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ON THE EFFECTUAL AND SPEEDY CURE OF INFLUENZA.*

BY JOHN CRERAR, M.R.C.P. EDIN., ETC.

[In the course of his address Mr. Crerar said that he had formed a new theory of the treatment of acute infective diseases, based on the "analogy of nature," whereby is meant such an inference, for example, that the earth is globular, from observation of the uniform shape of the other heavenly bodies. Applying this to the study of micro-organisms, he infers that their life and reproductive activity depend upon their inhabiting suitable nutrient media under fit conditions.] Thus Klein tells us that a cubic centimeter of beef tea, kept in an incubator at a temperature of 98° F., and peopled by bacilli, multiplies its population 80,000 times in the first twenty-four hours, 450 times in the second twenty-four hours, and only five times in the third twenty-four hours. We thus find that, as the food supply becomes diminished, and the peculiar product of the fermentative process increased, the reproduction gradually declines and ultimately disappears. During the process of reproduction and growth of a micro-organism there is a peculiar substance excreted, or formed, which is baneful to its own microbe, and as this substance increases in quantity it diminishes the vitality of the microbe, and when it reaches a certain proportion it destroys the life of its microbe. When the yeast fungus is placed in an infusion of malt, it grows rapidly, at a suitable temperature, until the alcohol formed in its presence accumulates to 20 per cent of the whole quantity of the liquid; the alcohol then arrests the growth of the fungus, and the alcoholic fermentation proceeds no further. In the same way, Dr. Burdon-Sanderson has shown that the peculiar secretion of a bacillus is very destructive to the bacillus itself. These facts are of the highest importance when pathogenic fungi are considered in their relation to disease. The application of such facts to the treatment of infective diseases would, then, consist in bringing about in the system a change in the environment of the microbes analogous to that which is spontaneously effected by their own activity, since they apparently excrete products which in sufficient quantity are inimical to their own existence. Hence the possibility of a disease exhausting itself, as it were, without any treatment, provided that the vital powers of the patient can resist the poison more than the microbe that produces it.

It appears then, that we are continually liable to attack, but if we can by any means (and I think we can) so alter the state of the body as to make it intolerable to the minute invaders, we secure a valuable truce, and gain time to allow the organism to build up a vitality high enough to get beyond the reach of our remorseless foe, and we may thus save our patient. Hitherto the search for such a desirable agent has been chiefly carried on in connection with the cultivation and study of the pathogenic microbe. I propose to look for a similar substance in connection with the changes which invariably take place in the system of the patient during the acute stage of disease. I propose, in fact, to transfer a baneful and death-producing plant—the pathogenic fungus—from its congenial soil and climate in the tropics to the uncongenial soil and climate in the poles, and I confidently expect that, in its new situation, it will not long retain its power to do harm. I have practically applied this theory to the treatment of the influenza with the happiest results. In the epidemic of 1889 and 1890, I was face to face with an extreme case of this disease, when it was quite clear to me that something more than treatment upon general principles was necessary if I wished to save my patient. A process of reasoning, similar to what I have tried to explain, occurred to me at that time, and acting promptly on the indication to which it pointed, I artificially altered the prevailing state of the patient, with the result that the disease very speedily disappeared. I subsequently repeated my new line of treatment in hundreds of cases, with the same fortunate result. During the present epidemic (1891) I have pursued similar tactics with identically similar consequences. Let me briefly explain what has been occurring. I am called in to see a patient. I find him with a flushed, woe-begone face; intense frontal headache; increased temperature, at the same time perhaps that he is complaining of cold, or shivering; a quick pulse, great prostration, and unspeakable distress. I prescribe,

* Being the substance of the presidential address delivered to the members of the Border Counties Branch of the British Medical Association, at the annual meeting held at Maryport, July 16, 1891.—*London Lancet.*

and when I visit him next day I find all the acute symptoms gone; no distress, pulse and temperature normal, and the patient comfortable, but weak. On inquiry, he declares, in nineteen cases out of twenty, that the relief was obtained after the second dose of the medicine, that is, within four or six hours after the commencement of the treatment. Let me instance two cases as typical examples of many others.

Case 1.—Mr. T—— is extremely ill, and believes himself to be dying; pulse 117, with the other acute symptoms mentioned. I venture to assure him that he will be nearly well to-morrow. Next day I find him quite relieved, and the pulse reduced to 61.

Case 2.—A. F——, a young married woman, was taken very suddenly ill, and when I first saw her she was raving and could not be made conscious of my presence. The next morning she was well, but weak, and I was assured that the second dose of the medicine marked the time of the amendment. On the third day she was quite well, dressed, out of bed, and attending to her duties in the house.

But I have not yet stated the exact nature of my *modus operandi.* Very important results can be obtained through very simple means. In the days of Sir Thomas Watson, the most intelligent answer to the question, "What is the best cure for acute rheumatism?" would be, "Six weeks in blankets, aided by drugs administered on general principles." But the salicylate of soda has changed all that, and has given us a short cut toward getting rid of the excruciating tortures of acute arthritic inflammation of a rheumatic nature; and so with other affections. Having regard to the essential state of a severe attack of influenza, I conceived that I would get the most effective antagonism in greatly increased alkalinity, and the *bicarbonate of potash* was the first agent that I thought of. This salt has many advantages. It is not unduly stable, to make it difficult to break up in the system. It is also readily eliminated, and thus soon leaves the system; so that the danger of potash poisoning is reduced to infinitesimal proportions. Having found this salt to answer all my purposes, I have not looked for another, although, according to my theory, other remedies of a similar nature might easily give like results. I give liberal doses (thirty grains) in a teacupful of milk every two or three hours. I add a few drops of the tincture of capsicum, but this is not at all essential.

A word or two of caution. In two or three cases the action of the heart was weakened to an unpleasant degree; but digitalis and the aromatic spirit of ammonia quickly restored normality. Diarrhœa also sometimes supervenes, but is effectually met by Dover's powder. In cases where weakness was induced by previous disease, or where some other disease was a concomitant, or where pregnancy existed, the action of the remedy was somewhat retarded, but not rendered by any means less certain. Where the salt was intermitted too soon, the symptoms returned; but they readily gave way again on the resumption of the treatment. I trust that those who have the opportunity will test the accuracy of my statements by careful clinical observations, as I feel confident they will obtain equally favorable results; for the remedy acts uniformly and satisfactorily; *tuto, cito, et jucunde.*

SUCCESS THE RESULT OF KNOWLEDGE.

In his 5th chapter on Hints to Engineers (published in the *Scientific Machinist*) Mr. Edwin Woodward says:

In no practice is it more eminently true than in steam engineering, that success is the result of knowledge. Knowledge is the outgrowth of study and practice, and while study must inevitably result in knowledge, if rightly directed, such may not be said of practice without the same qualification, paradoxical as it may seem; for though it is usually said that practice and experience are the parents of knowledge, they are often seen united with no more creditable progeny than ignorance or pomposity. So it naturally behooves the enterprising learner to bribe the keeper of the Storehouse of Success for unlimited stores of his choicest supplies.

The mechanical paper is the most direct avenue; seek its aid. Success often seems to be the result of a happy combination of circumstances, usually termed luck, and when one is fortunate in that way, he is usually envied. But such fortune, if received uninterruptedly for any considerable space of time is usually more destructive than misfortune, for it renders the recipient reckless of chances, and always ready to trust to "his luck," which will sometimes turn and end in ruin, perhaps, for the "lucky" man, and perhaps disaster and hardship to others.

It is prudent to study the conditions under which the boiler performs its functions. If it is a plain cylinder boiler properly set, the tubes and sheets kept clean, there is no place in it in which the water is not in a constant state of ebullition, which is attendant on the process of making steam. But directly over the grates where the heat of the fire is greatest, the ebullition is most intense, and as a natural result any sediment or foreign matter held in solution in the water will boil up fiercer there and pass out to a cooler and less agitated portion of the water, and then will settle upon the tubes, sheets or stay bolts. And since the ebullition of the water at such places is not sufficiently active to keep the sediment in motion when once settled and burned fast, it is there to stay; and, unless removed by mechanical means, it will thenceforth rapidly accumulate, the coating rendering the fire more ineffective with every additional supply, till eventually the space is thoroughly full and the water will not boil any. The thickening scale and slush prevents the water keeping the tubes or sheet from overheating and they soon begin to burn and scale rapidly, and almost before the defect in the steaming capacity of the boiler is detected the boiler is blistered or burned, the tube sheet twisted and the tubes warped and sprung.

Any boiler maker will affirm that this is no fancy, but a fact of every day occurrence, and it shows the need of having the interior of every boiler made easily accessible for the purpose of keeping it clean. In large boilers the man-hole gives ingress but in small ones other means must be devised.

Of ordinary types of boilers, the water leg in the upright or vertical, as they are indifferently termed, and the locomotive styles are usually the most liable to excessive deposits. The writer has seen the water spaces beneath and between the tubes at the rear end of the latter style of boilers completely filled from the bottom to the water line, and back from the head from twelve to twenty inches with scale and mud so compact that the hand-hole plate is with difficulty removed.

The engineer (?) usually in charge is very loud in his denunciation of the "old tea-kettle" that "won't heat water hot enough to scald a hog." If by chisel and scraper, and the cultivation of the reputable virtue of which Job was so celebrated, a portion of the hard-burned accumulation—a monumental testimony to the skill of the engineer—is removed from the tubes and head, and a communication opened to the water in the boiler, it is usually found that the tubes are ruined and leaky. It is then that the evils arising from the neglect to keep the boiler clean is made apparent. For if the engineer cannot remedy the evil by driving an iron plug in to expand the tubes and "thimbles" the next make-shift is equally abortive, and a machinist is called to repair the leaks; then of course, the cause of the trouble comes out, and also the fact that the tubes must be replaced by new ones, as the ends are burned and therefore worthless.

The water leg of the locomotive type, especially that portion that extends below the grates and under the ash pit, is very susceptible to deposits of mud and slush.

The evil of this is not so much the difficulty of converting mud into steam—for that portion of the boiler generates but little steam—as the difficulty of keeping a portion of the mud from mingling with the water in other parts, where the heat is more effective, when, if a surface blow-off is not used daily, a considerable portion is carried over with the steam into the engine, much to its detriment. The mud also does its destructive work when the boiler is supposed to be empty and idle, for the mud will not run out but lies soggy and wet in the bottom, rusting and eating when all the rest is dry.

It is the practice of some engineers to blow the water out of the boiler at almost any pressure from ten to fifty or sixty pounds, and this is about all the cleaning such engineers give their boiler. They err in thinking the deposits can be removed. A small part immediately around the blow-off will be discharged, and the same results could be had by letting the water out with no pressure, while the harm that is done to the tubes, sheet joints and rivets from the heat to which they will be subjected, when no water or steam remains to guard them, is very great.

Between this method of cleaning and no cleaning, there is in truth a large balance in favor of the latter, for while the results from either course are equally certain, the latter will most certainly clog and fill the boiler with scale and slush, eventually rendering new tubes imperative, the former will also do it—for blowing out does not clean—and in addition will ultimately ruin the shell joints from the great heat and expansion to which it is so exposed.

As a rule, the blow-off cock should be placed in the lowest portion of the boiler—or at least the coolest—which is generally the lowest for the reasons that if it is at the lowest part it will drain all the water out, and sediment collects in the lowest places and can be removed daily quite effectually by blowing out for a few seconds. The writer does not indorse the practice of opening the blow-off suddenly and wide for this purpose. The steam pressure has been seen to drop ten pounds in half a minute from this cause and the belief that the course is injurious is reasonable. The cock should be opened but a limited part of its capacity and remain so for a longer period. Thus no bad results follow, the pressure does not fall perceptibly, and the small opening longer continued creates a more extensive movement of the water towards the cock, and thus necessarily carries out a much larger per cent. of sediment than the short, hard blow, which blows out one-tenth of the water perhaps, without giving that at a distance time to flow to and discharge its load. To assist the blow-off at the bottom of the boiler in maintaining pure water and freedom from foaming, there should also be one at the water line, a surface blow-off.

When the water is very impure, and a scum rises in boiling, a surface blow-off is very essential. It should also be placed in the cooler part of the boiler, as the scum bubbles up where the water is most, and seeks the smoothest place to rest. It may be introduced at any convenient place, and a pipe extended to the place of receiving. When it is possible much advantage is gained by having the receiver made funnel-shaped and quite large, the rim at the water-line or a little below.

The advantage gained by the funnel receiver is principally due to the fact that the water boils up fiercely at its edges, and that within it the water is comparatively still, and so gathers the scum at the very place where the blowing-off must take it, and largely to the wide rim of the receiver which takes from a large area. The value of the surface blow-off to the engine is very noticeable when the feed water contains a large percentage of lime and is used without a purifier. Much of the lime, resembling magnesia, is very light, and when precipitated by the heat, floats upon the top of the water, and is carried over by the steam into the cylinder. Its presence there is readily detected by the indifferent performance of the engine, and the increased amount of cylinder oil necessary to keep the valves and piston working smoothly.

The engineer, if observant, will soon discover how often the boiler should be cleaned, and if prudent will make thorough work of it, knowing that anything slighted will demand correspondingly greater labor the next time. Various forms of scrapers are essential and should be devised to suit the work. Often it is impossible to use scrapers by reason of the indifferent means of access provided, and frequently from the intricacy of the tubing. In most cases a force pump, hose and nozzle will reach the places and do the work much better. Indeed, if two nozzles are affixed to a small gas pipe, one in line and the other at right angles with its length, an implement of great value is had, with which the boiler may be washed much cleaner than it can be scraped. It is understood that the gas pipe, to which the nozzles are attached, is employed, that the nozzles may be manipulated any distance in the boiler far or near, and flexible connection made between it and pump with hose.

A Good Cement.—For a glass-metal cement insoluble in carbon bi-sulphide, alcohol, water etc., dissolve gelatine in water, add a small percentage of glycerine, and also a small quantity of potassic bichromate.

HOLDING WORK ON FACE-PLATES AND IN CHUCKS.

BY A. D. PENTZ.

Every machine shop should have appliances to do special work with, if it makes any pretence of being modern. All modern shops do a variety of work outside the product for market, either in repairs or tools, so good appliances pay everywhere.

In fine shops where watch tools are made, they use a face-plate having principles like that in the accompanying figure. I have made the sketch different in some particulars from the face-plates in the shops named, but I do this to apply it to heavier work, rather than to improve it.

The stock A, is made to be screwed on the spindle of the lathe in the ordinary way. The eccentric plate B, is let into the stock A, and secured at any required position by the bolts D and nuts E. The work-plate C, comes through the eccentric plate B, and when such plate B, is secured by its bolts, it also fixes the work-plate C, to the position it then occupies.

The center G, of the work-plate C, is, in the sketch, the center of the stock also; and when the eccentric plate B, occupies the position there shown, this center will be true with the spindle that the whole device may be mounted upon.

When the plate B, is turned to a new position within the stock A, the center G, will become eccentric, and some other point on the plate C, will be concentric to the spindle. Then, again, turning the plate C, in its bearing will bring other points opposite, and thus by adjusting these two plates, every point on the work-plate C, may be brought in line with the center of the spindle.

Work may be fastened against the plate C, by bolts having heads within the slots F, as usual; and when so fastened, any point on such work may be brought in line with the central position, and finished as required. Thus, a plate to have a number of holes that must be parallel to each other—for instance, a drill jig—may be finished at one sitting. The simplicity of this device will be apparent to every mechanic, and its value will be equally clear.

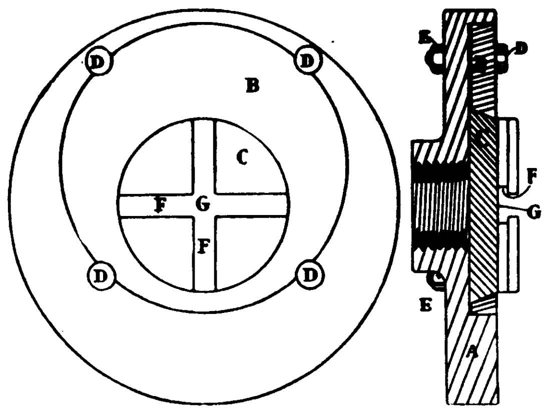
Ordinarily, the whole work in making this tool could be done on the lathe it is to be used on, except planing the slots F, and there are no hair-splitting kinks to be straightened out in any operation on it. The heads of the bolts D, should be counter-bored into the stock A, about one-quarter inch deep. Then the lips which overhang the plate B, should be cut under so that the cylindrical parts of these heads shall be partly removed; and while their lips overhang this plate, the walls below them will prevent the bolts from turning while the nuts are being tightened.

On this plate C, an angle-plate or a chuck may be attached, and thus extend the capacity greatly.

It frequently happens that it is necessary to attach pieces to a lathe face-plate that cannot, for one reason or another, be either held by the edges in a chuck or by clamps on its outer face. Such a piece as a thin disk of brass, which must be finished on the periphery and on a face at one operation, would be in point.

If the operation to be made is a light one, and the piece be not of too great weight in comparison to the surface to lie against the face-plate, this method will suffice:—To the face-plate of the lathe, and to the surface of the piece that is to be fastened to it, apply a coat of ordinary shellac varnish, such as pattern-makers use. If this varnish be very thin, let one coat dry, and apply another one over it, on both pieces. At once, after the second coat is on the two faces, set the varnish on fire and let it burn out. This will burn the alcohol out of the varnish and heat the gum to a sticky consistency. It will also heat the face-plate and the piece to be attached to it, a trifle. At the moment the flame vanishes from the varnish, carefully place the piece on the face-plate in the exact place desired, and press it on tightly with the tail stock spindle. Ordinarily it is requisite to put a plate, of a size to cover the piece, between it and the spindle, in the tail stock, to obtain an even pressure.

The person who has not tried this method of fastening, will be surprised at the strength of this joint. At the same time, if care be not taken to get everything just right, the joint may be a very poor one. Like all else, if it be done well, it will be good; but, *vice versa.*



This method of attachment is useful in a thousand places besides the one set forth, and the places where it can be of benefit will be understood by any one who needs to use it. I may say, however, that pattern-makers will find this a reliable way to change and mend patterns in a hurry. They must be careful to not scorch the edges of the wood in the burning operation. If pattern-makers will varnish a joint, allow it to become dry, and then heat both pieces before a fire until they become sticky, a good joint will be secured. Yet shellac is not as strong as glue, and it is only recommended where haste is the chief element in a job.

Where a strong joint must be made between a piece and the lathe, and where the piece is not of a character to be either bolted or clamped, this method is recommended:—Take a false plate of parallel thickness, and of a size larger than the piece to be operated—great enough to be clamped to the face plate of the lathe without interfering with the work. Cut a piece of tinfoil as large as the back of the piece to be attached; wet the foil thoroughly, and also the back of the piece as well as the plate, in strong ammonia; place them in the positions desired, the one above the other, the foil between and the piece on top; then heat the plate until the foil is melted, and then squeeze by heavy weights, or between the jaws of a vise, as most convenient. This plan permits of the piece being changed in position on the lathe to suit the operations. If the surfaces of contact, in applying this method, be large, a cut of considerable size may safely be taken. And this way of attaching surfaces together is also capable of indefinite extension in other operations beside lathe work.

Many years ago I had a great number of cast bevel gears to bore. Whoever has had experience in these things, will know where the trouble lay. All were more or less warped, and some were so bad that they were useless. In truing them up in a lathe, all the foundry faults had to be averaged to get any kind of a job. It was piece-work. It had been taken at too low a price, and if the job should be done as usual by holding the hubs in a chuck and truing them up experimentally, there would be a loss of about fifty cents a day. Something must be done, and this was what saved me.

The gears were about five inches, and two and a half inches in diameter, to run together, and the faces were about one inch long. Two thick flanges were got, both alike, and these were fitted to the spindle of a lathe in the usual way, like face-plates, chuck-plates, etc. These flanges were about nine inches in diameter. The experiment was made with the pinion or smaller wheel. The shape of the teeth surface on this wheel was turned into one plate the full length of its face, very carefully, and to the correct conical angle. Then this internal cone was divided into three equal parts and laid out into as many surfaces, each about one half inch wide, and directed toward the apex. The spaces between these surfaces were cut away, one-eighth of an inch deep, so that the gear should bear alone on the three equidistant conical seats.

It will be seen that this kind of chuck will, and did, position the teeth of a gear at three points that were distributed equally about the entire circumference, so that the teeth that lay on them at least were true, and the teeth that lay between them a general average. The gears were held in this chuck by a "yoke" strap and two bolts.

In about 500 gears thus chucked, there was not one lost by this method of holding them; and four could be set in position while one could be adjusted by the previous method. The other gear was arranged in the same way, and instead of a loss I came out more than a dollar a day ahead of the usual pay.

Of course such internal cones are often cut to position bevel gears in. But what is not generally known, is the arrangement of the three high conical surfaces to average and equalize automatically the usual warped condition of cast bevels. If there were but six gears to bore, it would pay to make a wooden chuck of this kind, and bolt it on to the face-plate.—*The Manufacturer and Builder.*

JOURNEYMEN STEAM FITTERS.

The profession most nearly related to that of steam engineers is the working steam fitters' occupation. Strictly speaking, the engineer should produce the steam, and it is the steam fitters' place to fix up all the steam pipes and make all the necessary connections.

Too often the engineer is called upon to be steam fitter as well. Where the steam plants are small, the engineer may be steam fitter also; but where the engines and boilers demand an engineer's whole attention, he should be relieved from work that may distract his thoughts.

The professional steam fitter's avocation calls for special studies, and his own particular work is enough for him to attend to, if he is to do his work in a thorough and efficient manner. A Jack-of-all-trades is a master of none, is a true saying, and worthy of consideration in this connection. If an engineer attends to his engine properly he cannot afford to "waste time" on the steam fittings of the establishment, otherwise his mind may become too divided to do one thing or the other well.

It is a great mistake to overtax the energies of an engineer, or any other man. Senator Plumb has just died at Washington, through overwork. And many a locomotive engineer has been so overworked as to be totally unfit to hold his responsible position.

For a man to keep his equilibrium it is necessary for him to eat well, sleep soundly, have a clear conscience, and not have too much to do. A steam fitter is the stationary engineer's friend; he relieves the engineer from work that does not properly belong to him. And in this age of sub divison of labor, the steam fitter supplies a "much felt" want.

Owners of steam plants will find it is the truest economy to have each man fill his own place, and no more, and that it will be cheapest in the long run to have a steam fitter as well as an engineer, instead of insisting that the engineer should do the work of the two. Of course, when one plant is not large enough to take up the entire time of a steam fitter, two or three (or more) establishments may join together to have a competent man to attend to the steam fitting department in each house.

SURFACING GELATINE PRINTS.

I know of nothing more aggravating than after carefully finishing a fine positive to your satisfaction, having it stick fast to a glass plate, defying all attempts to remove it, and having finally to scrape it away in shreds to get the glass clean. But a few failures lead to success. I soon found the right way, and curiously enough, when thoroughly accustomed to the work, you become absolutely certain and confident of the result; not the slightest hesitation nor fear of sticking enters the mind.

Almost any kind of glass will do, provided its surface is good and free from bubbles, scratches, or other defects. Although plate glass is usually recommended, it is the least suitable, owing to the porosity of its surface.

To clean the glass, I know of nothing more suitable than a brand of soap known as "Monkey Soap," used only for cleaning non-destructible articles. After this the plate is well polished with clean chamois leather or an old silk handkerchief. Now comes the critical point, *i.e.*, the application of the French chalk or powdered talc. This is the time when the operator may know whether his prints will stick or not. The chalk must be dry; a little spread on to the glass plate and rubbed all over with a pad of cotton wool; with the silk handkerchief it is then dusted off again. Now, what is the appearance of the glass? Does the chalk adhere still to any parts, forming white patches? If it does, the glass still remains imperfect, and must be again washed, polished, and treated with the chalk. If the chalk is dry, and the cotton wool in the same state, the chalk should leave the glass by just drawing the handkerchief over it once or twice. When this is the case, you may squeegee your prints on with perfect safety, and if placed in a moderately warm room, they will not be long before they fall away from the glass with the required polish.

If they do not, however, all that is necessary is to insert a sharp knife under one of the corners, and they may be easily loosened. Above all things, make sure that the prints are perfectly dry before attempting to remove them. They often feel dry at the back, while the surface of the print, which is the most important part, and which, being furthest away from the air, is the longest in drying, is still damp.

Sometimes it happens that a portion of the picture is dry and will come away easily, but other parts stick and must be left to dry still more. This is always bad, as it leaves an ugly, ineffaceable mark on the print.

When the print is apparently dry it is always better to gently warm both sides of the glass before attempting to remove.

After the pictures are taken off, the glass may be used again if simply polished and dusted over with chalk, and the chalk again removed. If any of the powder be left on the plate, it will be afterward noticeable on the surface of the print. It is certainly a fact that the glass plate, after having been used several times, improves considerably, and it soon becomes a matter of difficulty to make the prints stick, should such a thing be required.

Instead of French chalk, other substances, such as wax or oil, can be used. If the plate be coated with a weak solution of wax in alcohol, there will be no difficulty in removing the prints. A little oil—one drop will be sufficient, rubbed over the plate with a piece of flannel—will have the same effect. There is, however, a marked difference between the surfaces of prints surfaced in this manner and those done with chalk, which in reality has the effect of making the glass thoroughly clean. The latter, of course, are much more brilliant.

Gelatino-chloride of silver emulsion prints do not require the same amount of washing as albumen pictures; it should be short and thorough. By thorough is meant the continual change of water, not only by a running stream, but by continually emptying the dish in which they are washed. If the prints be allowed to remain for a great length of time in water, the gelatine film becomes slightly decomposed and softens. This will cause them to adhere tightly to the glass, no matter how carefully it has been previously prepared. Therefore, avoid prolonged washing, but do not err on the other side by washing too little, as the permanency of the prints will be seriously affected.

A few words might also be said upon the squeegee itself. The flat ones are undoubtedly the best, and far superior to the new-fangled roller absurdities. The India-rubber should be evenly cut, and neither too hard nor too smooth. In squeegeeing, never bear too hard upon the print, as the film is likely to be injured. All that is required is to remove all the air between the film and the glass; by reversing the glass this can be easily seen.

As a final remark, I would say: Never attempt to use artificial heat for drying the prints upon glass, except, as already stated, to give a final warmth after the prints have apparently dried spontaneously. It must be remembered that the gelatine film is a soluble one, and the image is easily destroyed by heat. Even if rendered insoluble by an alum bath, the effect of heat will be to cause the film to adhere firmly to the glass plate.—*W. E. Woodbury, in the Photographic Art Journal.*

SULPHUR.

BY GEORGE L. BURDITT.

One of the important elements used in the arts and in manufactures is sulphur. It is a comparatively abundant substance, widespread, and was known to the ancients by the name of *brimstone.* Being an active chemical element, it is found in numerous combinations with other elements, and also in the free state. Most of the free sulphur used in commerce comes from Sicily, but it is also found in Iceland, Mexico, and South America in the free state, and always in the vicinity of volcanoes. When found in this state, it is mixed with earth, from which it must be separated. The separation is carried on by heat, which melts the sulphur, leaving the earth. The earth is first put into an iron pot and heated; the sulphur melts and is taken out and put into cold water, where it solidifies. The remaining earth contains a little sulphur, which is obtained by distillation. It is placed in earthen pots in a furnace, and the sulphur melts. The pots are so arranged that they connect with other pots outside the furnace which act as condensers, and into which the melted sulphur flows. There is an opening at the bottom of the condenser, through which the sulphur flows out into water, where it becomes solid. The sulphur is now in the rough or crude state, and must be purified. The process is carried on in a large brick furnace. The sulphur is put into an iron pot at some distance from the fire, where it melts and runs down through a pipe into another pot nearer the fire; here it boils and is vaporized. The vapor passes into a large brick chamber, upon the walls of which it condenses in the form of minute crystals. When in this state, it is known as flowers of sulphur. Gradually the walls become hot, and the sulphur melts, flowing down to the floor. At the bottom of the chamber there is an exit, through which the melted sulphur flows out into wooden molds, in which it receives the form of a stick or roll.

When sulphur is found in combination with other elements, it is separated by different means. Considerable quantities of it are obtained in England from iron and copper pyrites. In this process, a quantity of brush-wood is spread upon the ground, or upon a layer of broken pyrites. On this brush is placed about two thousand tons of ore, a space being left for a flue. The pile is fired by dropping lighted brands into the flue, and, as it burns, the sulphur melts and runs out, collecting in cavities. About twenty tons of sulphur are usually obtained from such a pile.

Sulphur (S, ii, iv, vi, 32) is a light yellow, solid, brittle substance, with a vitreous lustre, and breaking with a conchoidal fracture. It has a hardness of about 2.5, is very inflammable, burning with a blue flame, and is insoluble in water. When rubbed with hair or wool, it becomes negatively electrified, but is a bad conductor of electricity. It melts at 116°, forming an amber-colored liquid. If heated above 120°, the liquid turns dark and grows thick. As the temperature rises, the liquid grows thicker, and its color deepens, until, at 200°–250°, it is nearly black, and so thick that the dish containing it may be inverted and none of the paste will run out. Then it begins to grow thin as the heat increases, forming a brown gas at 440°—the boiling point.

Sulphur may occur in three allotropic forms, which are distinguished by their crystalline forms and solubility in carbon bi-sulphide. The ordinary form is the rhombic, which may be got by evaporating carbon bi-sulphide in which sulphur is dissolved. The crystals are in the form of rhombic octahedrons, yellow and glassy. The second kind takes the form of oblique prismatic, slender, needle-like crystals, which are made by melting sulphur and allowing it to cool, so that a surface crust is formed. The crust is broken, and the liquid beneath poured off, leaving transparent crystals. These are not permanent, but in a few hours grow dull and fall into minute rhombic forms. The third form is black sulphur, which is made by pouring liquid sulphur at about 280° into cold water. A soft gummy mass is formed, which may be drawn into strings. These grow darker as the temperature is raised. When left to themselves, they change in a short time to the rhombic form, becoming yellow, opaque and brittle. Hence, the only permanent form is the rhombic.

Sulphur combines with numerous other elements. With hydrogen, it forms sulphuretted hydrogen; with oxygen, sulphur dioxide and sulphuric anhydride; with carbon, carbon bi-sulphide. It is also found in minerals, where it forms sulphides and sulphates. In manufacturing, it is used extensively in matches, gunpowder, sulphuric acid, and other products.—*Popular Science News.*

EMPLOYER AND EMPLOYE.

We once knew a cotton mill superintendent who seemed to have an easy time of it. A woolen mill superintendent who envied him his position asked him what was the most difficult thing about cotton mill superintending, when he dryly answered: "Getting the position." From our observation we would say that keeping a position after it was obtained was the most difficult part of the undertaking. Few people deliver in the shape of service, what they bargain to deliver, hence we see good men secure good positions and keep them for a year or two, and then lose them. They were not discharged and they did not leave. "Big head" is sometimes the cause; big head seldom gives one dollar's worth for a dollar, hence dissatisfaction follows; big head gets so important that he thinks time tables were not made for him. In fact, he sometimes gets more important than his employer; when he gets to this stage he is ripe, and should quit and get a position as an oil drummer.

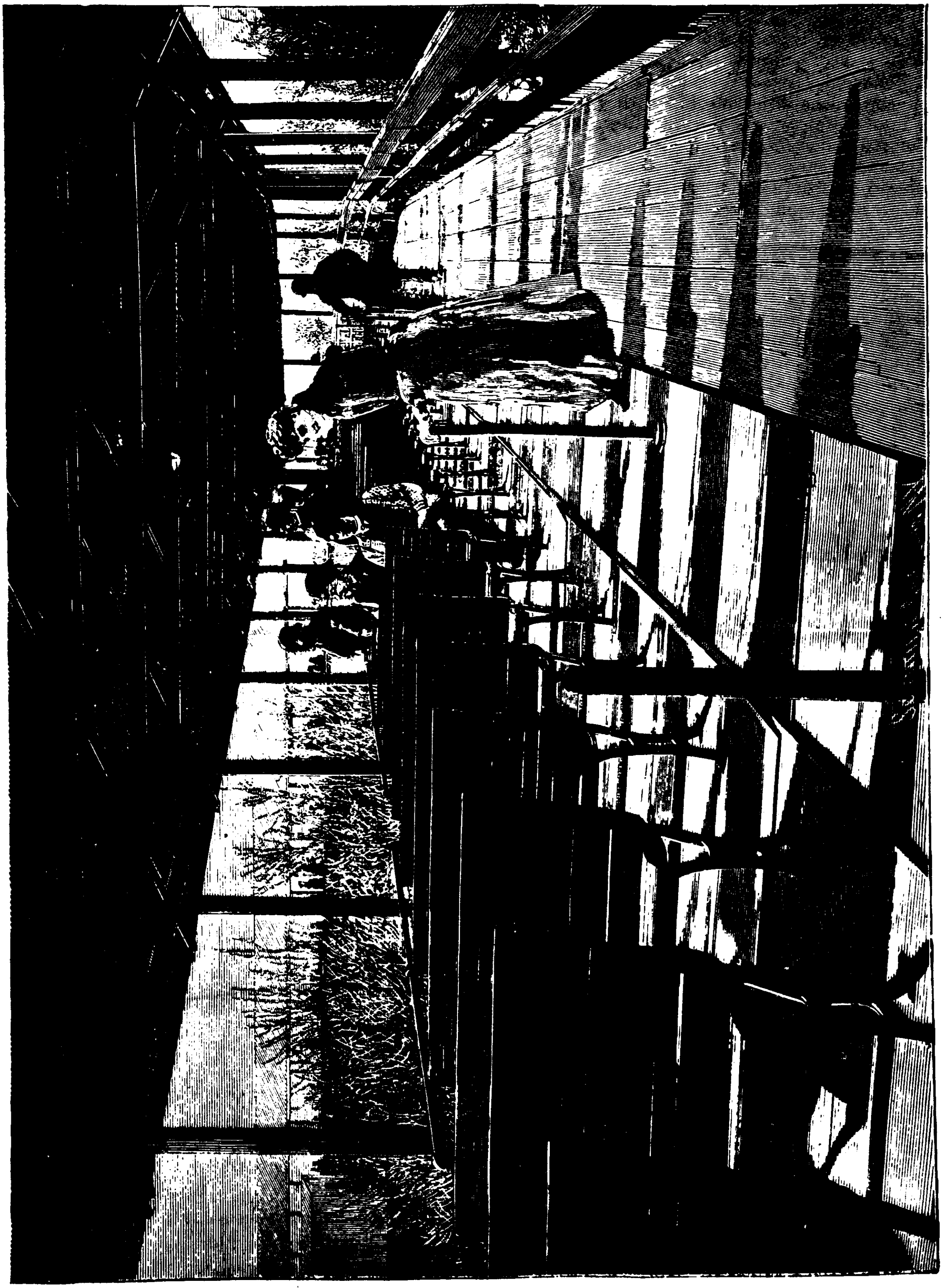
There is another class of men who are smart enough, but they have always some business outside of the mill to attend to. In fact, they are trying to serve two masters equally well, and no one has yet succeeded in doing it. The result is, the time table is neglected, and the pay-day looked for as if it was the most important thing in life: all of which is noticed by the employer, and the employe is put in the balance and found wanting, and a change of position is the result, bringing a loss to both parties. A great many good men lose positions because they did not give a dollar's worth for a dollar. This may come about in many different ways, but no matter what the cause, employer and employe suffer alike both in mind and finances, and there is a breaking up of homes and changes to new localities, all of which could be avoided by a proper understanding of what constitutes thine and mine.

COLORS MADE AUDIBLE.

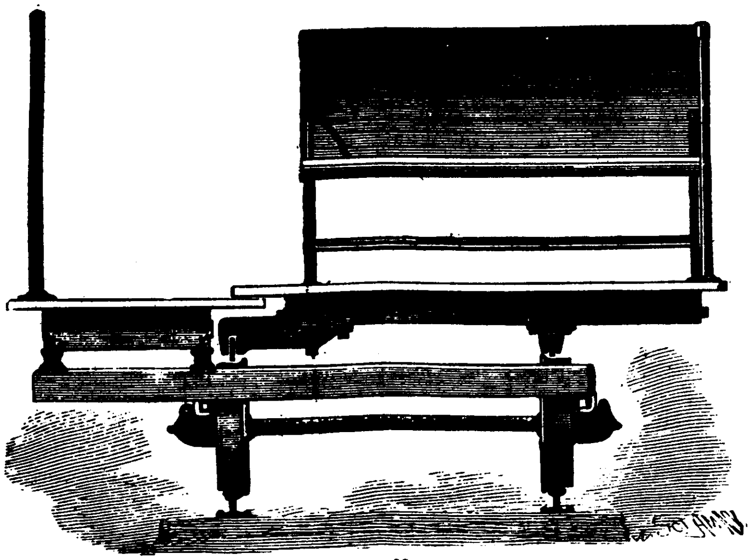
A beam of sunlight is thrown through a lens on a glass vessel that contains lampblack, colored silk or worsted, or other substance. A disk, having slits cut in it, is made to revolve swiftly in this beam of light, so as to make alternate flashes of light and shadow. On putting the ear to the glass vessel, sounds are heard so long as the flashing beam is falling on the vessel. If a beam of sunlight is made to pass through a prism, so as to produce the solar spectrum, and the colored light breaks through the revolving disk, and if, for instance, the vessel contains red worsted, and the green light flashes upon it, loud sounds will be given. Only feeble sounds will be heard when the red and blue parts of the rainbow fall upon the vessel, and other colors make no sound at all. Green silks give sound best in red light. Every kind of material gives more or less or no sound in different colors.

CHEAP RESERVOIRS.

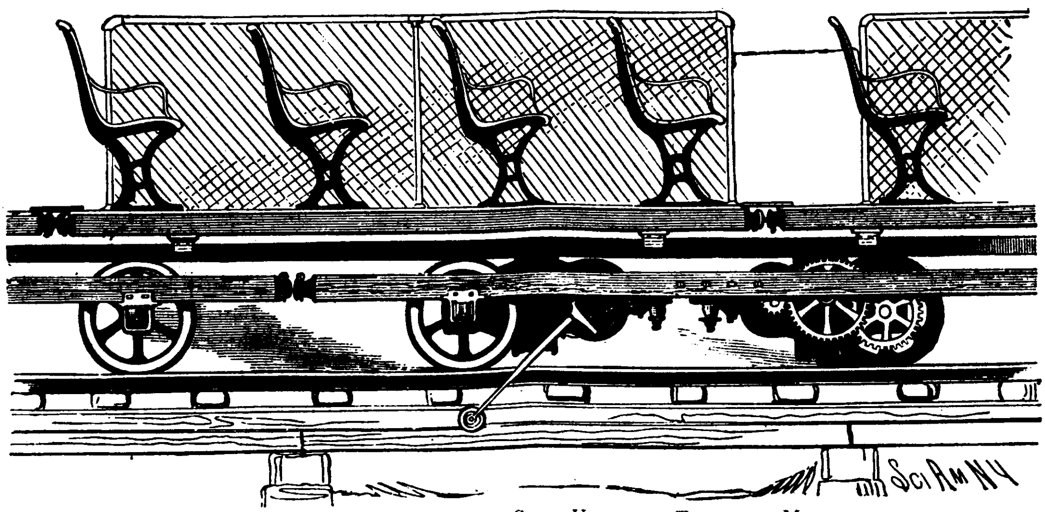
Mr. C. D. Durban says that the cheapest reservoir that a man can build on his land for retaining water for irrigation purposes is a tunnel run into a hill. An open reservoir in a canon or other suitable place will lose one-third of its water during the summer from evaporation, while in a tunnel there is no loss. A small spring will supply a tunnel with sufficient water for many purposes. He has illustrated this in a practical manner. On his own land at Mesilla Valley he ran a tunnel thirty-five feet long into a hill, in so doing tapping a spring; this tunnel he dammed up, leaving a space thirty five feet long and the size of the tunnel, which is about five by six feet, to be filled with water. The water he carried to his house in pipes and we observed that it supplied his dwelling, another near by, his barn and drying house for raisins, as well as irrigated quite a space devoted to flowers for a garden. He says that the tunnel is the cheapest and best form, and that for each dollar expended one can obtain a space of twenty-five cubic feet.—*Ex.*



THE WORLD'S COLUMBIAN EXPOSITION—THE TRAVELING SIDEWALK NOW IN OPERATION.



THE TRAVELLING SIDEWALK—END VIEW OF MOVABLE PLATFORMS.



THE TRAVELLING SIDEWALK—SIDE VIEW OF ELECTRIC MOTORS.

THE TRAVELLING SIDEWALK.

On a section of the World's Fair grounds at Chicago there is now being operated, on an endless elevated railway track, elliptical in shape and 900 feet long, a travelling sidewalk, a portion of which moves at the rate of six miles an hour, while another portion by its side moves three miles an hour The whole structure is under cover, as shown in the principal view below, and the system, which is a patented one, has been put in operation as a test of its practicability by a company of which Arnold P. Gilmore is president and O. Chanute vice-president. The slower-moving platform, as shown in the end view, is carried at one side on a frame of $2\frac{1}{4}$ inch by $6\frac{3}{4}$ inch pine sills, from the cross beams of which depend boxes in which are journaled the wheel axles, the wheels being 18 inches in diameter with 3 inch tread, and running on an ordinary T rail track of 3 foot gauge, while the faster moving platform, extending slightly over the edge of the first one, is carried by two flexible steel rails resting directly upon the peripheries of the wheels. The rail is held loosely in a shoe or socket in each cross beam, and the weight of the platform, whether loaded or empty, presses upon the rail sufficiently to give the necessary friction to move the load. The rails are of rolled steel, 4 inches high and half an inch thick, and are made in lengths of 30 feet, joined to make a continuous rail the entire length of the road.

The shoes are made of case-hardened steel, and the rail slot has an opening of five-eighths of an inch, allowing an eighth of an inch play to the rail for lateral motion in rounding curves. The difference of speed of the two platforms arises from the fact that the top of the moving wheels, on which the flexible rail travels, has a forward motion twice as fast as that of the axles, from which the slower moving platform is supported, and this ratio of one-half difference in speed of the two platforms would be maintained with wheels of any size. The platform moving at the rate of three miles an hour adjoins a stationary platform, from which one can step on to the movable platform without jar or inconvenience, as almost any one readily walks at this speed, while no greater change is felt in stepping from the slow to the faster moving platform, on which are stationary cross seats. There are gas pipe posts at intervals of 12 feet on the slower-moving platform, for the convenience of any one desiring such assistance in stepping from the stationary platform.

In this construction it will be noticed that the moving sidewalk and the sidewalk car do not stop at all, the differential speed allowing the passenger to readily and conveniently get off at any time, while the travel of the car is continuous, the passenger stopping himself instead of the car. With the six mile continuous speed thus obtained it is claimed that this method offers great advantages for the moving of large crowds over short distances, where the traffic is constant, and this method has been proposed for transporting visitors about the Fair grounds during the Exposition period.

The motive power is electricity, furnished by a Thomson-Houston generator of 107 horse power. There are three trucks provided with two 15 horse power Thomson-Houston motors, each handling 25 platforms, the platforms being each 12 feet long, and each connected with its predecessor and trailer by an ordinary pin coupling. The current is conveyed by a trolley wheel and pole from the feed wire beneath the platform, the return current being through the rails. The greatest speed which has been attained on this test structure is eighteen miles an hour. The cost of constructing a sidewalk railroad of this kind is evidently far less than that of the usual elevated railroad, and, as there are no stops, the power required to operate it would probably be much less than half of that of the present system for the same volume of traffic. The section now running is said to be practically noiseless.—*Scientific American.*

THE ETHICS OF PROFESSIONAL CERTIFICATES.

It has been said that in industrial progress the sweat of the brow is lessened by the conception of the brain, and it is true that at the present time more than at any previous period the welfare of the nation depends on the applications of science to the manufactures of the country. In every branch of technology the process of manufacture is dependent on scientific research, and is controlled and improved by the manufacturer, who avails himself of the aid of the technical expert. This expert has trained himself to be quick at devising means by which his knowledge may be rendered useful to others. The improvement in the material produced resulting from the utilisation of this knowledge is made known, partly through the press, and partly by the manufacturer seeking the aid of the professional man to describe the nature of the improvement to the general public. The dependency of national progress on the extension and application of scientific knowledge is thus admitted on all sides, and it seems, therefore, the bounden duty of those societies which represent the progress of science to guarantee, as far as possible, that nothing in the name of science shall be used by the adventurer to mislead or deceive the public. From the Royal Society downwards, this duty seems at the present time to be of paramount importance, and we are glad to notice that the younger professional societies are beginning to realize their responsibility to the public in this respect. The older scientific societies, even including the Royal Society, in proportion as the work of their Fellows becomes of public utility, likewise have the same responsibility.

At the present day, when it is a matter of frequent occurrence for a Fellow of the Royal Society to appear and give evidence in the witness box, and receive a proportionately high fee because he is a Fellow of the Royal Society, it seems essential that the Society to which he belongs should adopt a course such as that we have indicated. If this is true of the Royal Society, it is equally urgent that the younger and smaller scientific and professional societies should take steps to counteract the evil arising out of unprofessional acts. The medical profession, which from its nature has always been intimately related to the public, has in all countries made provision that the public should have a perpetual guarantee that its members are generally qualified to perform the work expected from them, and that unprofessional conduct carries with it the penalties of ostracism, and in some cases of prosecution. In some countries the quack is indicted either on information of a public medical officer, amongst whose duties it is to watch trespassers upon medical practice, or sometimes through the spontaneous act of the authorities. The medical profession, in short, determines that its members shall work by a fixed code of ethics under penalty of withdrawal of license.

We now urge some like control on the part of the more modern professions—as, for example, those of the engineer, surveyor, electrician, and chemist—as exists in that of medicine, in all cases involving questions of public faith. On a previous occasion, in connection with the Institute of Chemistry, we urged that a qualification to practice should only be given by those bodies who are prepared to imitate the medical profession in controlling the professional public work of its members. Perhaps, next to medicine, the applications of chemistry attract, at the present time, more public notice than other branches of technical knowledge, and we shall be pleased to learn that the Council of the Institute of Chemistry have recognised their responsibility towards the public by formulating a code of professional conduct which may effectually stop the evils which arise when swindlers, fanatics, and humbugs are let loose on a credulous public without any control. A preliminary meeting to discuss the ethics of professional certificates was recently held in London by the Institute of Chemistry, but, being of an informal character and poorly attended, no resolutions were arrived at as to the attitude that the Institute intends to take up on this matter, which is of great importance to the public, if a certificate of the composition or nature of any product can be given by a Fellow of the Institute, and such statement can be used by the manufacturer as a recommendation of his wares. Unfortunately, at the present time, the Institute has refrained from taking any steps to mitigate the evils which arise in this connection (1) from laudatory and misleading certificates emanating from quacks, and (2) from laudatory and misleading certificates emanating from certain of its own Fellows. The Institute has been fortunate in obtaining a charter and constitution which enables it to cope with these two evils. In the preamble to its charter, its functions are defined as the elevation of the profession of consulting and analytical chemistry, and the promotion of the efficiency and usefulness of persons practising the same, by compelling the observance of strict rules of membership, and by setting up a high standard of scientific and practical proficiency. It is obviously the external duty of the Institute, if it wishes to live up to its charter—which is the elevation of the profession of consulting and analytical chemistry—to publicly denounce the laudatory certificates and trade puffs which purport to be analytical certificates emanating from Fellows of the Institute, Fellows of the Chemical Society, or fellows of no society. The Institute should not only publicly denounce misleading certificates, and warn the public against putting faith in certain trade puffs, but it should deal summarily with offenders amongst its own Fellows. The censors already appointed by the Institute from year to year might do much in this direction, by framing a code of professional ethics, infringements of which should be punished by censure or expulsion from the Institute.—*Industries.*

ELEMENTARY MECHANICS.

By "The Doctor."

Matter.—Matter is the substance of which bodies are composed; it is that which may be apprehended by the senses, and which may be acted on by force.

Body Particle.—A body is any portion of matter which is bounded in every direction. A material particle is a body of dimensions so small that it is unnecessary to consider the differences in position or motion of its different parts.

In many cases the differences in the relation of the parts of an extended body are, in like manner, left out of account, it being considered as a single unit, and then the body is treated as a particle.

Molecule.—The smallest portion into which a given kind of a matter can be conceived to be divided, without a loss of its properties, is called a molecule. The molecule is an ideal unit, the existence of which is supposed to be proved by experiment, although it cannot be by direct observation. The smallest portion of matter, obtained by any method of mechanical subdivision, would consist of a large number of molecules.

According to the conclusions of Sir William Thompson, if a drop of water were to be magnified to the size of the earth, the molecule, of which it is made up would be coarser than fine shot, and probably finer than cricket balls.

Physical Science.—All changes which involve a material body, either as a whole or with respect to the relations of its molecules, are considered under the head of natural philosophy or physical science. Thus, the fall of a body to the earth; the flight of a rifle-ball; the ring of a bell; the melting of iron, its magnetization—these and all other analagous phenomena are included under physical science.

Atom.—Every molecule is supposed to be made up of one or more indivisible units called atoms. Thus, the smallest conceivable particle, or molecule, of salt, possessing all the properties of the mass, is believed to consist of two dissimilar atoms, one of the metal sodium, the other of gas the chlorine.

Chemistry.—All phenomena which result in a rearrangement of the atoms and a consequent change in the molecules of a body—that is, a loss of identity of the substance involved—belonged to chemistry. For example, the change of ice to water, or of water to steam, involves no change in the molecules but only in their mutual relations and position, hence these phenomena belong to physical science, but when a rearrangement of the atoms takes place and the water is thus decomposed into its constituent gases, hydrogen and oxygen, this last is a chemical change. The molecule is the physical unit; the atom is the chemical unit.

States of Matter.—Matter may exist in three different states—the solid, liquid and gaseous states.

The solid is characterized by a greater or less degree of rapidity. The molecules are bound together by the molecular force of attraction, called cohesion, and hence a solid body tends to retain its own shape.

The liquid is characterized by its inability; the molecules are free to move about each other, and the liquid takes the shape of any containing vessel.

The gas is characterized by its tendency to indefinite expansion. The molecules are believed to be in rapid motion and constantly coming into collision, and then repelling one another, so that a gas tends to occupy a greater volume, and hence exerts pressure on the sides of any vessel in which it is confined.

The term fluid is sometimes employed to include both liquids and gases.

Many substances under varying conditions exist in three different states; water, as ice; liquid and steam.

Properties of Matter.—All forms of matter possess the essential properties of extension, impenetrability, inertia.

Extension.—Every body occupies a definite position of space; that is, it has length, breadth and thickness.

Impenetrability.—Two forms of matter cannot occupy the same space at the same time.

Inertia.—Matter has no power to change its own state of motion or rest, hence it offers an apparent resistance to a force tending to change its state. This apparent resistance is inertia.

Other properties of matter are——

Porosity.—The molecules, of which a given body is supposed to be made up, are believed to be separated from one another by a greater or less space. In addition to these true or physical pores, most bodies exhibit also visible open spaces, or sensible pores, as those of a sponge.

Compressibility.—A body may be made by pressure to occupy a smaller space; this is a direct consequence of its porosity.

Divisibility.—A given kind of matter admits of being divided into a very great number of parts.

Elasticity.—A body whose shape has been altered by a force acting on it, tends to regain its shape when the force ceases to act. Solids vary widely in elasticity; for example, compare steel and lead, or clay and ivory. Liquids and gases are perfectly elastic.—*The American Engineer.*

An antiseptic soap for physicians and nurses, which has been found to possess the property of closing scratches and healing sores and cracks, has been introduced by M. Vigier, and is having considerable sale in Paris. It is made of 12 parts dried sulphate of copper incorporated with 88 parts of any good soap material. The product has a pleasing green tint and is devoid of any irritating action.

ELECTRICAL

A CENTRAL STATION COMBINING THE ADVANTAGES OF BOTH THE CONTINUOUS AND ALTERNATING CURRENT SYSTEMS.*

BY H. WARD LEONARD, NEW YORK CITY.

We are all well aware of the fact that the greatest strength of the three-wire system is due to features, the lack of which constitutes the greatest weakness of the alternating system, and that the reverse of this statement is equally as true.

The high efficiency, reliability, safety, and adaptability to supply almost any requirements for electric energy, which are the features of strength of the three-wire system, are the very points upon which the alternating system suffers by comparison, for its efficiency is much lower, its reliability is less due to the fact that its machines are not practically operated in multiple arc, its safety is necessarily less due to the existence of the high primary pressure, and its current is not adaptable to commercial use for motors, charging storage batteries, electro-deposition, and so forth.

On the other hand, the low first cost of an alternating system, the simplicity of its circuits and of the operation of the central station and its ability to reach with moderate expenditure of capital, lighting at any practical distance, make it the only possible pioneer in new and untried territory without great risk and almost the certainty of expending capital which will never be remunerative.

Hence it is that we find the three-wire system in possession of the densely settled centers of cities and towns, and not extending to the outskirts because of the uncertainty of a sufficient return upon the necessary capital, and both the central station-manager and the distant would-be consumers anxiously awaiting the development of improvements which will enable the three-wire central station to supply such distant consumers. And hence it is that the manager and consumers of an alternating system anxiously await the day when motors can be operated and a more economical, safe and reliable current than the present alternating current can be furnished by such a station to supply the imperative wants of the heart of a busy city.

If the above statement of the present existing conditions be a fair one, it will be evident that if we could only in some way secure the advantages of both systems in a common distribution, we should greatly improve matters. The object of this paper is to point out what appears to the writer to be a step forward in that direction.

The following conditions seem to be necessary :—

1. We must supply a continuous current for the central portion of a town during the daytime when power is required.

2. We must supply the outlying districts with an alternating current during the night-time when lighting is required.

3. We must not operate the alternate system under conditions of light load when its efficiency is very low.

4. We must be able to supply current for lighting continuously throughout the 24 hours of the day.

5. We must have but one set of conductors in any consumer's place.

In order to to meet the above conditions I propose the following :—

1. Wire all consumers upon the standard three-wire systems.

2. Connect all consumers upon standard three-wire mains.

3. Arrange the network of mains so that the central section of the network can be disconnected from the outlying sections through the agency of switches.

4. Install three-wire feeders to supply the central portion of the systems at full load, and install 1,000 volt primary wires and alternating current converters with a three-wire secondary circuit to supply the outlying section at full load.

Let us see how we will operate the station. Suppose it is eight o'clock in the evening. The switches which serve to connect the central and outlying sections are open, and our three-wire plant is supplying the full load of the central portion of the city. The alternating plant in the same central station is supplying the converters of the outlying section, which convert from 1,000 volts primary to 220 volts in the secondary, and the secondary coil has a connection at the center which is led off to supply the central wire of the three-wire system of the outlying section, the outside terminals of the secondary being connected to the outside wires of the three-wire system. It will be noticed that both plants are being operated at full load.

Now, suppose it to be eleven o'clock. The load has gone off rapidly so that the alternating plant is now operating under the worst possible conditions, and these conditions will continue for the outlying district until dusk the next day—that is, for probably 18 hours. An operator is now sent out who goes to each section supplied by a converter, and by throwing a switch transfers the secondary wiring from the alternating system to the three-wire mains. In this way the small remaining load is gradually transferred to the three-wire plant and then the alternating plant is shut down. The three-wire plant continues in operation all night and all the next day, supplying all devices with a continuous current. Motors can be operated in all portions of the system, even for domestic purposes in the distant residences, and all consumers get the opportunity of the use of the continuous current for any purpose desired for 18 hours out of the 24.

Dusk now arrives and soon the heavy lighting load will rapidly come on, and in such case the outlying section could not be supplied by the small wires feeding the distant three-wire section during the day, which are only about one-tenth the size which would be necessary to supply the full load.

The operator again goes round the circuit and now transfers the load of the outlying section from the three-wire plant to the alternating plant, and this condition prevails again until eleven o'clock arrives, when the operation is repeated, as before described.

The switches for transferring the load of the outlying section from one system to the other, can readily be controlled by simple means from the central station itself, if desired.

Now, let us look at some of the advantages we have gained.

All of our inside wiring is done on the three-wire systems for use of a lamp of 110 volts. This means that for the same

* Paper read before the N. E. L. A., Montreal.

distances and loss in conductors, we will save eleven-twelfths of the cost of copper which would be required by a secondary using 55 volt lamps upon a two-wire system ; or to put it another way, we can supply 110 volt lamps upon a three-wire system with the same cost of copper, and the same percentage of loss in conductors, at three and a half times the distance which would be permissable for 55 volt lamps on a two-wire circuit.

We all know the great desirability of using large converters, on account of their cheaper first cost per lamp and their higher efficiency, and also because a far more perfect regulation of pressure can be obtained upon a lot of lamps scattered in different kinds of store throughout a block, if they be supplied from one converter, than can ever be obtained by supplying these lamps by a lot of small converters loaded differently in almost every case, and consequently supplying a different pressure at the secondary terminals of each converter.

Under the system proposed by me one converter would ordinarily supply the entire lighting of a block, resulting in less first cost, higher efficiency of conversion, longer life of lamps, greater reliability and greater simplicity of plant.

A point worthy of notice is that for 18 hours out of the 24 an absolutely safe pressure is in use throughout the entire system, and that during all daylight hours when the greatest liability to accident from contact with high pressure wires exists, no high pressure is in use.

With such a system no consumer need be turned away.

The consumer who wants to charge storage batteries, and also make electric welds by electricity, can do so upon the same day and from the same wires that supply his incandescent lamps.

The factory upon the outskirts of town, which runs its isolated plant, and must to-day either use storage batteries or run machinery all night to supply a few watchmen's lights, can now switch on to the central station at six o'clock, and operate the few lamps it may need until dusk next day, when heretofore the alternating system, which was the only one which could reach it, did not run after midnight, or possibly after daybreak, because of the loss of money in so doing.

With this system the outlying districts can be pioneered with the least first cost and least risk. Any outlying section in which, for any cause, the demand increases greatly beyond that originally anticipated, can be supplied permanently by the three-wire system by merely running the necessary feeders to supply the already existing mains, and in such case the switches and converters would be moved out further or transferred to some new section ready for pioneer work.

The combination of a storage battery system and an alternating system also presents peculiar advantages. The storage battery is at its best when supplying a small steady load, such as we have for at least 16 hours out of the 24. The alternating is at its best when supplying the full load possible only during the remaining eight hours. The average electrical load on a general system is only about 12 per cent. of the maximum, consequently we are entirely safe in the statement that the greatest load during the 16 hours of light load is not more than 10 per cent. of the maximum load for the 24 hours.

If we were to attempt to operate the heavy load by storage batteries, we must either make an enormous investment, or, what is even worse, operate storage batteries at a disastrous overload. On the other hand, if we try to operate the 16 hours light load with converters, our efficiency, when operating at 10 per cent. of our converter capacity, would be unmentionably low. But reverse the case and everything works at its maximum efficiency. During the eight hours of possible heavy load, we operate all devices by the alternating system. At the same time a continuous current dynamo charges our storage batteries located either in the central station, or, if more desirable, at different centers in the system of distribution. At the end of the eight hours' run we shut down the plant, lock up the station, and leave it for 16 hours, the storage batteries meantime supplying all devices.

If, for extraordinary reasons, we have not capacity sufficient in the storage batteries to supply the demand, we run the continuous current plant to assist it ; and if that should fail or prove insufficient, we start up our alternating, and supply all or a disconnected part of the system with it.

With this plant distances are of no consequence ; we can use 1,000 volts for the continuous current plant as well as for the alternating, and the single two-wire distribution is all that is necessary for perfect results.

The weak spots of this latter arrangement will, no doubt, be thought to be the storage battery, but my experience with this device is that if you use it properly under suitable conditions, and do not attempt to squeeze impossible results out of it, economical and satisfactory service can be obtained from it, and certainly no better conditions could be obtained for it than those described above.

Up to this time a bitter fight has waged between those believing that the alternating, the direct, or the storage battery system, respectively, was the only suitable one.

I believe in them all, each operated so as to be used under the best conditions for its use, and I trust that the suggestions given above may lead to our being better able to meet and overcome our common enemies—High First Cost, Low Efficiency, Danger, Unreliability, and the Inflexible Conditions of the existing demand.

SOME DETAILS OF THE CARE AND MANAGEMENT OF AN ARC LIGHTING SYSTEM AS PRACTICED IN THE "MUNICIPAL" OF ST. LOUIS.*

BY JAMES I. AYER.

As central station men, it seems to me that we should demand of each other as much knowledge of the practice and experience as is practicable to give. In fact, if this Association is to be useful, our meetings should be largely "experience meetings," and the practical experience of those engaged in the development of the lighting and kindred industries, if given liberally at each meeting, would be followed closely by those interested in the production of electrical apparatus and supplies, and would do much to advance the business and improve appliances. Believing that we are here, as central station managers, for mutual improvement and for the free interchange of ideas and experience, I have presumed to present you with a limited, though doubtless dry, outline of the practice which obtains in the central station under the writer's charge.

The station, as designed, has a working capacity of 6,000 arc lights, and is now operating daily 3,500, and about 200 constant current motors. 2,000 of these lights are distributed over an area of 60 square miles, suspended between and from poles 50 and 65 feet in length, at a height of from 35 to 50 feet above the roadway, an average distance apart of about

* Paper read before the National Electric Light Association, Montreal.

900 feet, and used for street lighting. The motors and about 1,500 lamps are operated for the usual varied service of private consumers. 69 circuits supply the lamps and motors, containing about 1,200 miles of wire, and supported on 12,000 poles.

For generating the current, we have six 600 H.P. Corliss engines, which drive 300 feet of shafting, from which are driven sixty-five 60 light, and twelve 80 light, 2,000 c.p. arc dynamos. The arrangement of the dynamos is such that we have ample room for the care of 85 machines on a floor space of about 100 x 45 feet, and are able to operate a large number of dynamos with a very limited amount of help. Four boys and one young man of very limited experience care for all the machines during the night, in an entirely satisfactory manner; while a suitable man, with three assistants, give the necessary care to the dynamos during the day.

Thirty-one trimmers, with horses and carts, travel about 500 miles a day to renew the carbons in the street lamps. The average number of lamps to each of these trimmers is 68. Sixteen trimmers care for the 1,500 commercial lamps. Five inspectors, or troublemen, with carts and horses, care for the lines night and day, answer fire alarms, locate faults and correct minor troubles on the lines. Two day and two night inspectors care for the commercial arc and 2,500 incandescent lamps. A stable of 20 horses, in addition to the 40 horses owned by the trimmers and inspectors, is required. The maintenance of 60 vehicles justifies a blacksmith and waggon shop, which, with the stable, require the service of eight men. Two men care for the shafting, and three engineers and four oilers for the engine room. In the boiler house, where there are nineteen 300 h.p. boilers, there are two pump men, with two assistants, twelve stokers, one boiler cleaner, and six coal shovelers. These, together with an average force of 35 line and ground men, foremen, chief trimmer, chief inspector, superintendent of lines, store keeper, repair shop employees, carpenters, clerks, etc., constitute a force of about 170 men. A very large per cent of these men are called upon to perform duties which are simple, yet, because of their extreme newness, are not thoroughly comprehended by them. To get the best results, each man requires clearly written rules, as few of them as possible, and their rigid enforcement. In all practice this is the wise way to put it; but it is absolutely necessary that it be so with a large force, where many of the men do their work independently, and free from the constant supervision of a foreman.

In the room used as an office at the station by the inspectors and foremen are city maps, mounted on boards, where the locations of the lamps are indicated by tacks and the circuits by strings. For the central part of the city, where there are many circuits on the same line of poles, each circuit is shown on a separate map of that section. A number of printed slips, which represent a pole with cross arms, indicate the location of the wires on the poles on the different streets traversed by the different circuits. Any change of circuits is noted on a separate blank when the work is ordered, and when completed the maps are corrected to correspond. It takes but a few days for a man to become quite familiar with the circuits, by keeping them so conspicuously placed. In large stations this method of indicating circuits is almost indispensible, and will prove of great value if used in smaller ones.

For testing purposes we have a portable tachometer for indicating speeds, two Thomson indicators for the engines, a recording steam gauge, two standard ammeters, and a voltmeter reading to 5,000 volts for the dynamo room; on each circuit a spring socket for attaching ammeters and a current indicator for indicating the direction the current is flowing through the circuit; near the lightning arresters on the upper floor, a switch-board specially arranged for testing only; a wheatstone bride, magneto bells, etc. The engines are indicated once each day.

Evaporation boiler tests are made every month to see that the quality of coal is maintained at the standard. All the circuits are tested four times each day. All live circuits during the day are tested for grounds, and all others for apparent open circuits as well. In addition to this, all circuits are tested while alive by taking volt and ammeter readings simultaneously. The number of miles of wire and number of lamps being known, any material increase in the energy consumed gives evidence of a fault not always easily discovered by other methods. In testing for grounds on circuits not alive, a strong magneto bell is used. For all other testing a battery current of from 30 to 50 volts is used, and the circuit is required to pass at least one ampere to operate an ordinary call bell. When this bell is placed in series with a circuit which has more resistance than will pass this current at the pressure, the circuit is at once inspected and the fault located. In locating the trouble, one side of the bell circuit is connected to the line and the other to earth. The inspector or trouble man carries a similar bell with him, which he connects in series with the earth and line at various points, until the fault is located. The value of circuit testing with low voltage is keenly appreciated by those who have practiced it. When the circuits are alive, ammeter readings are recorded every two hours, and all readings are from the same instruments. These instruments are arranged so as to be read singly or in series, and one is used to check on the other. The value of first-class instruments in plants of any size cannot be overestimated, and should be in daily use in all stations, rather than the makeshifts generally supplied.

The stopping and starting of engines and boilers, pumps, dynamos, circuits, etc., are all recorded on reports made by those in charge of the different departments. Each inspector, trimmer, line foreman, storekeeper, and all heads of departments make daily reports of work done, and time and material used by them. Each trimmer is charged with a certain number of demerits for each fault on his route, such as defective or dirty lamps, broken or dirty globes, carbons used in excess of the required number, etc., and each month prizes are awarded to those having the best records.

The advantage of using vehicles for trimmers for all street-lighting work is being recognized. Provide a man with proper appliances and your service will improve. He cannot carry all that he should and walk long distances, nor will he take the same care when he is worn out with tramping that he otherwise would. We find it desirable for the trimmer to own and care for his own horse, while the company provides a suitable vehicle and harness, which he turns into the stable once a week for inspection, cleaning and repairs, when needed.

We select from our line men those whom we class as inspectors or trouble men, who are equipped with a light-running cart, with a suitable place for the storage of all tools necessary to use in an emergency. In addition to the special duty required of them during storms or at fires, these men correct all minor troubles reported to the office from various sources. During the first year's operations the average time lost, due to open circuits at night—that is, the average time lost from the time the circuit was opened until it was closed and the lights restored—was an hour and five minutes, notwithstanding that all circuits are more than ten miles in length. When these troubles occur, it is almost always during a storm, but the conveyances with which they are provided and their thorough knowledge of the circuits enable them to become very expert in locating and correcting troubles. During the past year nearly 15 per cent of all the calls answered by our trouble men were to correct troubles on the lines of other companies. Because we have wires all over the city, the police, and the public generally, think that all the wires belong to us, and, when they discover any trouble with them, are very apt to report the same by telephone to our station. During the entire twenty-four hours there is always one man on duty, ready to answer just such calls and correct the troubles.

All arc lamps, before leaving the station, are placed in a test rack, where they are supplied with a current maintained absolutely constant. Voltmeter readings are noted soon after the lamps have been lighted, when the carbons are about half consumed, and also when they are burned quite short. During the early part of the burning the lamp is adjusted so that the readings taken at three different points, give an average reading of 46 volts. In case of double lamps, this work is carried out on both rods. This extreme care in regard to adjustment we regard as absolutely necessary. If a lamp is permitted to consume its carbons, any fault which would not be discovered with a brief test is quite likely to develop. To determine the length of arc by the current and voltage is more likely to result in uniform lamps than were tested by the eye. With ten lamps, adjusted to burn at an average of 46 volts, with 9-5-10 amperes, the average number of watts per lamp was 436. Without changing the adjustment of the lamps, the current was increased to 9·8-10 amperes, and there was an average consumption of 524 watts per lamp, an increase of 20 per cent of energy; and by increasing the current to 10 amperes, the average number of watts per lamp was 550, the average voltage 58, the increase above normal being 33 per cent. That means 33 per cent more coal, 33 per cent more work at your dynamo, 33 per cent less capacity in your dynamo, and probably 33 per cent less life in your armature. One is apt to think that the difference between 8-5-10 and 10 amperes, when supplied to the lamp, is only a difference of 5 or 10 per cent, which is not very serious. This would be true if the lamp were adjusted each time for the ampere current it was to be operated with. To those who have not made this experiment, perhaps, a portion of the mystery as to where the coal goes will be cleared up. By using the ammeter and voltmeter for adjusting the lamps, and then seeing that the circuits are provided with the same ampere current indicated by the same ammeter, one will be apt to bring about like conditions in all lamps; at least, they are more likely to be uniform than if independent ammeters are used on each circuit. By reference to this statement relative to the amount of energy consumed by change of current, it will be easy to see how expensive one or two low lamps would be on a circuit, where the operator, to correct the trouble, supplies them with current enough to make them bright. Of course it is understood that better service as well is obtained by operating the circuits with no more current than that for which the lamps are adjusted. In this connection, I believe it is proper to again call attention to the well-worn subject of connections. A great deal of time and trouble is spent in soldering joints, and when the lines are led to the lamp they are apt to be poked into the binding posts, held with set screws indifferently tightened, and between these binding posts and the lamp connections proper there are perhaps three or four, if not more, indifferent contacts, all of which look very well in the factory, but are very bad after a few months' service. Hanger-boards should be used which have the line wire soldered to connections which cannot get loose. In our practice we accomplish this by using about 18 inches of flexible insulated cable, which is soldered to the hanger-board binding posts at the station (cut-out boxes are treated in the same manner), leaving the lineman nothing but an ordinary line joint to make, which can be easily done outside. Where lamps are suspended from the hanger-boards by the hooks which conduct the current, we always insist on some character of second connection being made to the lamp besides this. A simple way to do this is to take some small wire and tie the hook to the loop, in much the same manner as you would with a piece of twine. We have no screw connections anywhere in our circuits, and with a little ingenuity and care, they can be avoided always in arc lighting circuits. By the use of a special socket in each circuit for connecting an ammeter, we are able to take the readings with volt and ammeter, and get a correct indication of the actual consumption of energy on a circuit while in operation. With the data relative to the number of lamps in service and the number of miles and size of wire, we are able to discover any excessive consumption of energy and prevent the development of a series of little faults, which, in a short time, grow to be very serious ones if permitted to continue. Usually these readings are taken on each circuit three times a week, and during the time these observations are made, indicator cards are taken from the engines. From these two sources we get the actual consumption of electrical energy per circuit and per engine. We also get the indicated horse power. From a set of eleven observations taken from July 30th to August 28th, at various hours during the night run, the station shows an efficiency, between indicated horse power and electrical horse power at dynamo terminals of 74.9 per cent, ranging from 70.3 per cent, the lowest, to 77.5 per cent, the highest efficiency shown. The circuit readings indicate an average consumption of energy per lamp of about 6-10 of an electrical horse power. The average indicated horse power is about 8-10 per lamp. A good condition of the circuits is maintained constantly, because any neglect in any department is quickly shown by the data obtained from our records. Some months ago, when press of business caused the measurement of circuits to be neglected for a few weeks, the writer discovered an increase of over 10 per cent in the consumption of fuel, when there should have been a slight decrease. An investigation showed that an accident to an ammeter had caused a false reading, which increased the cost of fuel alone about $16 a day. The difference in the appearance of the lamps was not such as to call forth special comments then by those interested, yet, when the fault was discovered, it was remembered that some seemed to have been burning high for a week or two. On suburban circuits on long loops, it is our practice to place cut-out boxes on the pole where the line branches. This saves a great deal of time in locating troubles; but, let me add that, unless a thoroughly water-tight and substantial cut-out is used, it will prove more of an annoyance than an advantage. A log of each circuit and dynamo, as well as of engines and boilers, is a very satisfactory and desirable part of the records, and will frequently assist materially in locating troubles and saving expense.

Throughout the country it is almost the universal practice to wire for arc lights without cost to the customer. There is no valid reason for this custom, and for more than a year it has been our custom to charge for cost of labor, with the result of reducing expenses more than $600 per month. In every case where lamps are discontinued in the spring, we require a contract for fall and winter service, else the wires are removed when the lamp is taken down. We invariably cut down the line between the house and pole where the service is discontinued for the season, though it is to be renewed later. To induce annual contracts, a rebate of 5 per cent is given at the expiration of the year, and is found to work to advantage.

There are very many details of construction, as well as of office work, which could be referred to, if it were not that this paper is now too long; but I will be glad to furnish a copy of "general instructions to employees," used in the government of this plant, which refer to and bring out some points of management which are not mentioned here, to those who care for them.

EXPLANATION OF ELECTRICAL WORDS, TERMS, AND PHRASES.

(From Houston's Dictionary.)

Centimetre-Gramme-Second System, or the C. G. S. System—A system of units of measurement in which the centimetre is adopted for the unit of the length, the gramme for the unit of mass, and the second for the unit of time.

This is the same as the *Absolute System of Units.*

Chamber of Lamp.—The glass bulb or chamber of an incandescing electric lamp in which the incandescing conductor is placed, and which is generally maintained at a high vacuum.

Charge, Density of, or Electrical Density.—The quantity of electricity at any point on a charged surface.

Coulomb used the phrase *Surface Density* to mean the quantity of electricity per unit of area at any point on a surface.

Charge, Electric.—The quantity of electricity that exists on the surface of an insulated electrified conductor.

When such a conductor is touched by a good conductor connected with the earth, it is *discharged.*

Charge, Distribution of.—The variations that exist in the density of an electrical charge at different portions of the surface of all insulated conductors except spheres.

The density of charge varies at different points of the surface of conductors of various shapes. It is uniform at all points on the surface of a sphere.

It is greatest at the extremities of the longer axis of an egg shaped body, and greater at the sharper end.

It is five times greater at the corners of a cube than at the middle of a side.

It is greatest round the edge of a circular disc.

It is greatest at the apex of a cone.

Charge, Residual.—The charge possessed by a charged Leyden jar a few moments after it has been disruptively discharged by the connection of its opposite coatings.

The residual charge is probably due to a species of *dielectric strain,* or a strained position of the molecules of the glass caused by the charge. Such residual charge is not present in air condensers.

Charging Accumulators.—Sending an electric current into a storage battery for the purpose of rendering it an electric source.

There is, strictly speaking, no accumulation of electricity in a storage battery, such, for example, as takes place in a condenser.

Chimes, Electric.—Bells, rung by the attractions and repulsions of electrostatic charges.

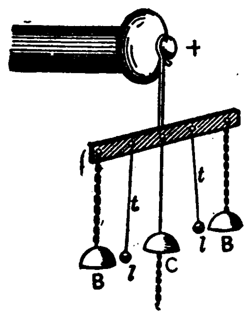


FIG. 95.

B and B, Fig. 95, are directly connected to the *prime* or *positive* conductor +, of a frictional machine. C is insulated from this conductor by means of a silk thread, but is connected with the ground by the metallic chain C. Under these circumstances the clappers, *l*, *l*, insulated by silk threads, *t*, *t*, are attracted to B, B, by an induced charge and repelled to C, where they lose their charge only to be again attracted to B, B. In this way the bells will continue ringing as long as the electric machine is in operation.

Chronograph, Electric.—An apparatus for electrically measuring and registering small intervals of time.

Chronographs, though of a variety of forms, generally register minute intervals of time by causing a tuning fork or vibrating bar of steel, whose rate of motion is accurately known, to trace a sinuous line on a smoke blackened sheet of paper, placed on a cylinder driven by clockwork, at a uniform rate of motion. If a fork that is known to produce, say, 256 vibrations per second be used, each sinuous line will represent $\frac{1}{256}$ part of a second.

An electro-magnet is used to make marks on the line at the beginning and the end of the observation, and thus permit its duration to be measured.

Chronoscope, Electric.—An apparatus for electrically indicating, but not necessarily recording, small intervals of time.

The small interval of time required for a rifle ball to pass between two points may be determined by causing the ball to pierce two wire screens placed a known distance apart. As the screens are successively pierced, an electric circuit is thus made or broken, and marks are registered electrically on any apparatus moving with a known velocity.

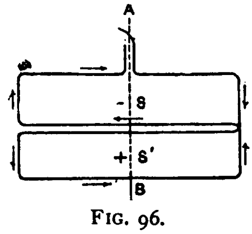


FIG. 96.

Circuit, Astatic.—A circuit consisting of two closed curves enclosing equal surfaces.

Such a circuit is not under the action of the earth's field. The circuit disposed, as shown in Fig. 96, is astatic and produces two equal and opposite fields at S and S'.

Circuit, Broken or Opened, Made, Closed, or Completed.—A circuit is *broken* or *opened*, when its conducting continuity is disturbed, or when the current cannot pass.

Circuit, Closed, Completed, or Made.—A circuit is *closed*, *completed*, or *made*, when its conducting continuity is such that the current can pass.

Circuit, Electric.—Literally, to go around.

The path in which electricity *circulates* or passes from a given point, around or through a conducting path, back again to its starting point.

All simple circuits consist of the following parts, viz.:—

(1) Of an electric *Source*, which may be a *voltaic battery*, a *thermo-pile*, a *dynamo-electric machine*, or any other means for producing electricity.

(2) Of *Leads* or *Conductors* for carrying the electricity out from the source, through whatever apparatus is placed in the line, and back again to the source.

(3) Various *Electro Receptive Devices*, such as electro-magnets, electrolytic baths, electric motors, electric heaters, etc., through which the current passes and by which they are actuated or operated.

Circuit, Grounded.—A circuit in which the ground forms part of the path through which the current passes.

THE ECONOMIC BASIS OF IMPERIAL FEDERATION.

The problem of Imperial Federation is one which profoundly affects our national industries and commerce, and therefore should be carefully studied in its economic aspects. Some time ago Lord Salisbury threw out a hint to a deputation from the Imperial Federation League, that it was advisable that a more definite programme or set of proposals should now be issued, so that public opinion might be formed on the subject, and that its difficulties might be clearly recognized and discussed, for it must be admitted that with many people Imperial Federation has been more a matter of sentiment than of sober reasoning. The subject, however, is now beginning to attract the attention of thinkers of different types, and papers and articles are appearing which should be very useful in reducing the somewhat nebulous ideas which at present prevail to a practical plan on which definite opinions may be formed. Of course, such a question can be approached in many different ways, but if they are all directed to the same result they must have many points in common. One of these, of course, is that they should rest on a sound economic basis, and interfere as little as possible with the financial requirements of the different parts of the Federation. It has been felt that the great variety of tariffs, and of methods of commerce, made the solution of the problem very difficult, and it is to the removal of some of these difficulties that attention is now being chiefly directed. One of the best papers on the subject is by Professor Shield Nicholson, which was recently published in the *Scottish Geographical Magazine*. As the author treats the subject with the full knowledge of a skilled economist, some of his suggestions may be noted, as they seem to proceed on right lines and to indicate the most probable solution of the matter in so far as the variety of tariffs is concerned. Professor Nicholson points out that Adam Smith propounded the most definite and most practicable scheme ever yet published of Imperial Federation, and that he was not afraid of substituting for the British Parliament the States-General of the British Empire. He said: "There is not the slightest probability that the British constitution would be hurt by the union of Great Britain with the Colonies. That constitution, on the contrary, would be completed by it, and seems to be imperfect without it. The assembly which decides concerning the affairs of every part of the Empire, in order to be properly informed, ought certainly to have representatives from every part of it. That this union, however, could be easily effectuated, or that difficulties, and great difficulties, might not occur in the execution, I do not pretend. I have yet heard of none, however, which appears insurmountable." He, moreover, was not content with the mere ennunciation of general principles, but actually examined the system of taxation in force at the time in Great Britain, especially the customs, excise, the land tax, and stamp duties, with a view of determining how far they might be applicable to all the different parts of the Empire, and he devised a scheme according to which "the British Empire would afford within itself an immense internal market for every part of the produce of all its different provinces." Of course, a great deal has happened since the days of Adam Smith, and the problem has become much more complicated, but if the general principles which he laid down were attended to they would greatly simplify matters. His great merit as a financial reformer consisted, not in his mere condemnation of Protectionism pure and simple, but in his substitution of a few broad principles of finance in place of an unintelligible mass of historical survivals. It is evident that if British statesmen had applied these principles as they were generally adopted by the United Kingdom to the rest of the Empire, Adam Smith's Utopia of an immense internal market would have been already realized. But British statesmen as a rule do not look very far before them; they are content in many cases to legislate for the hour, and the result very often is a mass of incongrous details and contradictory principles. A glance at the admirable synopsis of the tariffs and trade of the British Empire which has been prepared by Sir Rawson Rawson reveals the inexplicable and purposeless differences in the articles selected for duties and in the rates charged upon them in different parts of the Empire. Even the mind of the compiler, skilful economist as he is, seems to have been filled with dismay, and he refers to the few enthusiasts who have dreamed of or longed for a common British tariff. Professor Nicholson, however, remarks that evidences should not simply be numbered, but also weighed, and that by following the principles laid down by Adam Smith most of the economic reforms of the present century have been carried out. Bad as things are at present in the matter of colonial tariffs, they are nothing compared with the state of taxation in the United Kingdom at the time of Adam Smith. Every one knows Sydney Smith's description of the taxed Englishman—taxed on every article that he used from the cradle to the tomb. Compared with him the most heavily taxed of colonists bears an easy load. Professor Nicholson asks the people of the mother country and the colonies to remember that the tariffs of the United Kingdom, even fifty years ago, were in a worse confusion than those of the Empire at present, and that a century ago the confusion was infinitely more confounded.

Professor Nicholson's main object is to point out the principles and advantages of the financial reforms of the present century in the United Kingdom, with the view of showing that, to a great extent, similar reforms might be carried out for the rest of the Empire. He considers the question first from the point of view of Revenue (with the indirect consequences), and secondly, from the point of view of Protection. He is of opinion that the first and more important question has too often been neglected in favour of the second, and he makes an attempt to restore the due balance of emphasis. Our space will not allow us to enter into the details of his arguments, but he maintains that, so far as revenue from customs duties is concerned, the colonies might with advantage tax few articles instead of many, and he points out that the smaller the number the greater the scope there is for uniformity, and that every reduction brings us nearer to fiscal consolidation. He illustrates at considerable length the absurdities of the present system, and the arguments for and against it. He points out, as a curious illustration of the original sin of all taxation, that the idea of taxing the foreigner, instead of appearing contemptible, seems to have a peculiar attractiveness both for statesmen and the people, and is apparently a survival of the time when in all languages the words for stranger and enemy were identical. As Professor Nicholson remarks, fortunately for the interests of peace and the development of international trade, taxing the foreigner is very like "shearing the wolf." The incidence of import duties is indeterminate and the effects are very far reaching, and some of these react on the people of the country who are supposed to be protected, for all trade is reciprocal and interdependent. Moreover, the whole subject of taxation is so difficult that practical statesmanship cannot deal fairly with the changing industrial conditions, and to adjust complicated tariffs to complicated changes is well nigh impossible. Professor Nicholson is very cautious, however, and does well to point out that the advocates of Free Trade have unquestionably damaged their cause by dogmatism and exaggeration. They have made their opponents believe that the general case for Free Trade is destroyed if one particular exception can be proved.

The conclusion at which Professor Nicholson arrives is that if our colonial statesmen would, little by little, follow the example set by the great British financiers of this century, and reduce and abolish their duties, it would be easy to establish a fiscal union. Such a union would bind far more closely than a nominal association for defence. It would naturally lead to the creation of other commercial ties, and would silently and insensibly weld together the fragments of our scattered Empire. He reminds those who advocate reforms that the most fatal obstacle is the exaggerated emphasis laid upon the difficulty of making any change. If we can get rid of the "idea of impossibility," the task is more than half accomplished.—*Industries.*

STATIONARY ENGINEERS.

Just now is the time of year when associations of stationary engineers should begin their winter's work in earnest. These associations base their usefulness mainly upon being educational factors, and the long, cool evenings now ensuing should, and undoubtedly will, prove an incentive to activity.

The art of stationary engine running is, it is true, one that cannot be learned otherwise than by actual practice, but such schools as the numerous societies of stationary engineers can organize may be a wonderful help in perfecting the members in the art. When, for example, fifty working engineers meet together at stated intervals, their collective information represents a vast amount of knowledge. Nearly every one of them has solved some problem in the line of his work that the others have not solved, and the point should be to bring this out for the benefit of all.

Too much dependence is placed in engineers' societies, as in all other similar societies, on eminent lecturers. Lectures by such men should by no means be despised. On the contrary, the services of men competent to give information should always be obtained when at all practicable. But this should not be the entire or the principal aim of engineers' associations. Their meetings should be so conducted as to bring out, from time to time, the combined knowledge of the membership on the diverse points connected with the business of competently managing a steam plant.

The number of stationary engineers in this country is not known, but it is many thousand. Steam has grown so rapidly into use that those who manage its use have come to be a large army. And just as in every branch of business the supply meets the demand—meets it frequently in a way just about as a mechanic shop or a foundry could be filled with laborers—so the demand for engineers is met. But this is not the way the demand for engineers should be met. Not only for economical reasons, but for reasons of safety, good men—men who have made a study of their business—are required.

A good deal of harm has been done the steam engineers by the builders of engines who have made a point of advertising that their engines did not require an engineer to operate them. No steam engine can be properly operated without the service of an engineer. The assumption that a steam engine doctor can come around once in a while and make everything right is fallacious. The engineer must be the doctor, with his finger always on the pulse of his patient.

There is no school, properly speaking, for stationary engineers. If there were such a school it could no more make a stationary engineer than a law college could make a competent lawyer, or a medical college a doctor. Either one of the illustrations named can grant a diploma, but so far as competency is concerned it amounts to very little. Men employ the lawyer who manages their cases well, or the doctor who prescribes the right medicine for the case in hand. Lawyers and doctors alike learn by experience—by their own experience, and by the experience of others. All learn largely by the experience of others. And this should be the case with stationary engineers. They should patronize the meetings of their associations, giving and receiving information.

It is astonishing how much may be accomplished in this way. As an example, the writer recently had the pleasure of attending a meeting of stationary engineers at which a member brought up a case of some trouble in steam heating in a large building. And he does not hesitate to say that the information volunteered by the members present was more comprehensive in its scope than that which could be obtained through any book ever published on the subject of steam heating. It was the united efforts of all to help an individual out of his trouble.

There is one thing that comes in in this connection. That is the status of employers in relation to the purely educational societies of stationary engineers. Employers are by no means bound to assist in the education of their engineers. Men get pay for what they know and can do ; but there is nothing that so helps a man along and nerves him for better effort, as the knowledge of the fact that the man who pays him his salary, or wages, appreciates his efforts to always do better. It may be a curious fact, but it is a fact, nevertheless, that a man who receives the pay of another likes to know that his services are appreciated. Now when employers of steam engineers—or any other class of men, for that matter—see their men trying all the while to do better, spending their leisure time—perhaps burning the midnight oil—in becoming more proficient in their business, or in correcting some evil, it is as certain as anything can be that these men will appreciate some encouragement in what they are doing.

When an employer forgets this he makes a mistake—not a small mistake, but a large one.

To apply this to the stationary engineer, when his employer fails to recognize the fact that his engineer is working with all his energy, and to the extent of his ability, to reduce the cost of running his plant, he misses an important point.

The moral we draw from this is that the employer should co-operate with his engineer, or engineers, in giving him or them such encouragement as he can in perfecting his own or their knowledge in the use of steam.

To put it more plainly, the employer of stationary engineers should encourage the societies of stationary engineers that have for their object the perfection of their membership in the production and utilization of steam. This granted, there is no better way to accomplish the end than for employers to be present at the opening meeting of such associations, and to freely express their views on the subject under discussion.—*American Machinist.*

DANGERS OF LARGE FLY-WHEELS.

The bursting of the 68-ton fly-wheel of the great engine in the Amoskeag Mills, Manchester, N.H., furnishes additional evidence, if such were needed, to prove that with the means now at hand the possibility of flaws in large castings cannot be determined with certainty. In his testimony before the coroner's jury, the superintendent of the mill said :—

"The remnants of the fly-wheel show very many internal flaws where the iron is drawn badly by shrinkage in cooling, all of which it was impossible to discover without destroying the wheel ; sounding would not show the flaws. If you join two cubes of iron of equal size, one solid, the other filled with these shrinkage flaws, the parts would vary largely in weight ; such tests would be impracticable in castings as large as the integral parts of this fly-wheel."

According to the testimony the wheel was moving at its usual rate, the same being 61 revolutions a minute, and this is strange enough when we consider that it had been in use over eight years for about three months of each year, water power being employed in the interim. This, like all big wheels, was composed of segments bolted together, and, of course, it is possible that the trouble began on the rim, the bolts loosening, and the component parts of the wheel, or those of imperfect make, being unable to withstand the shock of the wrenching that followed.

In another recent fly-wheel catastrophe, that in the power house of the Electric Street Railway Company, of Cincinnati, O., the wheel, a 20-ton one, suddenly flew apart, and at a time when, so far as the engineer could see, there was not any undue acceleration of the engine's movements.

In this case there were no casualties, as at Manchester, and hence no inquest. The investigation that followed was conducted by interested persons who, notwithstanding the declaration of the engineer, who was present at the time, attributed it to a sudden withdrawal of the load and the consequent racing or "running away" of the engine. The fact that the automatic cut-off, operated by the governor, was found to be intact, might fairly be accepted as helping to sustain the assertion of the engineer, because, had the engine been relieved of its load, this automatic cut-off would undoubtedly have held the engine to within a few turns of its normal speed. It would seem, therefore, as if this, too, might be a case of defects in casting.

A recent inquiry among the makers of these big fly-wheels failed to discover one among them who knew of any test for large castings by which the presence of flaws, the result of air bubbles in moulding or improper cooling, could be discovered. About a year ago there was a report that a French inventor h d devised a means of doing this by electricity, the apparatus being called a "schiseophone." It was said for it that it would indicate the presence of flaws in steel rails that the ordinary hammer test could not be relied upon to discover, or, to put it more correctly, that the human ear is not sensitive enough to read the warning that may be given in the hammer test when put to large castings. Nothing, however, seems to have come as yet of all the promises made for this invention. Till such or similar means are found to discover flaws in segments for large fly-wheels, it is not safe to use them in the vicinity of work-rooms, as at Manchester.

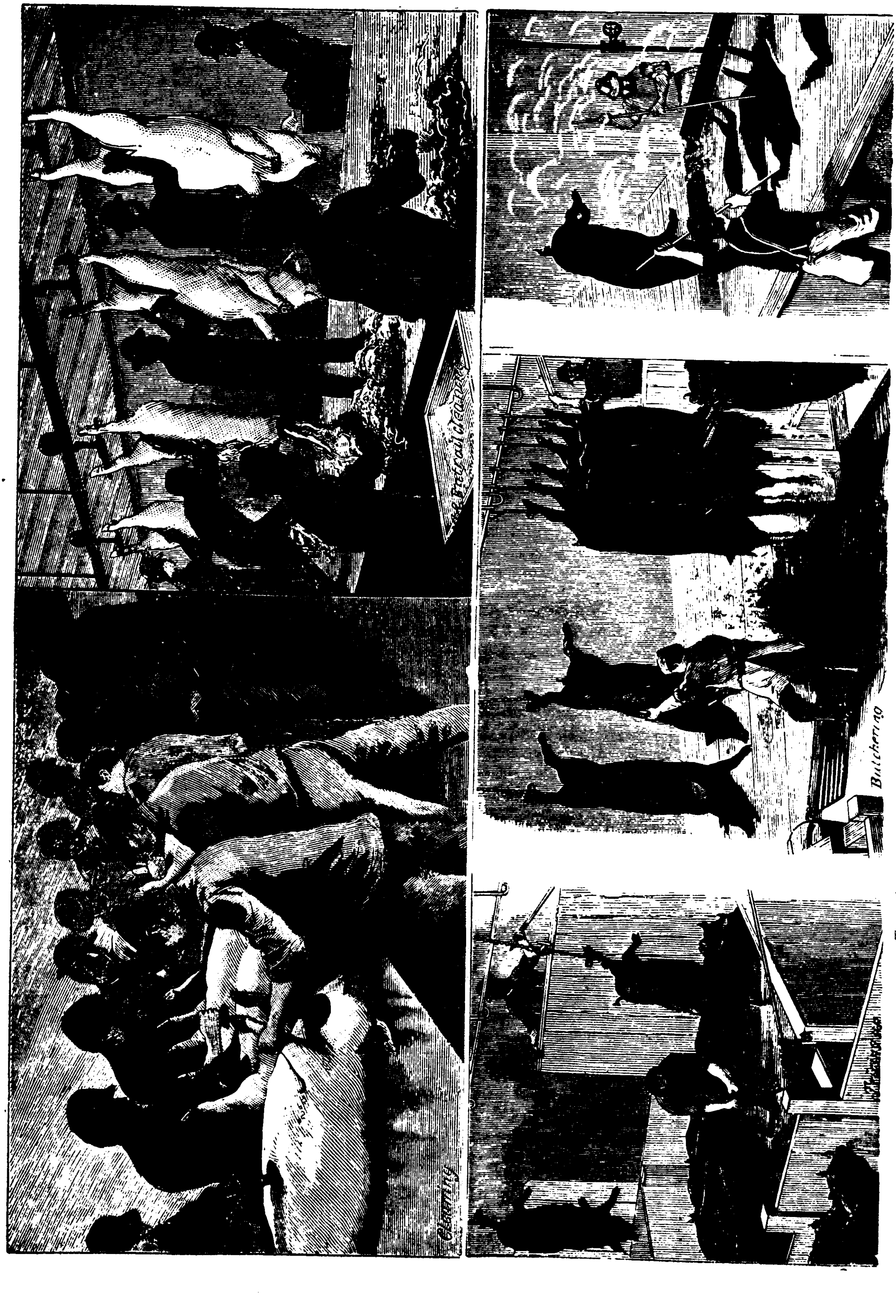
HOG KILLING AT THE CHICAGO STOCK YARDS.

According to the United States Department of Agriculture, there were, on Jan. 1, 1891, over fifty millions of swine in the United States, more than three-fifths of which were in twelve so-called packing States, four of these States, Iowa, Illinois, Missouri, and Kansas, having together 18,596,000, or nearly two-fifths of the total for the whole country. The city of Cincinnati was for many years familiarly designated as Porkopolis, as the leading center of the pork-packing business, but Chicago long ago passed the Queen City in this specialty, almost at the same time that it attained so striking a prominence in the business of beef packing. There is probably no more interesting subject to the economist and statistician, at the present time, than that presented by an investigation of the vast business carried on at the Chicago stock yards, and it is not surprising, therefore, that visitors to Chicago are always expected to make the tour of the stock yards before they can be said to have a proper appreciation of the enterprise and business ability which have made the city what it is.

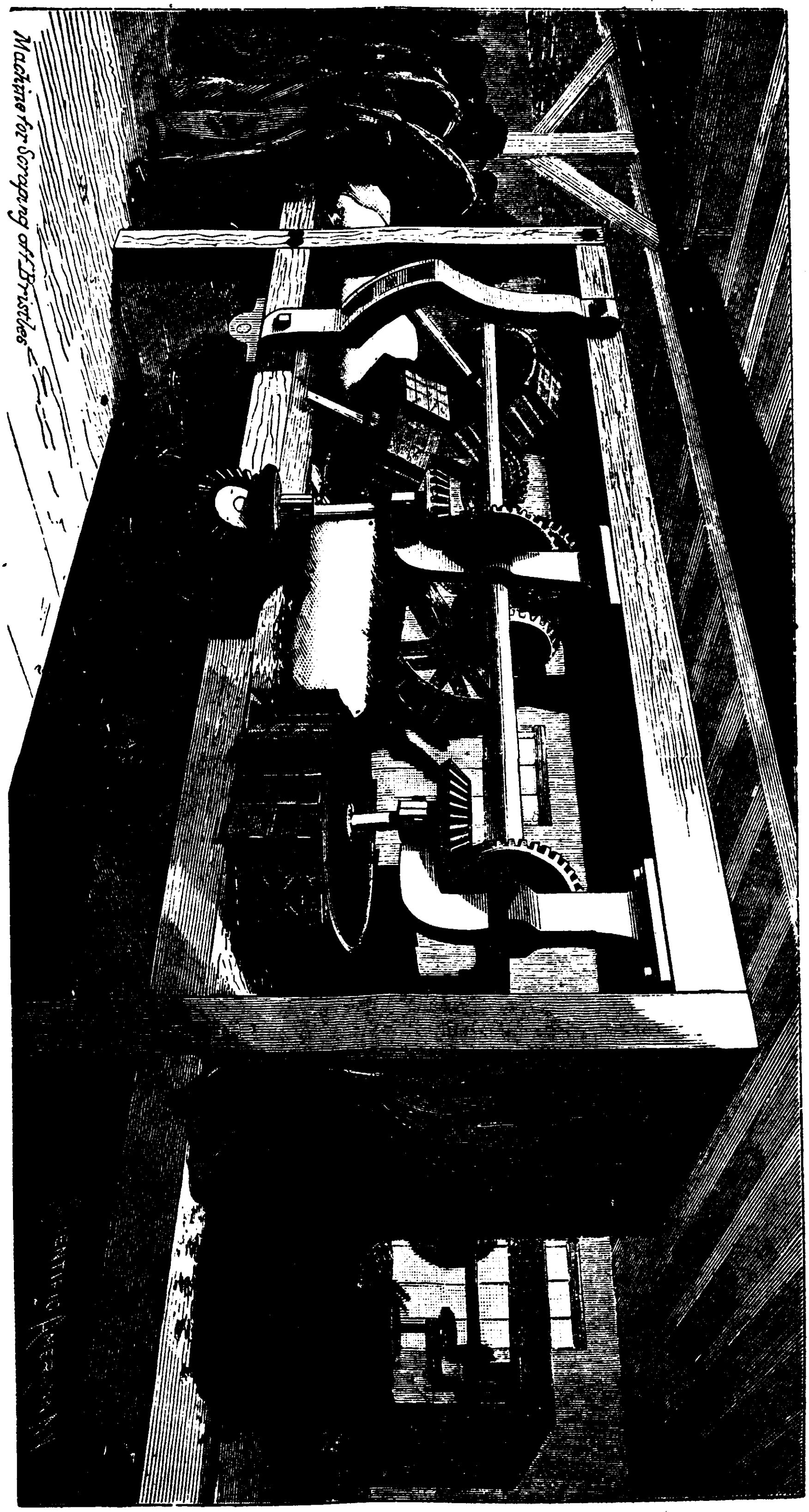
In the accompanying illustrations we have endeavored to make our readers participants in the advantages of such a visit, so far as our artist has been able to represent one of the most important branches of business carried on at the stock yards, the pictures showing the details of the pork-packing industry as carried on by the house of Armour & Co., who have long stood at the head of the trade as being the largest packers and shippers. Their trade extends to all parts of the globe, and the number of hogs killed by them for the year ending April 1 last numbered 1,714,000, besides 712,000 cattle and 413,000 sheep. They have 7,900 employes, and 2,250 cars are equipped with refrigerating apparatus for the transportation of their products. The ground area covered by the buildings is 50 acres in extent, giving a floor area of 140 acres, a chill room and cold storage area of 40 acres and a storage capacity of 130,000 tons. In addition the firm has separate glue works, with buildings covering 15 acres, where 600 hands are employed, their production last year having been 7,000,000 pounds of glue and 9,500 tons of fertilizers.

The hogs, as they arrive by train from all sections, are kept in the extensive yards and sheds adjacent to the buildings until they are wanted for slaughtering, which may be a few days or but a few hours. While they remain here, however, they are always well fed and watered, and they are selected for killing according to the various markets, their ages generally being from six to eighteen months, and the average weight being from 150 to 200 pounds.

Each lot of animals, as they are taken from the pens, is duly weighed on standard scales, after which they are driven



THE AMERICAN PORK INDUSTRY—HOG KILLING AT THE CHICAGO STOCK YARDS.



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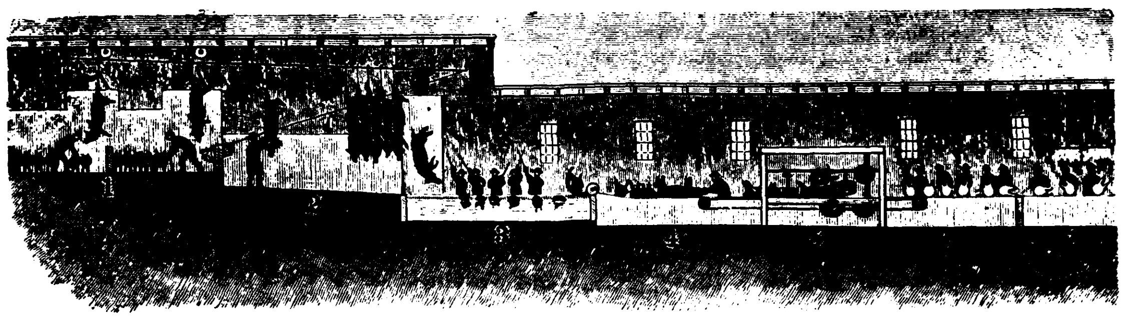
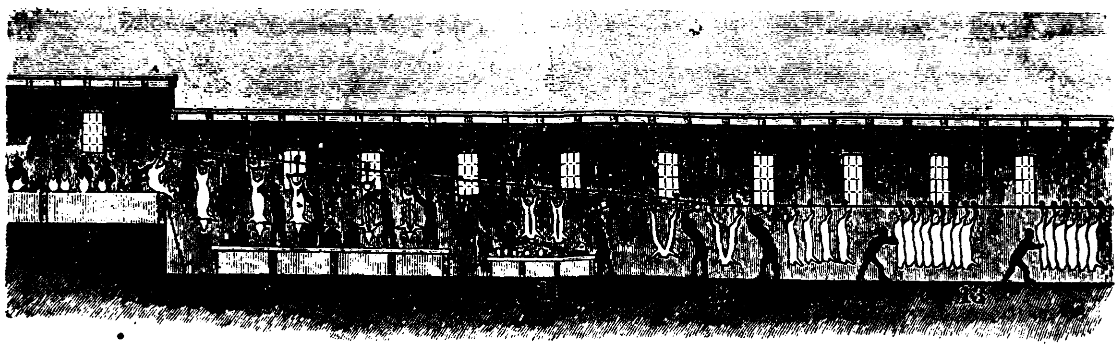


Tricing up. Butchering. Scalding. Attaching to cable. Scraping. Cleaning. Washing.



Inspection—throat cutting, hanging on trolley. Cutting open and entail stripping. Taking out leaf lard. Heads off, tongues out. Splitting. Running into cooling room.

THE CHICAGO STOCK YARDS—SUCCESSIVE OPERATIONS FROM CATCHING PEN TO COOLING ROOM.

over what is styled the "Bridge of Sighs" into an upper story of the building where the work commences, about a score being inclosed together in a catching pen. Then to one hind leg is attached a short piece of chain, having a ring at its opposite end, and into this ring the operator passes a hook on the end of a chain lowered from a roller overhead, the latter chain being steadily wound up by power. As the head of the animal is raised, another hook, suspended from a wheel, is fixed into the ring, and this wheel runs on a rail onward through several large rooms, always at an incline, down which the animal is carried by his own gravity. As he is swung over the wall of the catching pen, the butcher, with one thrust of a sharp, short knife, always reaches to the heart, insuring almost instant death, there being no squealing and but very little muscular twitching after the thrust. The blood flows through an inclined grating into a receptacle below, and of itself is an article of considerable value, utilized for several important purposes.

Passing on beyond the butcher, the animals are unhooked and plunged into a vat of steam-heated water, where nine or ten are immersed together, and where they are kept for about three minutes, that the hair may be readily scraped off. From the farther end of the vat, every few seconds, a curved, rake-like grid-iron, attached to a cable, lifts a steaming hog out on a table, along which passes an endless chain, to which the hog, hooked by the nose, is attached, to be drawn through a scraping machine, as shown in the lower picture in our first page illustrations. At the time of the visit of our artist, black Berkshire pigs were being slaughtered, and the white and black portions of the animal seen plainly indicate where the hair has been already removed in its passage through the machine. The accurately working spring scrapers of the machine are mounted on cylinders placed at such angles as will allow the blades to most effectually reach every portion of the animal, and in about ten seconds the hog emerges denuded of its hair. This work was done by hand some years ago, but the machine, which saves the labor of ten men, was invented and put in operation by one of the engineers of the firm in consequence of a strike of the scrapers, who did not imagine that machinery could be made which would perform their branch of the work.

The animal passes from the machine to hand scrapers, where any slight oversight is made good, after which follows a thorough washing by means of jets at the ends of rubber hose suspended over the table, to be directed as required for removing any adhering hair, dirt, or scum, perfect order and cleanliness being a marked feature of every detail. Next follows an inspection, after which the animal's throat is cut entirely across, so that the head hangs by but a slight connection, and the body is suspended by the hind legs from a trolley, and thus passed over the table where the disemboweling is performed. The leaf lard is removed at a following table, and further along the heads are removed and the tongues taken out, the last operation being the splitting, before the carcass is run into the cooling room, the time taken to catch the hog, slaughter, cleanse, dress, and deliver him in the cooling chamber being ordinarily only from ten to fifteen minutes.

Each portion of the internal organs is carefully separated, cleansed, and set aside for use, the lungs, heart and liver going to the sausage department, and the intestines, stripped of fat, cleansed and scalded, following to form the casings. Many kinds of sausages are made, among which are "liver," "blood," and pork, "Frankfurter" and "Bologna," while the soft parts of the heads are made into head cheese or brawn. The mincing of the sausage meat, which also includes trimmings from the sides and hams, is effected by steam-driven mincers operating in large vats. From hogs in good condition it is estimated that as much as forty pounds of lard is obtained on an average from each animal. The fat and other refuse is placed in tanks heated by worms from steam boilers, and after melting is drained off in different grades, the first quality being made only from the leaf and trimmings. Some of the bristles are used for brushes, and others go to cobblers, but the great bulk of the hair is mixed with horse hair for stuffing cushions and similar purposes. The blood is largely used for making albumen for photographic uses, as well as in sugar refining and for a fertilizer, the crushed bones and other refuse also forming a very valuable fertilizer, although many other uses are likewise found for the bones.

After the carcass has been thoroughly cooled, in rooms which are always kept at a temperature below 40° F., it is run along, still on the labor-saving rails, to the cutting-up department, where it is taken down and separated into two sides, and then a workman with a powerful chopper cuts off the ham, shoulder, and underlying ribs if necessary, separating the feet to be canned, pickled, or passed into the lard tanks. It is wonderful to what accuracy these workmen attain, never mauling the meat, and always cutting to a hair's breadth just where the separating cuts for the different parts are required.

A large portion of the product of the slaughter houses is distributed in bulk to the principal markets of this country, the number of hogs slaughtered singly by farmers for general consumption being small; but the cutting and packing of hog products, for both the home and export trade, is a business of such enormous extent that it has been made the subject of very careful and exact rules, recognized by commercial bodies generally in all the important centers of commerce. The requirements of the Chicago Board of Trade in this particular may be somewhat briefly summarized as follows:

In barreled pork, standard mess must be from sides of well-fatted hogs, split through or on one side of the backbone, and equal proportions on both sides, 190 to 193 pounds of green meat to make a barrel, numbering not over sixteen pieces including the regular proportion of flank and shoulder cuts, the packing to be done with forty pounds of coarse salt, and the barrel to be filled with brine. Prime mess is made of the shoulders and sides only of hogs weighing from 100 to 175 pounds, cut in square pieces of four pounds each, twenty pieces of shoulder cuts to thirty pieces of side cuts, and in addition to the salt twelve ounces of saltpeter are placed in each barrel. Extra prime pork is made from heavy untrimmed shoulders, and light mess pork is made from sides, but with as many as twenty two pieces to the barrel. Extra clean pork has the backbone and ribs taken out, fourteen pieces to the barrel, and in clear pork the backbone and half the rib next to it is taken out.

In pickled meats, careful requirements are formulated for standard sweet pickled hams and shoulders, New York shoulders, Boston shoulders, California hams, skinned hams, pickled bellies, etc., while cut meats form the subject of a long list of regulations in which are described, among other things, what must constitute Cumberland, Birmingham, South Staffordshire, Yorkshire, Wiltshire, and Irish cut sides, South Staffordshire and Manchester hams, etc. The bacon put up for foreign consumption is usually packed in boxes holding about 500 pounds each, and much of the Chicago picked meat is retailed at many places in England and other foreign markets as of the choicest domestic production in the neighborhood where it is consumed.

The promised removal of the long standing restrictions upon the trade in American pork by Germany, France, and Italy will undoubtedly result in a large increase in our exports of hog products, the total of which for the last fiscal year ending June 30, 1891, was $84,908,698. The sum is made up as follows: Bacon, $37,404,9.9; hams, $3,245,685; fresh pork, $56,-358; pickled pork, $4,787,343; lard, $34,414,323. For the preceding year our exports of the same articles were $372,476 greater than during the last fiscal year.—*Scientific American.*

AMERICAN INVENTIONS AND DISCOVERIES IN MEDICINE, SURGERY, AND PRACTICAL SANITATION.*

In connection with this celebration of a century's work of the American patent system, I have been requested by the Advisory Committee to prepare a brief paper upon inventions and discoveries in medicine, surgery, and practical sanitation, with special reference to the progress that has been made in this country in these branches of science and art. It would be impossible to present on this occasion such a summary as would be of any special interest or use of the progress which has been made in medicine and sanitation during the century, either by the world at large or by American physicians and sanitarians in particular; and I shall therefore confine my remarks mainly to the progress which has been made in these branches in connection with mechanical inventions and new chemical combinations, devised by American inventors, which will require much less time.

The application of the patent system to medicine in this country has had its advantages for certain people, has given employment to a considerable amount of capital in production (and to a much larger amount in advertising), has contributed materially to the revenues of the government, and has made a great deal of work for the medical profession.

So far as I know, but one complete system of medicine has been patented in this country, and that was the steam, Cayenne pepper, and lobelia system—commonly known as Thomsonianism—to which a patent was granted in 1836. The right to practice this system, with a book describing the methods, was sold by the patentee for twenty dollars, and perhaps some of you may have some reminiscences of it connected with your boyish days. I am certain I shall never forget the effects of "Composition Powder," or of "Number Six," which was essentially a concentrated tincture of Cayenne pepper, and one dose of which was enough to make a boy willing to go to school for a month.

From a report made by the Commissioner of Patents in 1849, it appears that eighty six patents for medicines had been granted to that date; for the specifications of most of those issued before 1836 had been lost by fire. The greater number of patents for medicines were issued between 1850 and 1860. The total number of patents granted for medicines during the last decade (1880-1890) is 540. This, however, applies only to "patent medicines," properly so called, the claims for which are, for the most part, presented by simple-minded men who know very little of the ways of the world. A patent requires a full and unreserved disclosure of the recipe, and the mode of compounding the same, for the public benefit when the term of the patent shall have expired; and the Commissioner of Patents may, if he chooses, require the applicant to furnish specimens of the composition and of its ingredients, sufficient in quantity for the purpose of experi-

* By Dr. John S. Billings, U. S. A., Abridged from Boston *Medical and Surgical Journal* by *Popular Science News.*

ment. The law, however, does not require the applicant to furnish patients to be experimented on, and this may be the reason why the Commissioner has never demanded samples of the ingredients. By far the greater number of the owners of panaceas and nostrums are too shrewd to thus publish their secrets, for they can attain their purpose much better under the law for registering trade marks and labels, designs for bottles and packages, and copyrights of printed matter, which are less costly, and do not reveal the arcanum. These proprietary medicines constitute the great bulk of what the public call "patent medicines."

The trade in patent and secret remedies has been, and still is, an important one. We are a bitters and pill-taking people; in the fried pork and saleratus biscuit regions the demand for such medicines is unfailing, but everywhere they are found. I suppose the chief consumption of them is by women and children—with a fair allowance of clergymen, if we may judge from the printed testimonials. I sampled a good many of them myself when I was a boy. Of course these remarks do not apply to bitters. One of the latest patents is for a device to wash pills rapidly down the throat.

I am sorry to say that I have been unable to obtain definite information as to the direct benefits which inventions of this kind have conferred on the public in the way of cure of disease or preventing death. Among the questions which were not put in the schedules of the last census were the following, namely: Did you ever take any patent or proprietary medicine? If so, what and how much, and what was the result? Some very remarkable statistics would no doubt have been obtained had this inquiry been made. I can only say that I know of but four secret remedies which have been really valuable additions to the resources of practical medicine, and the composition of all these is now known. These four are all powerful and dangerous, and should only be used on the advice of a skilled physician.

I said in the beginning that I cannot, on this occasion, give any sufficient account of the progress of invention and discovery in medicine and sanitation during the century just gone. The great step forward which has been made has been the establishment of a true scientific foundation for the art upon the discoveries made in physics, chemistry and biology. One hundred years ago the practice of medicine, and measures to preserve health, so far as these were really efficacious, were in the main empirical—that is, certain effects were known to usually follow the giving of certain drugs, or the application of certain measures, but why or how these effects were produced was unknown. They sailed then by dead reckoning, in several senses of this phrase.

Since then, not only have great advances been made by a continuance of these empirical measures in treatment, but we have learned much as to the mechanism and functions of different parts of the body, and as to the nature of the cause of some of the most prevalent and fatal forms of disease; and, as a consequence, can apply means of prevention or treatment in a much more direct and definite way than was formerly the case. For example, a hundred years ago nothing was known of the difference between typhus and typhoid fevers. We have now discovered that the first is a disease propagated largely by aerial contagion and induced or aggravated by overcrowding, the preventive means being isolation, light, and fresh air; while the second is due to a minute vegetable organism, a bacillus, and is propagated mainly by contaminated water, milk, food, and clothing; and that the treatment of the two diseases should be very different.

The most important improvements in practical medicine made in the United States have been chiefly in surgery in its various branches. We have led the way in the ligation of some of the larger arteries, in the removal of abdominal tumors, in the treatment of diseases and injuries peculiar to women, in the treatment of spinal affections, and of the deformities of various kinds. Above all, we were the first to show the use of anæsthetics—the most important advance in medicine made during the century. In our late war we taught Europe how to build, organize, and manage military hospitals; and we formed the best museum in existence illustrating modern military medicine and surgery.

As regards preventive public medicine and sanitation, we have not made so many valuable contributions to the world's stock of knowledge, chiefly because, until quite recently, we we have not had the stimulus to persistent effort which comes from density of population and its complicated relations to sewage disposal and water supplies; nor have we had information relative to localized causes of diseases and death which is the essential foundation of public hygiene, and which can only be obtained by a proper system of vital statistics. We can, however, show enough and to spare of inventions in the way of sanitary appliances, fixtures, and systems for house drainage, sewerage, etc.; for the ingenuity of inventors has kept pace with the increasing demands for protection from the effects of the decomposition of waste matters, as increase of knowledge has made these known to us. The total number of patents granted for sanitary appliances during the last decade (1880–1890) is about 1,175.

No doubt the greatest progress in medical science during the next few years will be in the direction of prevention, and to this end mechanical and chemical invention and discovery must go hand in hand with increase in biological and medical knowledge. Neither can afford to neglect or despise the other, and both are working for the common good. If the American system has not given rise to any specially valuable inventions in practical medicine or in theology, it must be due to the nature of the subjects, and not to fault of the system.

THE BREAD OF THE TROPICS.

It is safe to say that in Jamaica alone, whence we derive nearly one-third of our banana supply, the waste amounts up into the hundreds of thousands of bunches each year, though less than one-tenth of the available banana land is yet under cultivation. Bunches that are undersized, or that contain a certain proportion of undeveloped "fingers," are rigorously cast out by the buyers, and at many of the ports these may be had for the asking or at a purely nominal price. The writer has often seen such, and bunches that were too far advanced in the ripening process to stand shipping, left on the wharf after a vessel's departure, with no one anxious to claim them, the supply of rejected fruit being so far in excess of the needs of the immediate community, nearly all of whom were themselves banana producers.

Yet, as Von Humboldt has estimated, 33 lb. of wheat and 99 lb. of potatoes require the same space of ground as will produce 4,000 lb. of bananas, and three good sized bananas contain as much nutriment as a 14 oz. loaf of bread, so great is the ability of this "tree of Paradise," *Musa paradisiaca*, to extract the greatest amount of vitalizing material from ground and sun and rain. It has well been said that this whole tropical region is "the land where that rare old alchemist, the sun, packs earth's most delicate and fragrant essences in most attractive shapes." And of the banana another author has written: "They really save more labour than steam, giving the greatest amount of food from a given piece of ground with the least labour."

This "bread of the tropics," however, while it will withstand so much handling as is required to get it to our northern markets, by means of our most perfect methods of rapid freight delivery, a system at present impossible in any other country, is not sufficiently imperishable to withstand a much longer series of shipments. At present the fine-flavoured bananas are almost unknown in northern Europe; not because their excellence is unappreciated, but simply because the fruit is of necessity too long by the way to reach those countries in a marketable condition. So it comes that two lines of inventions having to do with banana culture are sorely needed in the West Indies, where with them the banana output would soon be doubled, and in time might easily be multiplied tenfold. These are a desiccating process and a flour or meal making process. The former is at present most in demand, and where-ever one travels in the banana-producing regions, from Demerara to British Honduras, from Colon to Samana Bay, the cry will be heard at every large plantation, "Oh! if some one would only invent and perfect a drying or preserving process that could be depended on." The man or men who can put before the banana growers of the West Indies, who send over $4,000,000 worth of this fruit to the United States each year, any system which will do for bananas what is now done for the fig, the grape, or the corinth, commonly known as "dried currants"; or who can succeed in treating that fruit as well as peaches, apricots, and prunellas now are, will find himself the possessor of a wealth-producing invention. And the same may be safely predicted of any system which will succeed in putting into the meal or flour state a fair portion of the marvellous sustaining and nourishing powers which make the banana the king among fruits. The improvements which this century has seen, that lead up from the crude mandioca meal of the Brazilian native to the beautiful pearl tapioca of commerce, have developed for the cassava, *Manihot utilissima*, a foreign consumption which now runs high into the millions of dollar annually. The same period has seen the crude black cacao of the Caribees and northern South America develop into the chocolate, breakfast cocoa and broma of to-day, and now the tree *Theobroma cacao* vies with coffee in yielding nourishment and producing wealth in many countries. So may it be with the banana, if inventive skill will but turn its attention in that direction.—*Scientific American.*

EQUALIZING WEIGHTS AND MEASURES.

Weights and measures have had a vagrant life and some very dramatic vicissitudes in their avoirdupois and arithmetic. Their origin was in accord with the date of their birth. The unit of measure, weight and value was not spontaneous, and in inches, ounces and prices it has been subject to fluctuations and local laws. Originally a "yard" was the length of a man's girdle, an abdominal development being in favor of the customer; an "ell" was the length of his arm; and a "fathom" the distance between his thumbs with his arms outstretched. The basis of this mensuration was conditional—a great deal of margin being left for adipose and anatomy. An acre was originally a field, and was representative of the amount of land one man could plough in a day. In 1324 a statute was passed in Great Britain pronouncing three barley corns should make a legal inch, twelve of these inches should make a foot, and three of these barley corn feet should be a legal yard. The French divided the foot with thumbs, as to-day we sometimes see a charge of gunpowder measured by the fingers. The quart is a numeral signifying one-fourth of a gallon, and the original gallon in France was a grocer's box, as indefinite in its dimensions as the anatomy of a tea chest.

In 1266 the old time legislators decreed that a "penny" should equal in weight thirty-two wheat corns, twenty pence should make an "ounce," and 112 of these granger ounces should be a "pound." On this original and somewhat variable basis was the authority of the pennyweight, the ounce and the pound, now familiar in schools and stores. In the weight of precious metals, twelve ounces made a pound, whilst in coarser and less valuable commodities, fifteen ounces made a pound, and in arithmetical logic 112 pounds made the misnomer of a hundred weight. An ale gallon represented 280 cubic inches, and was originally framed to the capacity of a box containing eight pounds of wheat.

The carat unit now used in the weighing of gold and diamonds, is a legacy of the middle ages, when the seeds of the carab tree were used by the Moorish merchants in placing the values of the metal and stone we have named. A scientific unit on an international basis has never yet been established, local custom and legislation being hitherto the determining factor. A few years ago it was found that in the United States there were four different bushels of corn, four of rye, five of barley, seven of oats and seven of buckwheat. These measures differed so widely that 1,000 Kansas bushels of barley, at 48 pounds to the bushel, would become 1,500 bushels in New Orleans, and between the two points 1,000 bushels of rye would magnify into the respectable surplus of 1,750 bushels. A gallon of milk in Vermont was 231 cubic inches, and in New Hampshire 282 cubic inches was the legal measurement. In the measurement of staves, lumber, shingles and other forest products, there were the same remarkable discrepancies. There has been some progress made in putting this confusion of units into shape, but the work of straightening out the crooked line will not be complete till an international adjustment is made. In the values of coin especially, a uniformity is the more necessary as foreign commerce is developed. The skill necessary to adjust differences is too often employed in making the fool pay for the wise man's wit, and there are some parasites on the commercial body that would have neither board nor lodging if the weights, measures and money values of the commercial nations, were as near as possible equalized.—*The Age of Steel.*

MECHANICS MADE EASY.

BY F. A. SMITH, C.E., M.E.

The three words forming the above headline cover a great deal of ground, and the writer is well aware that the subject must be handled carefully in order to present it in such shape as to make it useful and interesting matter for the readers of this journal. A good engineer is always a close student of nature and especially of matters and phenomena which directly enter into his occupation, and in this matter at least nine-tenths of our readers have gathered a practical knowledge of natural science covering the entire field in a successful manner; although they may not know the scientific names or formulas which express certain important apparitions in nature, they fully understand their importance as affecting the execution of their work.

The object of this treatise is not to present a college treatise or mathematical mechanics, but will be carefully confined to language which can be understood by any ordinary intelligent reader, and will strictly show the application of the natural sciences to machine and engine work.

Everything upon this world can be subdivided into three great divisions, namely: solid bodies, such as earth, steel, wood; or fluid bodies, such as water, oil, quicksilver, or vapors; gaseous bodies, such as air, gas, steam, etc. There are certain properties which are shared by all bodies, no matter whether they are solids, fluids, or vapors. These properties are:—

(1.) *Extension*, which means that all matter occupies space, a fact needing no further explanation or demonstration.

(2.) *Impenetrability*, which means that two bodies cannot occupy the same space at the same time.

(3.) *Weight*, which means that all bodies, solid, fluid, and vapors have a certain weight, caused by the attractions of the earth, of which we will speak later on.

(4.) *Mobility*, which means that the position of any body can be changed by the application of sufficient force.

(5.) *Inertia*, which means that all bodies have a tendency to remain in the state in which they are; or, in other words, a body that is at rest cannot change from rest to motion unless acted upon by an outside force, and a body in motion cannot come to rest unless acted upon by some force; this latter assertion may look as though it was not borne out by our every day experience, for we know that if we push a car along on a level track it will run a short distance and will soon be at rest; but if we look upon the subject a little closer we will find that the motion of the car is stopped by certain forces; as the car moves along, it has to displace the air which offers resistance; its motion is also counteracted by the friction in the running gear of the car and the friction upon the rails.

(6.) *Divisibility*, which means that all bodies can be cut into smaller parts. This is self-evident, and requires no further comment.

(7.) *Porosity*, which means the matter composing the different bodies is not entirely solid, but that small vacant spaces exist between the smallest parts (called atoms or molecules) of the bodies. There are quite a number of bodies where we can see these pores with the naked eye, but most bodies have pores so small that they cannot be seen by the naked eye, such as iron, steel, gold, etc. It has, however, been demonstrated that even gold has pores, and experiments have proven that water can, under high pressure, be pressed through solid gold.

(8.) *Compressibility* or *Contraction*, which means that all bodies can occupy smaller spaces when acted upon by pressure or decrease in temperature; this is a well-known property and is a direct consequence of porosity, for as matter in itself is unchangeable in size, contraction affects only the pores which are becoming smaller under pressure or lower temperature.

(9.) *Expansibility* or *Expansion*, which means that all bodies under the influence of higher temperature will occupy a larger space; this is also well known and is also explained by porosity, the pores being enlarged by the heat and the bodies thus expanded.

(10.) *Indestructibility*, which means that the matter composing the different bodies cannot be destroyed, neither can it be enlarged. This assertion will also require some explanation; for every reader will know at once of hundreds of phenomena where bodies actually entirely disappear; for instance, take a piece of ice in the summer and let it lay exposed to the warm air, and we will see that it melts and gradually disappears; but by studying the process we find that the ice has been converted into a vapor by the heat of the sun, and this vapor has mixed with the air.

Also the burning of a substance does not destroy the matter, but only changes the different parts of the same, so if a cigar, for instance, is smoked, the remaining ashes and the expelled smoke contains the matter which originally made up the cigar.—*American Engineer*.

BEET SUGAR IN UTAH.

Among the new enterprises in Utah is the great beet sugar establishment at Lehi, with a capital of $1,000,000. It has proved a great success. The *Irrigation Age* says.—

The main building is three stories high, 180 feet long, and has an average width of 84 feet. The annex, which contains the boilers, bone black house, and lime kiln, is 180 feet long and about 40 feet wide. Both of these large buildings are substantially built of brick. There are six beet sheds, 500 feet by 24, with a capacity of 14,000 tons of beets. The company has erected a boarding-house, which is 30 by 65, with an annex 24 by 60, and furnishes accommodations for fifty people. There are four pulp silos, 180 feet long, 24 feet wide, and 10 feet deep. The coal bins are 48 by 250 feet. These figures throw considerable light on the magnitude of the enterprise to the average mind. The water supply of the factory is the lake, fed by natural springs, with a capacity of 4,000,000 gallons in twenty-four hours. Besides this there are eight artesian wells, from 60 to 135 feet deep, which furnish soft, pure water, and have a capacity of 500 gallons per minute. After examining the works the government decided to locate the internal revenue inspector and weigher on the grounds, and for their accommodation the company has erected a four-room building to serve as a laboratory and office.

HOW BEETS ARE MADE INTO SUGAR.

When the farmer brings the result of his season's toil in the beet fields to the factory, the beets are first weighed and then stored in the long sheds, which have been made frost-proof by a double wall, filled with cinders and a roof covered with earth. As the beets are required at the factory they are thrown into a shallow sluiceway, which runs from the sheds to the factory, and enables the beets to float from the point where they are received to the place where they are needed. They are taken from the sluiceway by a wheel elevator and dropped into a washer, which is a trough-shaped contrivance, with revolving arms. The beets are then thrown out automatically into a bucket elevator, which conveys them to the top of the building, where the cutter is located. This machine cuts the beets into slices about one-eighth of an inch thick, three-eighths of an inch wide, and of various lengths. The sliced beets now pass from the cutter through a revolving chute into the great circular diffusion battery. This consists of twelve wrought iron cells, each holding about 126 cubic feet, and having an open manhole on top with swinging cover. The bottom is arranged to open and close by hydraulic pressure.

It is in this diffusion battery that the interesting process of separating the saccharine matter from the beet is performed. This is done by the use of water heated to a certain degree, from which it must not vary. As the water pours through the cells for the first time it carries with it about one-half of the saccharine matter, while the other half is left in the beet.

The hot water is turned on ten times in succession, each time taking more of the sugar, until at last it has extracted all but about one-eighth of 1 per cent of the sweetness which the summer's sunshine has stored in the beet. The juice now flows to an automatic register, which registers the quantity and temperature of the juice and draws out a sample for use in the laboratory. From the register it passes to a heater, which is heated to 90° centigrade, and it then passes into the carbonators or clarifying pans, where a portion of the impurities are removed from the juice by the application of lime. Fortunately a majority of the impurities combine with this substance and settle at the bottom of the pan. The sucrate of lime is decomposed by pumping carbolic acid gas through the liquid, which forms the excess of lime into carbonate of lime. When this operation is completed, the whole contents of the carbonator, 180 cubic feet of juice, or 1,350 gallons, is pumped by means of a plunger pump, having a capacity of 8,000 gallons per hour, through a mammoth filter press. This removes the residue of the clarification, the juice being treated twice with carbonic acid and once with sulphurous acid. In the last process all of the lime is removed.

The diluted liquid is now concentrated in a quadruple effect evaporator to a 50 per cent solution. From here there are two operations. To make the very finest quality of sugar it is necessary to run it over bone black, which removes impurities that cannot be taken out any other way. After this process the liquor is as clear as water, and the juice is then boiled into sugar in a vacuum strike pan. This is a closed kettle, 10 feet 6 inches in diameter and 23 feet high, and holds 35 tons of sugar. In this kettle the sugar is granulated, and forms a product technically termed melada, a mixture of molasses and sugar, 75 per cent of the latter. The sugar is then dropped into a mixer, which holds the entire contents of the kettle. The next step is to remove the syrup, which is done with Weston centrifugals. The sugar is then partially moist, and the moisture is removed by passing the product through a Hersey sugar drier. It then passes perfectly dry into the sacks, each of which holds exact 100 pounds. Here samples are taken, weighed, and marked by the internal revenue officials, and then at last we have the finished product of the Utah Sugar Company.

It has taken exactly thirty-six hours from the time the beet left the shed until the sugar is ready to sweeten your coffee.

Wherever any good industry, like a beet sugar factory, is located, it greatly benefits the surrounding community, especially the farmers. Among the direct benefits which Lehi has received is the erection of a $10,000 hotel, a $7,000 bank building, and a number of residences and stores. Real estate has appreciated in value perhaps 50 per cent, and the town has gained 600 population in six months. Another good result has been the establishment of a local newspaper, and many other improvements are in prospect, such as a creamery, a new opera house, electric lights, and general town improvements. The creamery enterprise contemplates an investment of $50,000. On many pay days the company has distributed $10,000 in this community, and will soon pay out something like $180,000 to the farmers for beets. We have already brought here 1,000 tons of machinery, and we shall have to haul 4,000 tons of coal and coke from Pleasant Valley, Rock Springs, and points in Colorado. We shall also bring a great deal of bone black, or animal charcoal, from Eastern cities. Our shipments of sugar will be very heavy, and the railroads have already built three miles of new track in Lehi. Mr. Granger, our agricultural superintendent, will tell you how the industry has benefited the farmers. The factory has doubled the capacity of the farmers to make a living. It increased the value of their land.

This is the first factory equipped with machinery made in the United States. All other beet sugar machinery is the product of European workshops. This is the product of American faith, American brains, and American labor.

The man who raises sugar beets has an absolute guarantee in advance of his market and his price. Contracts are made with the farmers in the spring, by which they agree to plant a certain acreage of beets from imported seed furnished by the company, and to cultivate the crop according to a plan laid down, and then the company agrees to buy their crop for cash, at a certain price per ton. When the farmer understands the cultivation of this crop, he will get from fifteen to thirty tons per acre, which will give him from $75 to $135 per acre, at $4 50 per ton. The beet crop can be handled, including every expense, from time of planting to the time when the beets are laid down at the factory, for $40 per acre. After the first thinning, one man can take care of from ten to fifteen acres. For the first thinning a man must devote four or five days to an acre.

With irrigation the Utah sugar beet will stand first in the world—first in amount of saccharine matter, first in purity, first in tonnage to the acre. There are some things, however, it seems difficult to make the farmer understand. The chief difficulty is his disposition to raise big beets. Now, the beet that contains the most sugar is the one that weighs from ⅞ pound to 1½ pounds. Above that it ceases to increase in sugar in proportion to its size. A good average beet of this size will go 14 per cent in sugar and 80 per cent in purity. Beets weighing 4 to 10 pounds will show not more than 3 to 6 per cent of sugar and 45 to 55 per cent in purity.

These beets are of no earthly use to any factory, and yet almost every day some farmer comes to me triumphantly with a beet nearly as large as a parlor stove, and he thinks it contains a barrel of sugar. He has forced the growth of this beet by giving it lots of water, and by every other possible means, and he has raised a beet that we cannot afford to undertake to make into sugar.

Beets do not impoverish the land much. The constituents of the soil go largely into the leaves and crown of the beet, which are left on the ground after the harvest and subsequently plowed in. So that the farmer really returns to the soil in plowing the strength that has been drawn out of it by the growth of the beet.

HOW THE OTHER HALF DOES LIVE.

When it is pointed out that an alleged half of the world doesn't know how the other half lives, the speaker is apt to wear a wiseacre air characteristic of the thoughtful person. What is always meant by the remark is that the speaker himself professes not to know much of the daily life of the very poor or the socially predaceous. But there remains still a full half of the world of whose life it is safe to say that the supercilious fragment knows even less than it does of that of the very poor. This remaining half is so astonishing in its activity that a glance at it can scarcely fail to minister to the pleasure of the *Evening Sun's* readers.

Sweeping this active half of the world, then, with a glance, we perceive it engaged in figuring up the piston surface for a pumping engine and the diameter of an aqueduct pipe ; tracking the bug to his lair and destroying his egg, exterminating mosquitoes and measuring earthquakes; making new probes to pull things out of folks' ears with; modeling creatures in clay and carving them in stone; designing World's Fair buildings for Chicago, and other buildings for Madison and and uncounted other squares, and cathedrals for New York; measuring the women's diaphragms to show why their noses are red.

Disinfecting sewage and disengaging aluminum; intercepting the floating germ and setting him to slay the innocent rabbit; finding drugs whose tremendous potency mocks even the purple fluid in the apothecary's shop window; ridden by nightmares and fashioning women's garments after the vision; speeding house elevators and testing timber trees; determining the course, S.E. and by S., ½S., which Sirius was sailing nine years ago when the light we get to-day set out from him; trying new crosses of blood for racehorses and fantail pigeons; painting impressionish pictures and composing music of the future and telegraphic cipher codes while mad-houses and suicides' graves multiply on every hand; applying liquid fuel and improving screw propulsion; identifying Sing-a-Song-of-Sixpence with the funeral chant over the body of Patroclus.

Finding out how cold the moon is, why water feeds the flames of burning oil, and observing the effect of electric light on trees, keeping them awake; photographing a wink and tracing the history of rain gauges; devising apparatus to test the adulteration of wine, and adulterants to beat the apparatus; devising better material for underclothing, new models of yachts, binnacles and oil-serving swabs to still storm waves, and improved methods of brewing beer; devising dynamite guns, mill workers' homes, and glue that doesn't unstick; determining the apex of the sun's way near Lyra and *not* Hercules; trisecting an angle and recording the chemical life history of Jerusalem artichokes.

Sounding the sea, hatching fish and finding out what kills the oysters; making butter out of petroleum and honey out of shingles, with by-products which smell like a cow's breath and blow up with forty thousand horse-power; identifying the rheumatism microbe and subcutaneously injecting heart juice for heart failure; poisoning marine worms, propelling bicycles by electricity and making sub-marine torpedoes out of paper; making folks wash themselves; proving by mathematic demonstration that the vortex atom is the one thing in the universe that really does exist, when along comes Edison, saying the atom knows good and evil, just like folks.

Raising ghosts and ghostesses, inventing chess problems for gain, and getting real money for treatises on grammar, on the immortality of the soul, on the moral purposes of Shakespeare's plays and of Walt Whitman's style, and diagnoses of Byron's club foot and Richard III.'s abnormal spine.

These are some few, and very few, of the ways by which that stirring half of the world, which is neither very poor nor thoughtful lives. Is it to be doubted that the fragment which titters to confess it doesn't know how the poor half does live, commonly knows even less about how this ingenious half is living and what it is living for?—*N. Y. Sun.*

PRINTERS' PROFITS.

Mr. Theodore L. De Vinne, in an address to the National Editorial Association, made the following remarks:

* * * The cost of presses is a serious expense, but if they can be kept fairly employed there need be no loss. As a rule, presswork is the profitable branch of the business. It is in the composing room that is the great sinkhole. It is in types and wages of compositors that the profits of the house are lost.

* * * When an office is small and can afford to buy but one or two presses, they should be of the best. A printing machine which can print a newspaper only and which cannot print a book form; that will print a poster and will not register for colors; that will print an ordinary pamphlet and that has not strength enough nor inking rollers enough to print wood-cuts—that machine is an expensive press, even if it does cost $1,000 or $2,000 less than a perfect machine. I know from experience that it takes a long time to earn $1,000 on one machine, but I know also that one can lose the chance of earning that $1,000 in delays and bad work in attempts to get on with a poor machine. A machine that can do any kind of work from a poster to a wood-cut is always a cheap machine.

Good machines call for good men. It is a mistake to allow a machine which costs thousands of dollars to be managed by an incompetent pressman. The incompetent man always does from three to ten tokens less a day, always uses more rollers, always wastes more paper and ink. The superior performance of the qualified workman justifies his higher wages. The damage that the machine receives from men who do not know how to handle it is great. Men who cannot keep their presses clean and who are viciously meddling with impression screws, bearers, and rollers, are dear at any price. Upon the pressman, more than any other workman, depends the credit of your office. Clean presswork hides a multitude of sins of composition. A good pressman can protract the life of your type one-half longer than the poor one.

MERCHANT NAVIES OF THE WORLD.

The estimate of the Bureau Veritas with regard to the merchant navies of the world for the present year puts the total number of vessels at 43,514, of which 33,876 are sailing vessels of 10,540,051 tons, and 9,638 steamers of 12,825,709 tons gross and 8,286,747 tons net. The figures as regards the steamers stand as follows:—

Nationality.	Number of Ships.	Gross Tonnage.	Net Tonnage.
English	5,312	8,043,872	5,106,581
German	689	930,754	656,182
French	471	805,983	484,990
American	419	533,333	375,950
Spanish	350	423,627	273,819
Italian	200	294,705	185,796
Norwegian	371	245,052	176,419
Dutch	164	220,014	149,355
Russian	230	177,753	115,742
Swedish	403	172,013	126.612
Danish	197	154,497	103,578
Austrian	111	149,447	96,503
Japanese	147	123,279	76,412
Belgian	55	98,056	71,658
Brazilian	129	75,970	48,901
Greek	68	70,435	44,424
Portuguese	41	49,364	29,564

AN INTERESTING EXPERIMENT.

A simple and interesting experiment enables one to trace sound vibrations in a glass of water. Take a fine, thin glass, such as will give forth a musical sound if rubbed with wet fingers, around the rim. Fill it nearly full of water, and, having wiped the edges dry and smooth, place upon the rim a cross made of two equal strips of thin cardboard (an old postal card will do for the material), with the four ends bent down at right angles so as to prevent its slipping off.

Now, if you gently rub the outside surface of the glass with a wet finger it will sing or give forth a sonorous musical note. But the principal phenomenon that you are to observe in this experiment is the following: If your finger rubs the glass below one of the ends of the cardboard strips the cross will not stir; but if, on the contrary, you rub any other part of the glass, not in a perpendicular line with one of the four ends of the cross, this latter will gently turn of its own accord until the end of the cardboard arms of the cross arrives at a point directly above the point where you are rubbing with your finger.

Thus, by placing your whole forefinger around the middle of the glass, you can make the cross turn at will, as if by magic, without touching it at all.

This experiment demonstrates the existence of what are called, in the science of acoustics, the nodes or knots of vibration in sonorous bodies. These nodes are the four points on the rim of the glass at which the arms of the cross stop. The spaces between these points is where the sound vibration is the strongest, and where, consequently, the branches of the cardboard cross cannot rest—*Philadelphia Times.*

HOW CORKS ARE MADE.

Did you ever happen to think what an immense number of corks are used? This seemingly small branch of industry is indeed a tremendous one. The Milwaukee breweries pay about $250,000 or more a year for the corks they use—in fact, one concern, the Pabst Brewing Company, uses about 20,000,000 corks a year, which cost upward of $100,000. And then think of the other industries that use corks in smaller quantities.

The cork tree is found in Spain in great abundance in the Provinces of Gerona, Carcers and Andalusia, especially in the Provinces of Huelvas, Seville and Cadiz, and, although in less quantity, in the Provinces of Cludad Real, Malaga, Bordoba, Toledo and some others. The United States Consul at Barcelona says that according to a calculation made by the administration of forests, the extent of cork forests in Spain is about 600,000 acres. The making of a cork is quite interesting. The bark is cut into large squares, the proper thickness. In the manufacture of the corks the squares made into octagons first pass into the hands of the workman, who is furnished with a knife composed of two pieces—one of them similar to an ordinary knife and the other a blade, the edge of which fits into the first. Consul Schench says that only by seeing it is possible to form an idea of the rapidity with which these men take hold of a square and from it make a cork. They hold the knife by a small iron catch to the table in front of them, and giving to the square a circular movement, the result is that the cork is made in a few seconds. The squares are usually boiled for about a quarter of an hour. They are then deposited in a cool place, and four or five days after, they are sorted and kept damp until required. The amount which the workmen receive for cutting 1,000 corks varies from 75 to 4 pesetas, according to the kind of workmen (the peseta is equivalent to about 9½d.)

Machines are also employed to make corks, and all consist, at the base, of a knife, the blade of which is placed horizontally, joined generally to a piece of wood, and to which a backward and forward movement is given similar to that of a carpenter's plane. In moving, the knife turns the square cork, which, being attacked by the knife, takes off a strip of cork more or less thick according to the distance from the axle of the cork to the edge of the knife. If these are parallel, the result is that the cork is cylindrical, and if not it becomes conical. The cork maker, or workman has a large basket, or several of them, in which he places the corks according to size or quality, but this first classification is not sufficient, and the corks are placed upon a table, the back part of which is furnished with boxes, the front parts of which are open to the operator. To classify the corks according to size, they also employ wooden boxes, the bottoms of which can be taken out or put in, having a kind of grating of wood somewhat resembling Venetian blinds. The boxes are suspended by ropes to the ceiling, and the workman gives it a swing backward and forward by which the smaller corks drop out at the bottom. With this apparatus worked by man, 100,000 corks are classified for their size in one day. The corks are washed in a solution of oxalic acid or ploxalate of potash. As soon as washed they are placed out to dry gradually in the shade in order to enable them to retain the silky gloss the cork has when it is dark. For packing, 30,000 corks constitute what is called a bale. For South America and Oceanica bales consisting of 5,000 to 10,000 corks are made, and for England the sacks or bales are made to contain 100 gross, or 14,400 corks, for those of the larger size, and 150 gross for those of smaller dimensions. The greater number of corks are manufactured in Province of Gerona, and the most important towns engaged in the industry are San Filieu de Guixois Palafrugell and Cassa de la Salva. The number of workmen engaged in the cork industry in Spain is said to be not less than 12,000. —*Yenowine's Illustrated News.*

CAN A WOMAN DRIVE A NAIL?

When Mrs. Palmer drives the last nail in the Women's Building of the World's Fair all the world will stand and listen.—*Chicago Paper.*

Now, what is offered on the speed with which Mrs. Palmer drives the nail? Two to one on the nail. Ten to two that Mrs. Palmer hits the building five times for once she hits the nail. One hundred to twenty-five that she hits her fingers if the nail isn't started for her. Even money that she gets the hammer tangled in the ribbons of her bonnet. Eight to ten that she shuts her eyes for the first blow. Five to four that she wrinkles her nose after the first twenty-five blows with the hammer. Even money that the world will have to take a recess for lunch before the nail is driven, providing that Mrs. Palmer doesn't begin to hammer at it before 10 o'clock. Even money that after Mrs. Palmer works eight hours the nail will have to be turned over to a carpenter. Ten to one that the nail is leaning to the south-west when Mrs. Palmer quits.—*Detroit News.*

A CURIOUS STEAMER.

A steamer which can be propelled on land by means of its own engine has just been constructed at the Ljunggren Engineering Works at Kristiansstad, in Sweden. It is intended for the traffic on two lakes close to Boras, which, however, are separated by a strip of land. Rails have been laid between the two lakes. The steamer, which has been christened very appropriately Svanen (the Swan), can run itself across from one lake to the other. At a trial trip, if one may call it so, at the works, the vessel fulfilled the tests very well. The engine is 10 horse power, and the Svanen can accommodate some 60 passengers.