in view, in that there may lurk behind a simple headache some lesion of unknown magnitude which may remain stationary if quietude can be maintained. There is a point worth attending to in the treatment of all headaches. See that the head it elevated at night, and the pillow hard ; for, if it be soft, the head sinks into it and becomes hot, which with some people is enough to provoke an attack in the morning if sleep has been long and heavy.

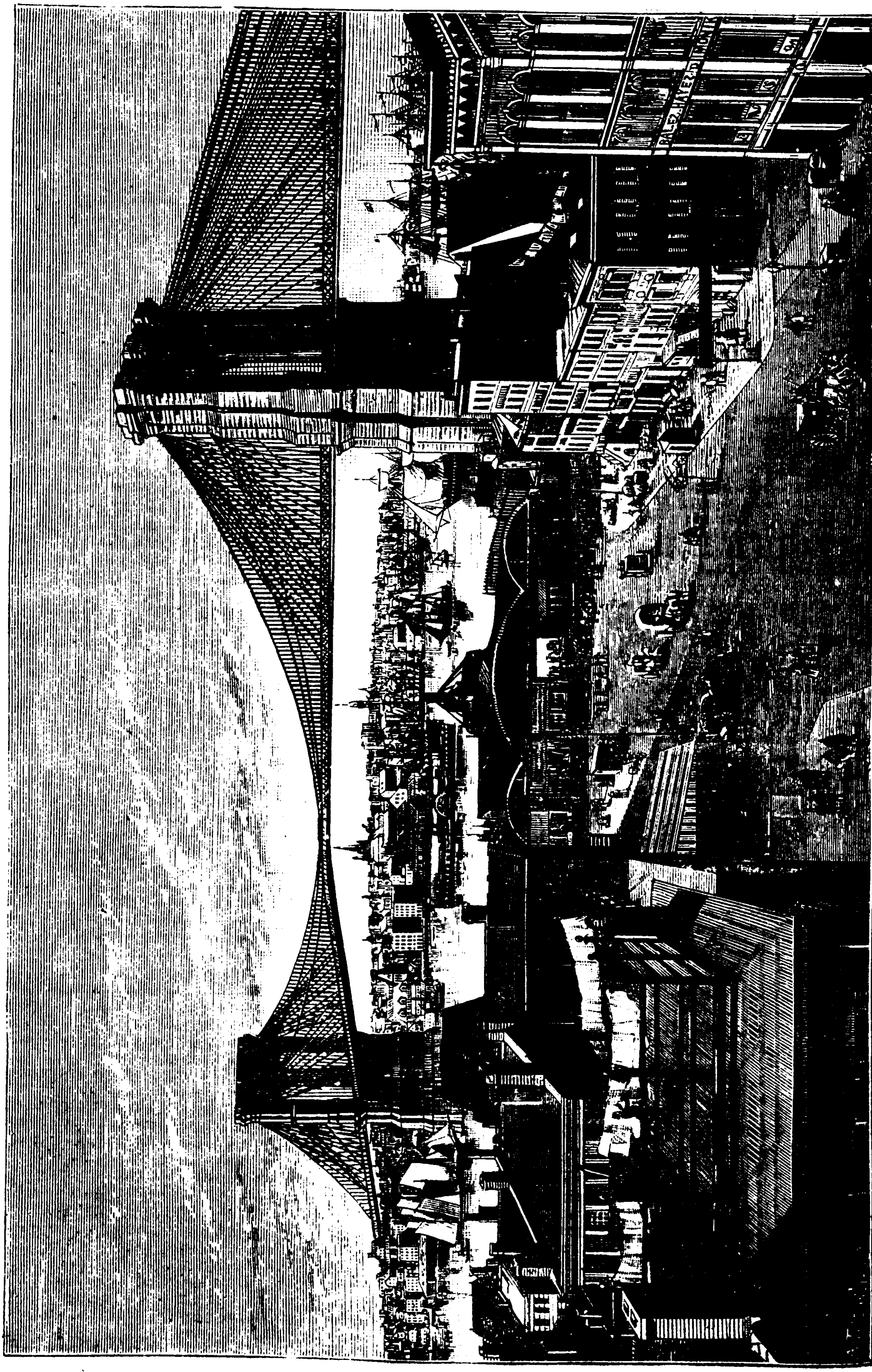
The Morning Cough.—The mucous rheum which calls out the morning cough is due to the changes of temperature to which the lining membrane of the air passages is exposed in cold and stormy weather. People pass rapidly from in-door to out-door temperatures, and then changes in the vascular supply of the mucous membrane of the air passages are set up. If everebody at all times only breathed through the nose, the inspired air would be warmed by passing over the coils of blood-heated plates which exist in the nose for that purpose, and would not affect the air passages behind the turbinated bones. But such is not the case ; they probably commence to talk, and in doing so draw in by the mouth cold air, which, on mixing with the residual air in the chest, lowers its temperature, and then a fluxionary hyperæmia follows, and after it, in its train, a mucous rheum. The best plan for persons who are subject to colds and coughs to adopt, is to keep their mouths closed ; talk as little as possible, and avoid stopping or standing still. If one out of doors keeps moving, and with his mouth constantly closed, there is very little danger of taking cold or contracting a catarrh.

Hot Water vs. Fever Germs.—According to Dr. Richardson, hot water at 120° Fah. will kill typhus germs, and soap acts as a poison to them. The remedy against typhus, then, is to be found in every household, and more's the pity if it be not applied. Considering the deadly nature of this fever, and the fact that 50,000 typhus germs will thrive in a space no bigger than a pin's head, it is clear, the *Christian at Work* thinks, that in such a matter, a quart of prevention is worth several hogsheads of cure.

Compressing the Bulk of Flour.—A French chemist some few years ago conceived the idea that it would be practicable to compress flour so as to diminish the bulk and yet not injure its quality. An experiment was accordingly made. Flour subjected to a hydraulic pressure of 360 tons was reduced in volume more than 24 p.c. On close examination it was found to possess all the qualities it had, previously to its violent treatment. It was then put into zinc boxes and sealed up. At the same time other flour manufactured from the same wheat, but not compressed, was sealed up. About three months after several boxes containing both kinds of flour were opened and examined. The pressed was pronounced to be the best. Twelve months after this, another examination took place, and with the same result. The two kinds were kneaded into loaves and baked. The pressed flour made the best bread. In another year the boxes were opened and examined, and while the loose flour showed moldiness, the pressed was sweet, and retained all its qualities. Made into bread the same difference was observable.

How to Wash Silks.—Lay the silk smooth on a clean board, rub soap upon it, and brush it with a rather hard brush. The amount of brushing requisite will depend on the quantity of grease upon the silk. When it has been sufficiently brushed with the soap to cleanse it from grease and dirt, it should be well brushed both sides with clean cold water. A little alum infused in the last water with which the silk is brushed will prevent the colors from spreading. Should there be any patches of grease upon the silk, they should be removed as previously described, or by the application of a little camphine and alcohol. Folding or wringing silk when wet must be scrupulously avoided, as creases made in silk when wet will never disappear ; and, in like manner, *hot suds* must not be used for washing silks, as it will in most instances remove the colors.—*Cassell's Household Guide.*

Errors.—It is a popular sanitary error to think that the more a man eats the fatter and stronger he will become. To believe that the more hours children study, the faster they learn. To conclude that, if exercise is good, the more violent the more good is done. To imagine that every hour taken from sleep is an hour gained. To act on the presumption that the smallest room in the house is large enough to sleep in. To imagine that whatever remedy causes one to feel immediately better is good for the system, without regard to the ulterior effects. To eat without an appetite ; or to continue after it has been satisfied, merely to gratify the taste.



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