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PROTECTION FROM LIGHTNING.

The present season of thunderstorms brings the question of protection from lightning into special prominence. It is a matter in which every one is interested, for the electric fluid is no respecter of persons, and strikes both at the hut and the palace, while it does not always spare the lonely wayfarer plodding along the road far from buildings of all kinds. It is, however, high and isolated edifices that suffer from it most; churches, factories, farm-houses and country mansions are specially liable to its attacks. There are, however, now very few of these not furnished with conductors which are presumed to afford complete protection. Usually they do, but still it is by no means uncommon to hear of the lightning leaving a stout conductor to play vagaries within the building, springing hither and thither, and leaving most unpleasant footmarks wherever it alights. Until very recently it was customary to assume that the lightning conductor was in fault when such an unexpected result was realized. Either the joints were bad or the "earth" was deficient. Among rods of early date the latter was very often true, for they sometimes penetrated but a very short distance into the soil, or ended in a stratum which became perfectly dry during the hot months of summer. But when every allowance has been made for such imperfections in construction and erection, there still remain many cases of failure which are not easy to explain without recourse to researches which have been made public during the last few years, and which tend to weaken our faith in the theories regarding protection from lightning which were current only a very short time ago. When electric self-induction began to be studied by practical men, it was seen that it must have a great bearing on the conditions under which a flash of lightning can pass along a conductor. The question of a more or less perfect earth loses much of its importance in the face of a counter electromotive force of thousands of volts suddenly generated in the rod, and opposing the quiet passage of the lightning. It only lasts the minutest fraction of a second, but then lightning cannot brook any delay, and it will strike out from the rod in gushes at any place where a neighboring conductor offers it an alternative path, often traversing a foot or two of air, or piercing a brick wall in its attempt to escape. For purposes of analogy we may compare the effect of self-induction to that of inertia, to which it bears a great similarity. The rod is full of quiescent electricity, when suddenly the lightning starts from the clouds, and with one mad spring through half a mile of sky, it enters the conductor, seeking to rush through it to the ground. But to do this it must set in motion the electricity with which the rod is already filled. The effect is like a piston coming down on a mass of water in a steam cylinder; an enormous pressure is set up, and the fluid seeks every avenue of escape, spurting through joints and stuffing-box, and sometimes carrying the solid iron of the cylinder cover with it. In the same way the electricity will often dart out from the rod, even though the lower end may make most excellent contact with the soil. The self-induction in the conductor is too great to permit of the electromotive force of the discharge falling immediately to a safe limit; it is, no doubt, immensely decreased, for after a flash has traversed half a mile of sky a few feet of air is but a small matter.

The difficulty of getting an electric discharge to traverse a metallic conductor has been demonstrated by Dr. Oliver Lodge in a very simple but convincing manner. He takes two Leyden jars and connects their inner coats respectively to the two terminals of a Voss machine. Between the outer coats there are practically three paths along which electricity can travel, namely, the table on which they stand, an adjustable air gap between a pair of discharging balls, and an insulated wire. The table forms an imperfect conductor between the jars and the ground, while the insulated wire guarantees that the jars shall remain at the same potential. There are also a pair of adjustable discharging rods between the terminals of the machine. Now, when the machine is worked the electricity accumulates in the jars, and while it is doing so the outer coatings remain at the same potential, there being no current in the wire connecting them, and no tendency to spark at the air gap. The tension in the jars, however, rises until it is able to leap across the space between the terminals of the machine, whereupon there is an instant rush of electricity between the outer coatings. There is practically no path for it along the table, and hence, it must go along the conductor, or across the air gap, or by both paths. Now, as the resistance of air is millions of times greater than that of metal, we might, at first sight, assume that there could be no spark between the terminals. But Dr. Lodge shows that when the conductor consists of 40 ft. of No. 1 (B. W. G.) copper wire, the discharge will as easily leap across a space of 14·3 tenths of an inch as take the easy path open to it. The effect of the self-induction is to raise the natural resistance of the wire from ·025 ohms to something which is comparable with 1½ in. of air. If the copper wire be replaced by a similar length of thin iron wire (No. 27) having a resistance of 33·3 ohms, a still more unexpected result is obtained. The resistance of the metallic circuit is now 1,300 times as great as before, but instead of the discharge being able to leap a wider gap, it can only bridge 10·3 tenths of an inch of air. If the continuous circuit be made through a capillary tube of liquid having a resistance of some 300,000 ohms, the spark length increases to 16 or 17 tenths.

We do not, however, need to employ even the very simple apparatus described above to demonstrate the tendency of an electric discharge to flash out sideways. If we take a yard of the thinnest platinum wire obtainable, and place it parallel to a thick copper rod, the ends of the wire being bent towards the rod until they approach it within a sixteenth of an inch, then, when the discharge from a Leyden jar is sent through the rod, it will be found that a part will leave it for the attenuated parallel path, leaping the air gap to reach it. The publication of Dr. Lodge's experiments has drawn attention to certain researches upon lightning discharges for protecting telegraph instruments carried out in 1864 by Professors Hughes and Guillemin. The results of the earlier trials are in substantial agreement with those of the later ones, except as regards the superiority of iron over copper as a conductor. It was found that no discharger would protect the coils of the instruments if a very powerful discharge from a large battery of Leyden jars was sent through it, and that if the discharger were replaced by a copper rod of 1 centimeter in diameter, sufficient electricity passed by way of the instruments to burn a fine iron wire. When, however, the wire was replaced by a flat plate, even of tinfoil, a very large measure of protection was obtained. We thus see that ordinary measurements of resistance applied to lightning conductors may be very misleading if other conditions are not taken into consideration.

When the existence and the effects of self-induction are appreciated it is easy to point out the means to minimize the latter. Clerk-Maxwell showed that "the electromotive force arising from the induction of a current on itself is different in different parts of the section of the wire, being in general a function of the distance from the axis of the wire as well as time." Professor Hughes has also experimentally investigated the comparative effect of disposing the metal of a conductor in different ways. He found that self-induction is reduced 80 per cent. in iron and 35 per cent. in copper by using the metal in the form of a flat strip or ribbon instead of in a cylindrical wire, and that if the ribbon were divided longitudinally into bands, and these were placed a little distance apart, the self-induction was still further reduced. He therefore recommended the use of copper strips for lightning rods. Dr. Lodge has also pursued the same line of investigations, using, however, the discharge from a Leyden jar, as more nearly resembling lightning than the interrupted currents of Professor Hughes. He proved, using the apparatus referred to above, that if a copper wire of given weight and length were employed to connect the jars, then when the air gap measured 8·36 millimeters the discharge would sometimes take place by the wire and sometimes through the air. If a ribbon conductor of the same weight and length were substituted for the wire then the air gap must be reduced to 6·25 millimeters before the same conditions were attained, thus showing that the ribbon presented an easier path for the discharge than the wire, although the metallic resistance of the two was equal. Dr. Lodge's experiments also seem to show that iron is quite as advantageous as copper as a material for lightning conductors, and he goes as far as to say that he considers the use of copper as doomed. It is well known that iron has far more self-induction than copper when tested in the ordinary way, and hence it offers a greater "impedance" to the passage of a current than the other metal. But when the discharge from a Leyden jar is substituted for the interrupted current then a result is obtained which suggests the explanation that the magnetic qualities of iron have not time to come into play during the passage of the discharge.

Now, in what way are the experimental data we have mentioned to be applied in practice? Shall we abandon our accustomed plan of seeing that the joints of the conductor are well and securely made, and cease to care whether the "earth" offers a great resistance or not? He would be a bold man, we think, who would venture to do this. The utility of the old plan has been proved in so many thousands of instances that it would be most foolish to abandon it on the strength of laboratory experiments. A Leyden jar is not a thunder cloud, and it is quite possible that its discharge does not exactly simulate the effects of lightning. But it would be equally unwise to neglect the latest teaching of science, for although lightning conductors generally serve the purpose for which they are designed, there is still a long list of unexplained failures which disturbs our faith in their efficiency. The safe course seems to be to graft the new principles on the old practice. Let us abandon the old cylindrical rod for the flat tape, or, better still, for a number of tapes or small wires led down different parts of the building, so that they may be beyond the sphere of each other's influence. Another point of importance is to provide plenty of electrostatic capacity for the reception of the flash, and thus to keep the electric tension moderate. Professors Hughes and Guillemin found that if they substituted a large condenser for their lightning discharger the result was far better. A splendid example of the protective power of an extensive metallic surface came to light in 1873, when the conductors of St. Paul's Cathedral were overhauled. It was found that the original conductors which had been erected for the protection of the dome had been cut through in the course of some alterations, and partly removed. The lead covering was absolutely insulated from the ground, and had been for some years. During that time it is certain that it must have been the recipient of many lightning flashes, yet it had never suffered any injury. It had taken them all in like the coating of a Leyden jar receives the output of a machine, and had held them until they leaked away down the wetted stonework, and thus gradually got away to earth. Unfortunately, leaden roofs are not very common in modern buildings, but where they exist they should be connected to the conductor at several points. This latter precaution is to avoid the destructive effects of the surging of the electricity which seems to take place after a flash, and it is of great importance. We have not, however, the space to enlarge on that point at present, but shall probably return to it in an early issue. For the present we must confine ourselves to the points mentioned above, with the addition of a caution against undue elevation of the point of a conductor. A lightning flash is too dangerous a visitor to be invited. Ample preparations must be made for its reception; but still its visit is not desirable, however hurried it may be.—*Electrical Engineer.*

THE DEADLY WIRE.

Recently an electric wire carrying a powerful current of the subtle and mysterious force fell across Bourbon Street, near the theatre of the French opera, at a time when many people were passing. It happened that a mule which was drawing a street car came in connection with this wire, and was at once stricken down by the deadly electricity and killed on the spot. The unfortunate mule was in some sense a sacrifice to save the lives of men and women, some of whom, but for the warning given, might, in all probability, have stumbled upon the fatal wire with a like result.

The electric wire has introduced a new element of menace to human life and to the security of property that seems scarcely to have come into the purview of law makers, who are charged with legislation for the protection of life and property. The industrial uses to which electricity is being put are constantly increasing, and scarcely a week passes without additional wires being erected to conduct the force which has been wrongly termed a fluid. Every such wire is a new danger—an additional thread from which to suspend a sword of Damocles over the heads of the people.

As to laws for their protection, there seems to be none. True, a general law exists which would make an electric light company liable for damage caused by wrongful or criminal negligence on their part, but so little is known of electricity as a practical industrial force motor, save by a few experts, that it would be extremely difficult in court, in a claim for damage, to establish undue or wrongful negligence on the part of an electrical company. Let us inquire a little. The wires are suspended from wooden poles over the streets of the city. Are the wires securely placed? What constitutes security in the premises? The wooden pole readily rots; it may be broken by the enormous weight of the wires it carries, and such a result is extremely likely when a great network of wires so suspended is violently and forcibly vibrated by the wind. There appear to be no restrictions as to the number of wires strung upon a pole. Almost every day additions are made to those already there. Then as to the methods of fastening the wires to the poles—the main thing considered is to insulate the wire from electrical communication with the posts. The fastenings may be deemed secure by those who use them. The fact is, however, that the wires frequently fall into the streets, with fatal consequences to the people at large, not to the corporations who own them. They may suffer temporary delay of business.—*N. O. Picayune.*

THE BEST FORM OF MOTOR.

The introduction of motors for power transmission will soon be governed by their cost. The questions of reliability, safety, and convenience are all important, but dollars and cents, says *Electric Power,* are the most conspicuous consideration, and this point is by no means overlooked by the manufacturer of motors.

The evolution of a perfect machine of this character is necessarily a slow process. Its original design and construction is in the hands of the inventor and a few practical mechanics. When it is placed in actual service, the modifications begin. It is strengthened in one part and lightened in another. Its construction is gradually simplified. The arrangement of the parts is changed in order to facilitate examination and possible adjustment. Nothing but the lapse of time and the exigences of actual service will develop all the faults and suggest all the improvements which may be made. When practical perfection is eventually attained, special machinery may be devised, which will bring the cost of production down to the lowest point, greatly enlarging the sales, even if the profit on each motor is reduced. This is the natural course through which any line of manufacturing must pass in order to attain the highest degree of perfection.

So long as competition tends toward the production of a better article at less money, it is beneficial, provided it is done at a reasonable profit; when, however, an effort is made to reduce cost by introducing an insufficient quantity of material, or that of an inferior quality, the result is more likely to show loss rather than gain. The high speed at which dynamos and motors are run, and their susceptibility to damage if not properly balanced and fitted, has led up to first-class workmanship. Therefore, it seems reasonable to suppose that in this particular branch of the electrical business there is little apprehension of retrogression.

MAGNETISM BY ELECTRIC DISCHARGES.

The experiments of Prof. Oliver Lodge on Leyden jar discharges, and the discussion of the relation of these experiments to lightning rods, at the late meeting of the British Association, writes Prof. H. S. Carhart in the *Western Electrician,* have drawn attention anew to the lightning rod question. The remarkable experiments of Prof. Lodge are explained by self-induction, arising largely from the oscillatory character of the discharge. Experiment leaves no doubt that a Leyden jar discharge is often and generally oscillatory. If lightning discharges are also oscillatory, then the conclusions derived from a study of Leyden jar discharges may fairly be applied to them.

Objection has been made to the inferences drawn from laboratory experiments, on the ground that it is not known that lightning is oscillatory; in fact, that the magnetisation of needles by lightning goes to show that it is not oscillatory —swinging back and forth like a mass of water in a long trough. Precisely such currents—alternating and slowly decreasing in intensity—have been found to effect complete demagnetisation.

It is known, however, that magnetic effects follow from the flow of an oscillatory discharge round a steel needle. I have examined many such with respect to the penetration of the magnetism and its lateral distribution. In many cases at least, and always under certain circumstances, a thin external shell is magnetised in an inverse sense to the deeper lying layers of the magnet. This outer portion may have its magnetism reversed without affecting the inner portions, and the resulting magnetic strength is equal to the difference due to the magnetism of opposite signs on the same end of the magnet. This peculiar distribution of magnetism I have ascertained by removing with acid successive portions from the outside of small rods magnetised by electric discharges, and determining at each step the weight and strength of pole or magnetic moment of the magnet.

The process of immersion in acid, cleaning and drying, weighing and determining magnetic moment, was continued till scarcely a trace of magnetism remained. The results can be exhibited most graphically by plotting magnetic moments as ordinates, and decreasing weights as abscissæ. Fig. 2 exhibits the results with a magnet 6 centimetres long, 1·8 millimetres in diameter, and weighing 1·21 grams. The unit of weight taken in plotting the curve is 50 mgs. The magnetic moments are quantities proportional to the deflections of the magnetometer. It will be seen that the magnetic moment at first increased to a maximum as the external shell is removed, and then decreases nearly with the weight. This demonstrates the reversal of magnetism superficially, while the deeper lying portions remain untouched; and this reversal itself is evidence of an oscillation in the discharge. The reversed magnetism is usually extended to about one-third the thickness of the magnetised shell after 10 successive discharges of

FIG. 1.—DISCHARGES. FIG. 2.—DECREASING WEIGHTS.

the Leyden jar through a circuit, the self-induction of which was chiefly due to the magnetising helix of 20 turns of wire insulated with gutta-percha. The inner portion or core of the magnet was always found to be free from magnetism. Occasionally a slight reversal was found at the inner boundary of the magnetised portion of the rod.

In all cases the magnetic moment increases with successive discharges up to about ten. Beyond that the increase, if any, is very small. Fig. 1 shows the relation of magnetic moment to successive discharges through the magnetising spiral. The two figures refer to the same magnet.

An oscillatory discharge is then capable of magnetising steel, and lightning may still be oscillatory, and produce magnetic effects. There are perhaps two explanations—at least two suggestions—which may explain the magnetic effects produced by electric oscillations.

In the first place the mathematical theory, based on self-induction, shows that the maximum values of the intensity of the discharge decrease in geometrical progression, while the alternating currents employed to effect demagnetisation decrease in something like arithmetical progression. It is not difficult to see that while the latter annul magnetism the former may not.

Again Kirchoff has shown that under certain conditions the time of one of the electric oscillations is much greater than the others. It is not unreasonable to suppose that the electro-magnetic effect of this oscillation of long period may be far greater than the others. It is known that time is required to magnetise iron and steel, and fig. 1 shows that the repetition of electro-magnetic impulses increases the total permanent magnetism.

We conclude, then, that oscillatory discharges do magnetise steel, generally, though not always, in opposite directions at different depths; and that the known differences between such discharges and alternating currents are sufficient to account for the difference in effect.

ELECTRIC ROAD WAGON.

Messrs. Immisch & Co., electrical apparatus manufacturers of London, have recently constructed an electric dog-cart for the Sultan of Turkey, which is excellently displayed in the accompanying illustration.

In the last issue to hand of the *Electrical Engineer* of London, the following description and account of the trial trip are given :—

"In appearance it is similar to an ordinary four-wheeled dog-cart, but without the shafts. In use the running is very easy and perfectly under control, but it must be said the absence of shafts and a horse gives it at first to the mind of the onlooker a curious, imperfect appearance, comparable to seeing a fowl running about without its head; this effect, no doubt, wears off, but it will be probable, if electric dog-carts come much into use, that a special form of carriage adapted to the needs of accumulators instead of horses will evolve, as the Pullman car has superseded the early railway imitation of the stage coach.

The dog-cart is constructed with a walnut body and white wood spokes, brightly varnished, and the cushions and hangings are of a harmonious brown color, and are embroidered with the Turkish Imperial crest—the star and crescent; it is beautifully finished, but, although destined for an Oriental Court, has not been designed to have any specially luxurious appearance.

The motive power is supplied by a set of 24 small E.P.S. accumulators, placed in the body of the cart, of sufficient storage capacity to drive the dog-cart for five hours at the speed of 10 miles an hour. The weight of the accumulators is 7 cwt., and that of the carriage, all complete, is 11¼ cwt.

The motor is Messrs. Immisch & Co.'s 1 h.p. type, using in this case a current of 20 to 25 ampères, with an E.M.F. of 48 volts. When the vehicle is running at a speed of 10 miles an hour, the motor makes 1,440 revolutions per minute, and

AN ELECTRIC ROAD WAGON.

develops ⅞ actual h.p. The motor is connected to one of the wheels by means of a chain, as shown, gearing into a sprocket wheel on the motor shaft. The ratio of gearing of motor to driving wheel is about 18 to 1; the circumference of the wheel being 10 ft. 9 in. On an ordinary road the amount of work required, of course, varies with the uphill or downhill gradient, and the total amount of work done is thus, on an average, about the same as on level road. The current required to start is about 25 ampères, and for very heavy gradients as much as 45 or 50 ampères could be taken for a few minutes without harm. The motor has been tested up to 90 ampères.

The dog-cart carries four persons; it is started, stopped and guided without any difficulty by means of a switch with three resistances, and a steering gear fitted to the fore-carriage, with a handle for the driver. The cost is $1,000. Rather a rattling noise is made by the commutators and sprocket wheels, but this is said to be not noticeable on ordinary roads above the noise of the wheels. One improvement we should suggest before sending away, and that is, that a small actual make-and-break connection should be inserted in the circuit in some safe place under a catch to act as a safeguard, which could be disconnected when the cart is not in use; otherwise, the Sultan's ostler might have the astonishing spectacle (if he happened to give the switch-handle an unexpected knock) of seeing the electric dog-cart spin off on a tour by itself, running down several Mussulmen, knocking them over and drenching them with battery solution.

The experiments made on Wednesday were very successful, many persons enjoying a ride, and the vehicle was under the complete control of Mr. Volk. Messrs. Immisch may be complimented on having produced a really serviceable electric carriage, not merely a king's toy; and we shall expect to see very important developments in commercial usefulness result from their continued work upon the Sultan's electric dog-cart."

TWO STROKES OF LIGHTNING.*

BY J. W. MOORE.

The record of the following strokes of lightning is interesting on account of the following facts :—

1. That for 33 years the buildings and fences of the enclosure described were exempt, although entirely unprotected and in an exposed position.

2. That within a month the highest and lowest structures were both struck.

3. That the highest was not protected with a rod.

4. That the lowest was, unintentionally, partially protected.

5. That notwithstanding the excessive violence of the storm, comparatively little damage was done in either case.

6. That in the case of the fence, an ordinary barb wire acted as a conductor, and

7. That the damage to the fence was all due to lateral discharges from points.

8. That the relative value of conductors and non-conductors is clearly shown in the building struck.

9. That the advantage of an extended surface of metal over a smaller surface is evident.

10. That sudden bends act disadvantageously.

11. That breaks in the conductor are bad.

No attempt is made to theorize in reference to any of the above facts.

Whether these strokes took place when rain was falling, it has been impossible to determine with certainty, although the evidence points strongly to the presence of rain. It has been said that a child was overcome by the "return stroke," several blocks away, on the occasion of the stroke to the building, but investigation has failed to connect the two phenomena.

The enclosure mentioned, consists of 30 acres of land in the suburbs of Easton, Pa., and is used for fairs. The situation is elevated, although not as high as some of the distant surrounding country. The principal building is 152 feet long with a projecting front 25 × 26 feet. It was built about 35 years ago, has never had a lightning rod and until two years ago escaped all damage from lightning. This structure is the highest in the immediate vicinity.

On the roof is a large dome, the extreme top of which is at least 90 feet from the ground. The roof of the small dome which surmounts the large one is tinned; also the roof of the dome proper; the walk surrounding the whole and the roof of the building itself. On the north side extending the whole length of the eaves, is an open tin water conductor, connected with a closed tin pipe, vertical in position. The lower end of the latter is placed loosely in a horizontal wooden trough, which carries the rain water to the cistern. A piece of old tin pipe is in this trough. An ordinary chain pump is in the cistern. On July 31, 1887, during a short but terrific storm this building was struck. The finial on the top was split, a panel in the small dome torn out, and part of a window frame demolished. A stud three inches by six was splintered into fragments smaller and thinner than matches. The tin roof of the building proper and its connections prevented any further serious injury. The open water conductor was beaten out of shape, presenting such an appearance as would be produced by the rolling in it of a heavy ball from side to side. All the solder joints in this and in the vertical pipe were melted. A "ground" was made in the cistern. A peculiar corrugated appearance presents itself where the short weather boards abutting the wrecked window frame were torn up. This seems to have been produced by the lightning in some way acting upon the iron nails.

The damage was greatest in the poor conductors. The wooden finial was torn to pieces, the tin roof was unhurt; the wooden panel was destroyed; the tin roof of the dome was unscathed; the wooden framework below was torn to shreds; the tin floor was uninjured. The woodwork below escaped, probably because the charge had nearly spent its force. Then the large tin roof formed a protection—the charge passing from this to the smaller surface of the water pipes produced the effect on them already described.

A month later, Aug. 30, 1887, the western part of the fence enclosing the grounds was struck. This fence is less than three-eighths of a mile from the main building above described. It is an ordinary board affair seven and one-half feet high, surmounted by a barb wire fastened to small blocks, to prevent the access of trespassers to the race course. One end of this wire was lying coiled up on the ground, a part of the wire having been removed to renew a portion of the fence. The length remaining attached was about 1,000 feet. On the west side of the fence at a distance varying from 250 to 300 feet is a large cluster of high trees; on the east, 14 feet distant, is a stable 200 feet long; 60 feet further east is the grand stand—a high structure with two unprotected flagstaffs. Facing the grand stand is the judge's stand, with another unrodded flagstaff. The fence is the least prominent of all the objects in this part of the enclosure.

The barb wire is of the ordinary kind with four sharp points at every three inches. It is continuous, excepting between posts 50 and 51 where there is a gate which leaned against the posts at the time of the flash. The posts are about nine feet apart; beginning at the north-west corner and numbering towards the south there are 82 posts. Numbers 6 and 82 limit the effects of the bolt. At 6, 36, 56 and 82 there are sharp corners, making sharp turns in the barbed wire.

The mechanical effects of the lightning are observable along the fence. Boards near numbers 6, 12, 14, 18, 20, 21, 22, 25, 27, 32, 33, 34, 40, 42, 47, 48 are splintered slightly or cracked. Near 51, the part of the gate next the break in the wire, is splintered. A board at 56 is split. Post, number 36—a locust—is split completely to the ground in two places. The wire touched the fence at this point. Number 42—a chestnut post—lost a piece five feet long, four inches wide and two inches thick. At 82 there is slight evidence of destructive action, after which nothing unusual is observed, although the wire runs 300 feet further and ends near a telegraph pole and a wild cherry tree. The "points" show no evidence of heating. At the four sharp turns the damage is more pronounced than at the other posts, excepting number 42. The distribution of mechanical action it will be observed is peculiar. No attempt will be made to explain it.

* A Paper presented to The American Association for the Advancement of Science, Cleveland meeting, 1888.

WOOD CLOTH.

Mitscherlich has applied the bisulphite process for reducing wood to the production of a fibre from wood which can be spun.

Thin boards or laths free from knots, but of any desired width, are cut into strips in the direction parallel with the grain, and are then boiled in a boiler containing a solution of sulphurous acid or bisulphite. This boiling effects disintegration without requiring that the strips of boards shall be reduced to very small pieces. After boiling the wood, it is dried in the open air or in specially constructed drying rooms. By thus drying the product, the fibre, which is originally very weak, and tends to break at the slightest strain, becomes comparatively strong and does not resume its very breakable condition on the addition of water. The operations are carried out as follows :—

The damp masses on the frame are transferred to a travelling endless cloth, which leads them to a pair of rollers, which may be plain or provided with corrugations in the direction of their length, the ribs of the one roller being made to gear into the recesses of the other one, whereby they effect a simultaneous strong bending and squeezing of the masses. The cutting of the material in passing through the corrugated rollers is avoided by causing the endless cloth to pass over the lower roller and by placing a canvas covering around the upper roller. The pressed masses fall from these rollers on to a second endless cloth, which conveys them to a second pair of rollers, from which they are conveyed to a third pair, and so on, they being preferably pressed in this way six times. By continued treatment of the wood the fibres become at length so pliable and isolated from each other that they can be employed directly for coarse filaments. For obtaining a perfect isolation of the fibres, however, without material deterioration, these operations alone are not suitable, and their special purpose is to loosen the fibres in the transverse direction, so that in the following operation a thin, long fibre may be obtained. For this purpose the boiled and pressed masses are completely dried. After drying they are combed in the direction parallel with the fibres by means of devices provided with pins or teeth, in a manner similar to the operations for combing flax, cotton, etc., but with the difference that the pins or teeth of the apparatus must be made very strong. The separation of the extractable matter from the fibre produced by boiling the gums and soluble organic matter can be effected at any time. It is, however, preferably effected after the fibre has been spun into threads, etc.—*Scientific American.*

PROTECTION OF THE EARS UNDER CANNON FIRING.

Dr. Samuel Sexton, of this city, says :—"It is the experience of many officers that the vibrations of great intensity which are given off from some field pieces and bursting shells, charged with high explosives, are more disagreeable than the heavier sounds of great guns. The metal itself vibrates under these circumstances similarly to a tuning fork.

"A very disagreeable jar is imparted to the temporo-maxillary articulation when the individual is near a great gun being fired off. This is lessened, it is believed, by standing on the toes and leaning forward. Some simple precaution, to be employed by officers and men during artillery practice, would seem very much needed, since aural shock is not only painful and distressing, but orders cannot be well heard while the confusion lasts.

"There is probably no better protection than a firm wad of cotton wool well advanced into the external auditory canal. In suggesting this protection, it is believed that harm can seldom take place from pressure of air from within, since it is known that the violent introduction of air into the tympanum from the throat, by means of Politzer's method of inflation, seldom ruptures the drum head, though, if such a volume of air were suddenly driven into the external auditory canal, the drum head would in nearly all cases be ruptured."—*Scientific American.*

ELASTIC ENGINE FOUNDATIONS AND SUSPENSION OF VEHICLES.

The complete and stable isolation of structures, machines, and vehicles, with a view to deadening shocks, preventing the transmission of vibrations, and diminishing the resulting noise, is a problem which has received a large number of solutions, none of which has hitherto given full and entire satisfaction. The processes employed for the isolation of machines consist in the use of rigid foundations or elastic substances. Masonry foundations, even with the superposition of framework, and surrounded with trenches, have proved insufficient.

The interposition of rubber has given good results in some cases but unsuccessful ones in others, and the causes of which are thus set forth by Mr. G. Anthoni in a recent communication to the Society of Civil Engineers :—

"Rubber simply interposed between the floor and the tool to be isolated has been used for a long time, and gives good results, because the isolation is complete, but it can rarely be utilized thus because there is no stability, and movements may be produced that interfere with or are even dangerous for the service. Besides, in impact tools, the useful effect is diminished.

"If, in order to overcome such inconveniences, we connect the piece to be isolated by bolts, the vibrations pass through the latter, and the isolation is destroyed. Moreover, if we compress the rubber in order to give stability, there is no more elasticity, and if, on the other hand, we do not compress it, but allow it to retain all its elasticity, we do not obtain the stability in view of which the connecting bolt is used.

"Want of success may be due also to the improper use of rubber, for, in order to solve a problem of isolation, we must study the conditions that have to be fulfilled by the blocks from the standpoint of their form, surface, and thickness."

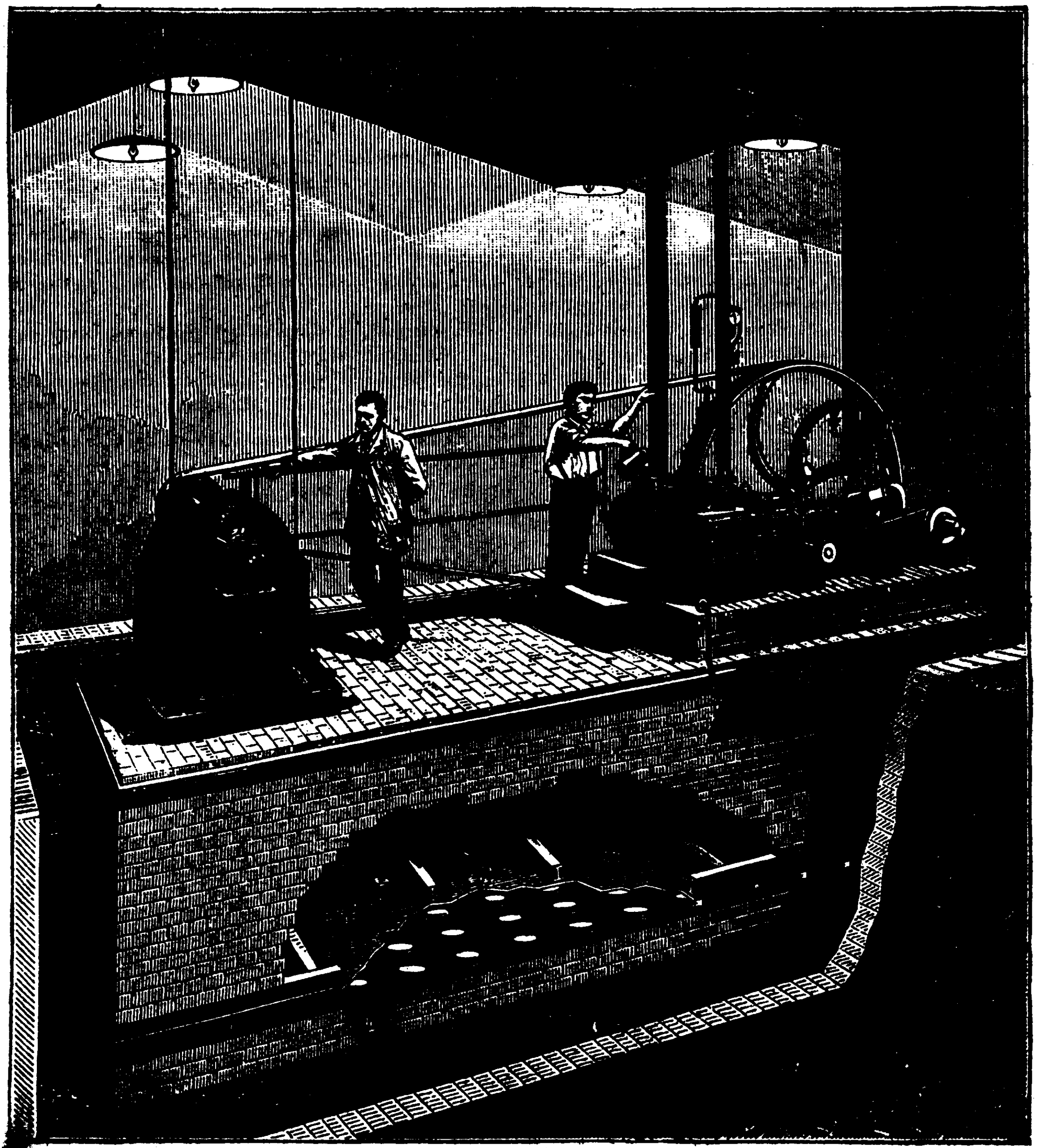
In order to leave rubber its entire elasticity, and to give the isolated system all the stability necessary, Mr. Anthoni has recourse to two methods, which at the same time secure isolation and stability : (1) An increase of the mass of the system to be isolated, and (2) an isolating and elastic attachment.

The first of these is applied to the foundations of machines, while the second is more especially designed for the suspension of vehicles of all kinds.

As an example of an elastic foundation for a collection of machines, we may cite the small central electric works established by Mr. Pulsford in the Faubourg St. Denis. The vibrations of these machines were annoying the neighbors considerably, and lawsuits were imminent, when Mr. Juppont, Mr. Pulsford's electrical engineer, conceived the idea of having recourse to Mr. Anthoni's method. The accompanying figure shows the application that has been made of it, and which is giving entire satisfaction.

A large oblong ditch was dug, the bottom of which was provided with a floor and a sheet of iron plate over which was distributed a certain number of rubber disks which formed an insulation at once electric and elastic. Upon these disks was laid a second iron plate riveted to a flooring that rendered the plate indistortable. It is upon this flooring that the foundation is built, places being left, of course, for the foundation bolts, and spaces being reserved sufficiently capacious to allow of the periodical cleaning of the ditch and for the accumulation of debris between two successive cleansings without interfering with the elastic suspension.

The foundation need not be of masonry, and in some cases



ELASTIC SUSPENSION OF MACHINES.

it may be advantageous to use a caisson filled with sand, thus permitting of the easy shifting of the foundation. The trench is covered with a flooring or iron plate permitting of the motions of the masonry in a horizontal direction if it is a question of a steam engine, or in a vertical direction if the elastic suspension is applied to a steam hammer or a pump.

The steam admission and eduction pipes are wound spirally at the upper part, so that they may have elasticity enough to permit of the motion of the whole without forcing the joints.

In the case under consideration, the oscillating motions reach an amplitude of $\frac{3}{16}$ inch, and nothing is more curious than to see the whole affair, whose weight exceeds 25 tons, displace itself rapidly without the least vibration being felt at the edge of the trench. The same process is applicable to the rails of railways upon metallic viaducts crossing cities, and to the engines of boats, etc.

The second method of isolation, applied to vehicles, consists in the use of a rubber support, which, placed between the axle and the spring of carriages, gives a complete and stable isolation, increases the ease of motion and the duration of service, diminishes the noise, and reduces the variations in the tractive stresses of the horses.

This rubber support serves to fix the spring firmly upon the axle, if it is a question of a vehicle, without interfering with the elasticity of the junction by too much tightening, a drawback connected with all the arrangements hitherto employed. This result is obtained by means of a mode of attachment which interposes (1) an isolating rubber tube between the coupling plate and axle; (2) of a foundation disk of rubber supporting the load; and (3) of a reaction disk which isolates the nut and lessens the rebounding. The compression between the metallic parts is effected without crushing the metallic joint.—*La Nature.*

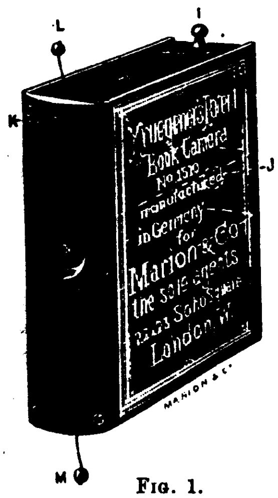
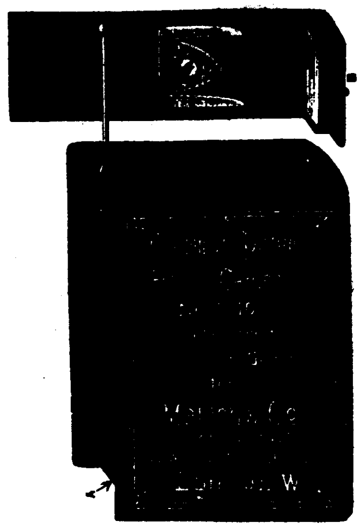


Fig. 1.



DETECTIVE CAMERAS.

The *Photographic News* says that a German officer, who recently occupied a châlet near Paris, has been expelled from France as a photographing spy, and that a lady, who was supposed to have taken a part of the châlet from him, turns out to have been a German military cadet. They both used to go wandering about with a perambulator, containing what seemed to be a sleeping baby, but was, in reality, a large doll that hid a photographic apparatus for taking views of the new forts and the positions commanding them. A great deal of ingenuity seems to have been expended recently in devising what are called detective cameras, which will, no doubt, be used for natural history and other scientific purposes where it is desirable not to attract the attention of the person or the animal photographed. Dr. Krügener, of Bockenheim, near Frankfort, has patented a detective camera in the form of a leather-bound book that holds a supply of twenty-four dry plates, which may be exposed in rotation without opening the camera by means of the rod I in fig. 1, which is shown pulled out in fig. 2. The reservoir E, fig. 2, holds the supply of dry plates, which are pushed upward against the cover by a spring; G, fig. 2, is the place where the plate is exposed on pushing in the rod I. The plate which has been exposed is pushed to F, and another plate is brought into position to be exposed. It is intended that the camera should be held under the arm of the operator, and the exposure is made by touching a spring. The object photographed may be at the back or in front of the operator. A Voigtländer lens is employed and the pictures taken are sufficiently sharp to allow of an enlargement to six or seven diameters.

AN IMPROVED DRAUGHTSMAN'S PROTRACTOR.

In plotting the courses of a deed or the meanders of a watercourse, the surveyor is compelled either to draw a new meridian at the close of each course, from which to lay off the succeeding one, or else to calculate the angle made by the intersecting courses and then lay off this angle with an ordinary protractor. The latter method is not onl laborious, but there is also the liability to error in such computation, and, as each course is dependent upon that which precedes it, an error in one course will be carried forward throughout all the successive courses. Gen. Duffield's patent protractor, illustrated herewith, enables each course to be laid off independently of all others. It is made of horn, celluloid, or other transparent material, and the graduation upon the outer circumference in degrees, etc., like that of the surveyor's compass, begins at 0° on the vertical line, and extends both ways to the right and left to 90° on the horizontal line. Below or on this horizontal or 90° line, and parallel therewith, a scale of equal parts is drawn, the graduation commencing with 0, at the intersection of the vertical or 0° line and the horizontal line, and also extending each way both right and left.

Duffield's Draughtsman's Protractor.

A similar scale of equal parts is drawn parallel with the first, as far removed from the horizontal or 90° line as the graduation of the outer circumference will permit, the 0 of such scale being at the intersection of the vertical or 0° line with the horizontal line, upon which this scale is drawn, and the graduation also extending each way, both right and left. To use this protractor meridian lines are drawn in pencil upon the paper upon which the map is to be drawn, whose distance apart will not exceed 3 inches, or the length of the scale of equal parts, drawn on the protractor. To lay off any given course, the centre of the protractor is made to coincide with the beginning point of such course on the end of the preceding course, and the protractor revolved about its centre until one of the pencil meridians on the map intersects each scale of equal parts on the protractor at the same point. The vertical or 0° line of the protractor will then be parallel with the meridian, and the given course can then be laid off from the graduation upon the outer circumference.—*Scientific American.*

MANUFACTURE OF LIGHT WITHOUT HEAT.

Prof. Oliver J. Lodge has been endeavoring to manufacture light by direct electric action without the intervention of heat, utilizing for the purpose Maxwell's theory that light is really an electric disturbance or vibration. The means adopted is the oscillatory discharge of a Leyden jar, whose rate of vibration has been made as high as 1,000 million complete vibrations per second. The waves so obtained are about three yards long, and are essentially light in every particular except that they are unable to affect the retina. To do this they must be shortened to the hundred-thousandth of an inch. All that has yet been accomplished, therefore, is the artificial production of direct electrical radiation, differing in no respect from the waves of light except in the one matter of length. The electrical waves travel through space with the same speed as light, and are refracted and absorbed by material substances according to the same laws. We only need to be able to generate waves of any desired length in order to entirely revolutionize our present best systems of obtaining artificial light by help of steam engines and dynamos, which is a most wasteful and empirical process.

In a paper given in *Nature*, Dr. Lodge further discusses the subject as follows:—

The conclusions at which we have arrived, that light is an electrical disturbance, and that light waves are excited by electric oscillations, must ultimately, and very shortly, have a practical import.

Our present systems of making light artificially are wasteful and ineffective. We want a certain range of oscillation, between 7,000 and 4,000 billion vibrations per second; no other is useful to us, because no other has any effect on our retina; but we do not know how to produce vibrations of this rate. We can produce a definite vibration of one or two hundred or thousand per second; in other words, we can excite a pure tone of definite pitch, and we can command any desired range of such tones continuously by means of bellows and a key board. We can also (though the fact is less well known) excite momentarily definite ethereal vibrations of some millions per second, as I have at length explained; but we do not at present seem to know how to maintain this rate quite continuously. To get much faster rates of vibration than this we have to fall back upon atoms. We know how to make atoms vibrate; it is done by what we call "heating" the substance, and if we could deal with individual atoms unhampered by others, it is possible that we might get a pure and simple mode of vibration from them. It is possible, but unlikely; for atoms, even when isolated, have a multitude of modes of vibration special to themselves, of which only a few are of practical use to us, and we do not know how to excite some without also the others. However, we do not at present even deal with individual atoms; we treat them crowded together in a compact mass, so that their modes of vibration are really infinite.

We take a lump of matter, say a carbon filament or a piece of quicklime, and by raising its temperature we impress upon its atoms higher and higher modes of vibration, not transmuting the lower into the higher, but superposing the higher upon the lower, until at length we get such rates of vibration as our retina is constructed for, and we are satisfied. But how wasteful and indirect and empirical is the process. We want a small range of rapid vibrations, and we know no better than to make the whole series leading up to them. It is as though, in order to sound some little shrill octave of pipes in an organ, we were obliged to depress every key and every pedal, and to blow a young hurricane.

I have purposely selected as examples the more perfect methods of obtaining artificial light, wherein the waste radiation is only useless, and not noxious. But the old-fashioned plan was cruder even than this; it consisted simply in setting something burning, whereby not only the fuel but the air was consumed, whereby also a most powerful radiation was produced, in the waste waves of which we were content to sit stewing, for the sake of the minute, almost infinitesimal, fraction of it which enabled us to see.

Every one knows now, however, that combustion is not a pleasant or healthy mode of obtaining light; but everybody does not realize that neither is incandescence a satisfactory and unwasteful method which is likely to be practiced for more than a few decades, or, perhaps, a century.

Look at the furnaces and boilers of a great steam engine driving a group of dynamos, and estimate the energy expended; and then look at the incandescent filaments of the lamps excited by them, and estimate how much of their radiated energy is of real service to the eye. It will be as the energy of a pitch pipe to an entire orchestra.

It is not too much to say that a boy turning a handle could, if his energy were properly directed, produce quite as much real light as is produced by all this mass of mechanism and consumption of material.

There might, perhaps, be something contrary to the laws of nature in thus hoping to get and utilize some specific kind of radiation without the rest, but Lord Rayleigh has shown in a short communication to the British Association, at York, that it is not so, and that, therefore, we have a right to try to do it.

We do not yet know it is true, but it is one of the things we have got to learn.

Any one looking at a common glow worm must be struck with the fact that not by ordinary combustion, nor yet on the steam engine and dynamo principle, is that easy light produced. Very little waste radiation is there from phosphorescent things in general. Light of the kind able to affect the retina is directly emitted, and for this, for even a large supply of this, a modicum of energy suffices.

Solar radiation consists of waves of all sizes, it is true; but then solar radiation has innumerable things to do besides making things visible. The whole of its energy is useful. In artificial lighting nothing but light is desired; when heat is wanted it is best obtained separately, by combustion. And so soon as we clearly recognize that light is an electrical vibration, so soon shall we begin to beat about for some mode of exciting and maintaining an electrical vibration of any required degree of rapidity. When this has been accomplished, the problem of artificial lighting will have been solved.—*Scientific American.*

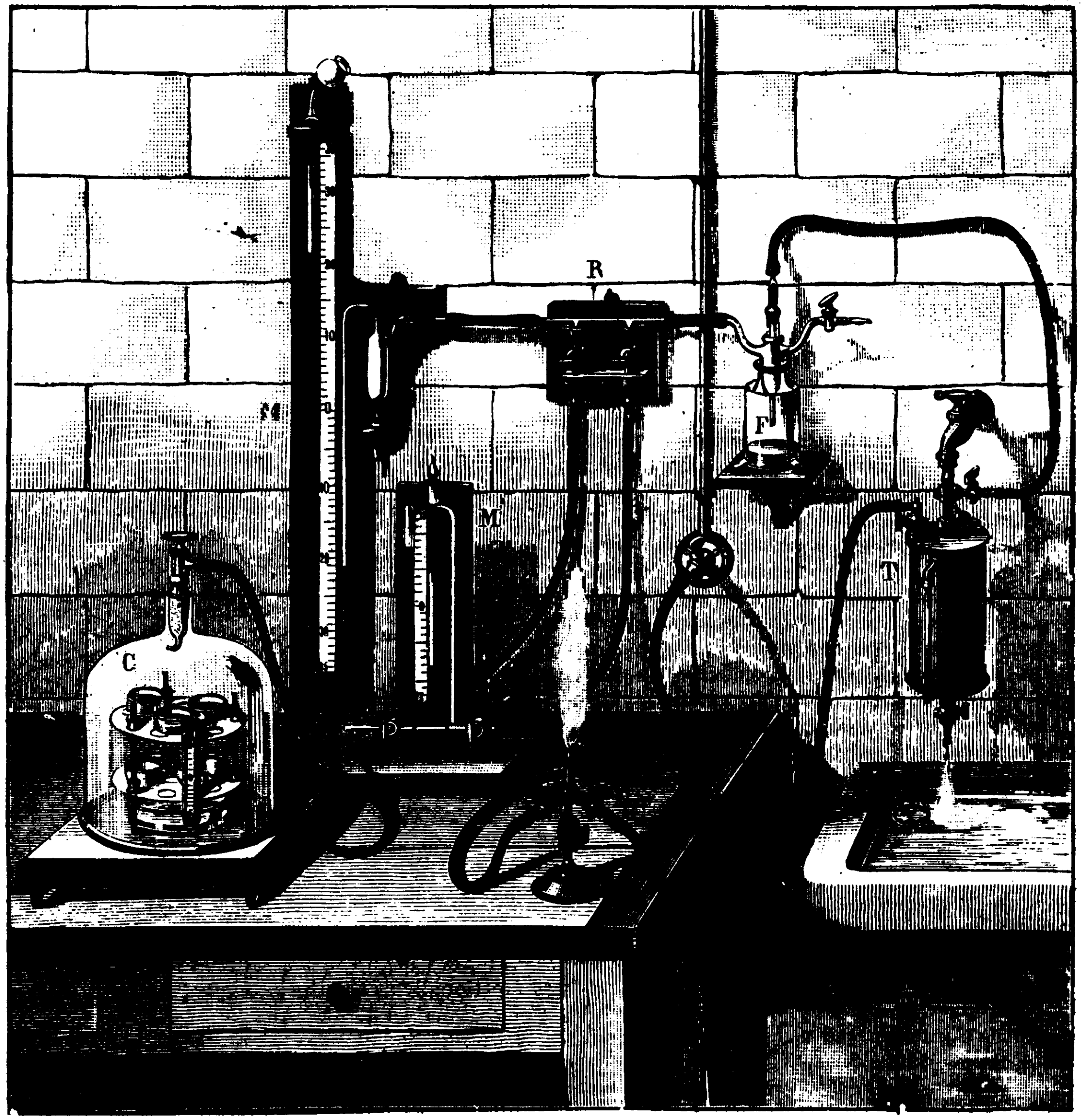
SEASIDE RESORTS AND THEIR ARCHITECTURE.

The projectors of new watering-places have scarcely entertained any other idea than drawing a number of holiday-making people to the seaside by amusements of a varied but very ephemeral nature. They imagine that a new pier, a pavilion for music, a few hotels, and a switchback railway are all that are necessary to equip an embryo seaside resort. A company is started with capital sufficient to set the place afloat. One or two hotels are erected facing the sea, and a plan is prepared and largely advertised by perspective views highly coloured, showing rows of neat villas, single and semi-detached; a church, of course, with a lofty spire; a marine parade, tennis-grounds, and pavilions interspersed with ample gardens and foliage, and surrounded by a landscape of unequalled attractiveness. We can point to a very admirable and naturally favoured place not far from Southsea, in which all these attractions were shown by the early promoters, but which to this day is still half-finished, if it is ever destined to attain the popularity its salubrity deserves. On the Kentish coast more success has attended the starters of at least one new resort. We may name Westgate-on-Sea as a select suburb of Margate. A capital being subscribed, it has not been difficult to make a beginning by an enterprising company by the aid and patronage of a great landowner. Eastbourne, we know, has thriven from the local and moneyed interests which one great landlord has thrown into the scale. Other places do not appear—although possessing like natural advantages—to have gained the same popularity. It is from no lack of energy that they are comparatively little resorted to by the general public. They have been pushed, well advertised, and a fair stock of attractions have been provided. Why is it we find one resort declining and another not far distant rising in public estimation? The natural advantages and facilities of both are about equal as regards their distance from great commercial centres, and the means of communication to each are good. The answer must be looked for in the manner the new town has been laid out—in the general scheme of building, engineering, and architectural treatment. In several new watering-places we know the natural peculiarities have been entirely neglected; the physical features have scarcely been considered in the general laying out of the roads, terraces, and esplanades; they have been allowed to break out here and there with abruptness, and natural scenery and building have been brought into strange and violent contrasts. Skegness, on the coast of Lincolnshire, is one of those places where the modern builder has unmistakably set his stamp on the locality. Flatness is the prevailing character of Lincolnshire scenery, as all know who have visited the Fens. Nature has divested the country of all the features most favourable to a resort, save the fine seaboard that skirts the land to the eastward. The straight rows of houses which form the lines of the streets and terraces only partially erected add to the monotony and intensify the flatness and level lines. It did not occur to the designers that there was one way to produce a little diversity to the scene by avoiding straight lines on plan, and building the houses in curved lines and in crescents. The curves would have broken the straightness by varying the ground and sky lines. Yet, not only in the plan of the streets has the straight line been introduced, but in the level roof-lines and continuous ridges, and so the evil has been rendered still more objectionable and disagreeable to the eye of the visitor. Nowhere do we observe the gabled or broken roof, which is the construction best suited to flat, plain-like localities. The parallel span roof abruptly terminates with gable ends. Then, in Skegness, all the buildings are of red brick, and of a hackeyed kind of architecture. There are very few houses in which any attempt is seen to give variety to the windows or the dressings. The balcony and bay window are inadequately treated. All is of the most commonplace character. The abrupt rows of houses leave unsightly gaps in the streets, rendering it impossible to follow out any plan of arrangement. The sea-front is thus patchy and disjointed; but there are some compensations for the dulness of the town, with its flat lands behind, where there are neither hedgerows nor trees, chimneys nor smoke, to break the horizon. There is the splendid pier constructed by a company in 1881, with its fine pavilion on the spacious head, rivalling in length even that of Brighton, and there is a magnificent sandy beach extending for miles along the sea. To the visitor these advantages do not altogether make up for the want of good planning and lack of rural surroundings which are so conspicuously noticed here. The building has spoiled the town irretrievably. The conclusion to be drawn is that the plan and conditions of building in new seaside towns have much to do with their success. Architectural conditions ought to have far more consideration than they usually have. We do not mean that it is necessary to have high class or even good architecture, that the houses should be either in this or that style; but only that the physical features and conformation of the locality should be studied with reference to the plan of the streets, and that in the design of the rows and terraces such features as roofs, and the materials to be used in the building, ought to be decided with special relation to the natural surroundings. Skegness might have been made more pleasing if the builders had been required to gable and hip their roofs, and if there had been a regulation that long, straight-eaved roofs of slate would not be tolerated, and that red brick must be varied by stone, white brickwork, or half timbering and stucco. Other towns take their example from what has already been done near them. Thus it is to be feared that the neighbouring watering-places of Sutton-on-Sea and Mablethorpe will be sacrificed to the intolerable cheap speculative builder style of straight-slated roofs and red brick, if some one does not show that even a flat and uninteresting country can be made agreeable by its buildings.

Bournemouth has been spoiled by the red brick craze; but its undulations have happily prevented anything like uniformity in the buildings. Brighton has been marred in the newer western parts; but its undulating downs have compelled the builder to follow them. So with Clevedon. Westgate-on-Sea and Birchington indicate what can be done by tasteful villa building, and the avoidance of the straight, continuous line of buildings, a tendency which has spoiled nearly half our new seaside places, except where nature has made it impossible to be followed.—*Building News.*

A CHEAP ELEVATOR.

A Berlin inventor has devised a simple and inexpensive elevator for private dwellings, in place of the ordinary staircase, which may suggest to some inventor a better means of accomplishing the same object. The Berlin invention is on the principle of the inclined railway, and the motive power is furnished by the city water, which is applied in the cellar; each flight has its separate chair, so that, for example, one person can ascend from the first to the second story while another is on his way from the second to the third, or still another is descending from the fifth to the fourth. The chair, being only of the width of the human body, leaves a free passage for any who wish to walk up or down instead of riding. It is set in motion by a simple pressure of one of its arms, and after it has been used it slides back to the bottom step, its descent being regulated in such a manner that the passenger is carried with entire safety. The motive power is, of course, more or less expensive, according to the cost of water, this being, it is stated, at Berlin, at the rate of a little more than one-tenth of a cent only for each trip.



LABORATORY TROMP AND OTHER APPARATUS.

A NEW LABORATORY TROMP.

The suction apparatus formerly used in laboratories consisted of a bottle from which water was allowed to flow, and which had the inconvenience of being cumbersome. For obtaining a vacuum, recourse was had to the air pump—a costly apparatus; and for forcing air into the blow pipe, the device used was bellows operated by foot. All this is now replaced by the suction and force tromp, which merely requires to be connected with the faucet of a water pipe. With this remarkable apparatus, one has nothing to do now but open and regulate two cocks in order to obtain a continuous supply of air under pressure. The apparatus is shown in its entirety at T, in Fig. 1, where are also shown some of its applications. In the first place, it communicates with a safety bottle, F, which is provided above with a valve to prevent the water from entering the vacuum apparatus—an event that would occur should the pressure of the water happen to diminish suddenly in the pipes. R is a board, to which are affixed two glass cocks, forming a double T. This arrangement permits of obtaining a vacuum in two different directions. M is a pressure gauge that shows the degree of the vacuum produced in the various apparatus. M′ is a pressure gauge that can be moved from place to place. These two instruments are so constructed that they can be easily filled and cleaned, and their scales are detachable. C is a bell glass with polished edges, and which is provided at the top with a polished glass cock. It rests upon a base which has been polished with emery, and which is cemented to a metallic frame supported by four legs. This bell glass covers a stand upon which capsules or vessels containing extracts may be placed. Under the lower shelf of this stand is placed a vessel containing sulphuric acid. The degree of vacuum is ascertained through a small manometer.

In the foreground may be seen the gas burner that the tromp converts into a blow pipe when air is forced into it. It only

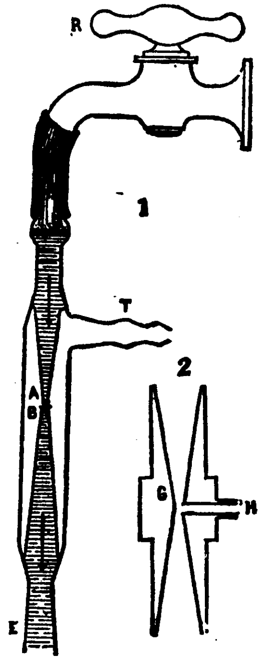


FIG. 2.—PRINCIPLE OF THE TROMP.

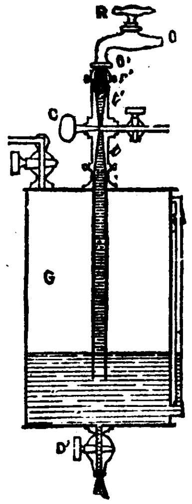


FIG. 3.—SECTION OF THE APPARATUS.

remains now to explain the mode of operation of the apparatus. The tromp is based upon the principle of the Giffard injector, and was devised in 1872 by Mr. Lane, a pupil of Deville's. Shortly after that period, the brothers Alvergniat put the first models of the apparatus into the market, and the use of them has now become general in laboratories.

The tromp, which is made of glass, consists of two conical nozzles, A and B, arranged as shown in the diagram in Fig. 2. The water enters through the faucet, R, passes from cone A into cone B, as in the injector, and, on making its exit, carries along with it the air that it has sucked in at T. The water that flows out at E is thus mixed with air. The suction of the tube, T, is very strong, and, upon putting the tube in communication with a bell glass, it is possible to obtain a maximum vacuum, which varies in winter and summer according to the tension of the aqueous vapor.

The apparatus may be made of metal. Mr. Alvergniat, in his new apparatus, has connected the two cones at G (2, Fig. 2), and left but one aperture, H, or two apertures, as shown in Fig. 3, which represents one of the metallic tromps at *t t'*. The tube through which the water flows is prolonged in a metallic cylinder, G. If the lower cock, D', be nearly closed, a certain quantity of water will accumulate in the cylinder and compress the air therein, and the latter will escape under pressure, through the cock at the top. It is possible to obtain a pressure of 0·10 m. of mercury. The discharge of compressed air is regulated through the cock, D'.

This exceedingly practical apparatus is destined to render valuable services to physiologists, botanists, and all laboratories of science.—*La Nature.*

CAPITALISTS AND INVENTORS.

Inventors often complain of the difficulty experienced in inducing capitalists to join them in their enterprises. No doubt there is often good ground for such complaint. Not infrequently, however, we think the blame rests as much with the inventor as with the man of money. It must be remembered that usually the inventor studies the field more closely than the capitalist, because he has more time, and his attention is more closely directed to the investigation. It can hardly be expected that the man who devotes one hour to a superficial investigation of the subject can explore it so deeply and satisfactorily as the one who has given to it months and perhaps years. The capitalist is often blamed for not seeing into the advantages of an enterprise, when the fact is it has never been presented to him in the right light. Some one makes an important discovery, which, if utilized, will seemingly yield large results. Capital is invoked, but no systematic method is employed to demonstrate that the returns for an investment in working this new field of discovery will yield profitable results. Inventors too often think that capitalists should take their simple assertion that the invention will yield large returns. This would be very well if inventors as a class were not over-sanguine, and their predictions in a business way did not so frequently prove futile.

Every investor has a right to have some reasonable assurance that his money will be spent in a profitable direction. Money is the great lever that moves the world. If judiciously employed, it is a source of great gain; if wrongly employed, it too often becomes powerless for good. Every man, therefore, who would seek the aid of capital in furthering his plans for introducing an invention should first be prepared to show the whole state of the art covered by such invention, and wherein the improvement exists. Second, he should, if possible, show what particular market needs to be supplied with such improvement, and something approximating to the returns which reasonably may be expected. Third, he should have some well settled plan of introducing the new product or furthering the new scheme. Fourth, it should be supported by well considered arguments tending to the convincing of the men whose money will be embarked in the enterprise. Because, however sanguine the inventor may be, the man who is called upon to risk his money should be shown a reasonable hope for obtaining fair returns, and, further, that investment is measurably safe.

The general denouncement of capitalists for their proverbial slowness in coming to the rescue of inventors is too often ill timed. There are millions of dollars to-day invested in experimental plants and in promoting new discoveries. We are glad to say that in the majority of cases these investments have proved very lucrative. Probably no field of enterprise offers more allurement than this, and if capital is not always secured, it does not follow that the man with the money is to blame. Inventors must employ business methods when approaching business men. If they are not capable of doing this, let them employ a third party, who, in many cases, furnishes the missing link between the patent and the bank account.

There are without doubt thousands of patents which have never been introduced to the public, which would yield very large fortunes to any one who would take them up and work them properly. Whose fault is it? Probably not the capitalists', for they are, generally speaking, only too glad to find a good way to invest their funds. The blame, if any, rests upon the inventor, who, in many instances, places so high a value on his invention that capitalists cannot afford to assume the risk of introducing the new thing, or because the inventor has not taken the right method or adopted the proper plan of bringing his matters to the attention of the men whose aid he invokes.

Inventors, often, get too easily discouraged. They bring their invention before three or four capitalists, none of whom feels disposed to introduce it, and they immediately give up, blaming the stupidity of capital, and bemoaning their own sad lack of funds. Now, the commercial traveler does not thus easily lie down under difficulties. He moves on from town to town. Each negative answer he gets only urges him forward to the man who he is sure sooner or later will be found to say yes. If the inventor had more of the commercial instinct, more of the commercial man's persistency and push, more of his indomitable will and pluck, he would succeed. There is far less trouble with capitalists than with inventors themselves. It really seems as though in most cases a "go-between" were absolutely necessary. When the inventor himself fails of eliciting help, the best thing he can do is to obtain the services of some keen, shrewd, far-seeing business man to help him out of his difficulty. If his invention is worth pushing, nine cases out of ten there will be little trouble in procuring financial help if the proper methods be employed.—*The Industrial World.*

LEFT-HANDEDNESS.

Dr. Daniel Wilson, president of the Royal Society of Canada, has lately contributed a paper to the *Proceedings* of that society on the subject of left-handedness, to which he has managed to give an unexpected and very practical interest, affecting all who have children or who are concerned in their education. The author had written previously on this subject, but not with such full and effective treatment. He reviews the various causes to which the general preference of the right hand has been ascribed, and also to which the occasional cases of left-handedness are attributed, and finds them most unsatisfactory. He shows clearly that the preferential use of the right hand is not to be ascribed entirely to early training. On the contrary, in many instances where parents have tied up the left hand of a child to overcome the persistent preference for its use, the attempt has proved futile. He concludes that the general practice is probably due to the superior development of the left lobe of the brain, which, as is well known, is connected with the right side of the body. This view, as he shows, was originally suggested by the eminent anatomist, Professor Gratiolet. The author adopts and maintains it with much force, and adds the correlative view that "left-handedness is due to an exceptional development of the right hemisphere of the brain."

A careful review of the evidence gives strong reason for believing that what is now the cause of the preference for the right hand was originally an effect. Neither the apes nor any others of the lower animals show a similar inclination for the special use of the right limbs. It is a purely human attribute, and probably arose gradually from the use, by the earliest races of men, of the right arm in fighting, while the left arm was reserved to cover the left side of the body, where wounds, as their experience showed, were most dangerous. Those who neglected this precaution would be mostly likely to be killed; and hence, in the lapse of time, the natural survival would make the human race, in general, "right-handed," with occasional reversions, of course, by "atavism," to the left-handed or, more properly, the ambidexterous condition. The more frequent and energetic use of the right limbs would, of course, react upon the brain, and bring about the excessive development of the left lobe, such as now generally obtains.

The conclusions from this course of reasoning are very important. Through the effect of the irregular and abnormal development which has descended to us from our bellicose ancestors, one lobe of our brains and one side of our bodies are left in a neglected and weakened condition. The evidence which Dr. Wilson produces of the injury resulting from this cause is very striking. In the majority of cases the defect, though it cannot be wholly overcome, may be in great part cured by early training, which will strengthen at once both the body and the mind. "Whenever," he writes, "the early and persistent cultivation of the full use of both hands has been accomplished, the result is greater efficiency, without any corresponding awkwardness or defect. In certain arts and professions, both hands are necessarily called into play. The skilful surgeon finds an enormous advantage in being able to transfer his instrument from one hand to the other. The dentist has to multiply instruments to make up for the lack of such acquired power. The fencer who can transfer his weapon to the left hand places his adversary at a disadvantage. The lumberer finds it indispensable, in the operations of his woodcraft, to learn to chop timber right and left-handed; and the carpenter may be frequently seen using the saw and hammer in either hand, and thereby not only resting his arm, but greatly facilitating his work. In all the fine arts the mastery of both hands is advantageous. The sculptor, the carver, the draughtsman, the engraver, and cameo cutter each has recourse at times to the left hand for special manipulative dexterity; the pianist depends little less on the left hand than on the right; and as for the organist, with the numerous pedals and stops of the modern grand organ, a quadrumanous musician would still find reason to envy the ampler scope which a Briareus could command."

That all this is true is abundantly shown by the numerous examples cited by the author, from the greatest of artists, the left-handed Lionardo da Vinci, to the distinguished ex-president of the American scientific association, Prof. Edward F. Morse, and (we may add) to Dr. Wilson himself, both of whom are known to be accomplished draughtsmen with this too-neglected hand. In view of these facts, it is evident that few more important subjects can be offered for the consideration of educators than that which is presented in this impressive essay.—*Science.*

TONING GELATINO-BROMIDE PRINTS.

Something extremely interesting to me was the appearance of a communication to a metropolitan society, embodying some experiences of the toning of silver bromide emulsion pictures with uranium nitrate and potassium ferricyanide, the constituents of Dr. Eder's negative intensifier. If one may presume to criticise Mr. Eder's remarks, they struck me as being very lucid, and I was able without difficulty to arrive at satisfactory modifications of the tones of bromide prints by following his instructions. That gentleman recommends 10 per cent solutions of both salts. The picture after fixation is to be washed in acidulated water and then freed of the acid and treated with equal parts of the solutions named in twenty parts of water. After toning, another washing and transference to a new hypo or alum bath. For the latter I do not recognize a necessity, and so in the few trials made omitted it, substituting for it, after a thorough wash and soak, an acid bath to remove any traces of insoluble compounds that may have remained on the print. A personal preference for less marked tones than the deeper browns given by employing the solutions at the strengths suggested led me to considerably weaken them. By this means I obtained what I aimed at, namely, an alteration of the cold black of the untoned print to a less determined hue, brown black, of greater range. I agree that a bromide print may be considerably improved in this latter manner by the application of the uranium ferricyanide toning solution, which, moreover, possesses great latitude of power in imparting a well graduated series of pleasing tones.

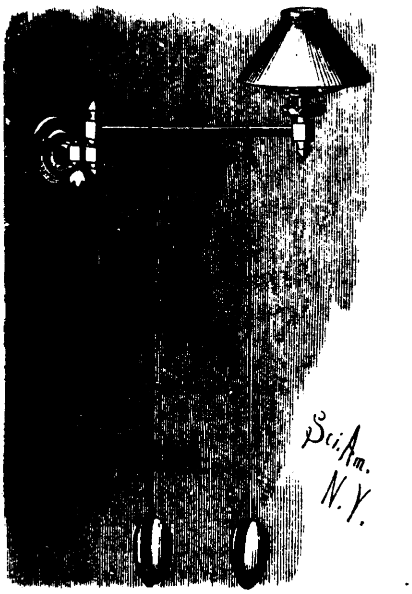
Another useful application of the uranium-ferricyanide toning solution is in the modification of the color of gelatino-bromide opal pictures. Here, as with paper positives, one may run up and down the gamut of the brown group of shades and tones with perfect success. I have so employed the formula detailed with satisfactory and pleasing results. For those who do not like blacks or cool grays, this method of toning may be confidently recommended. It will, of course, not escape remark that with bromide paper and opals that are developed with oxalate of iron very stringent care is required to free the film from ferrous compounds before the application of the uranium-ferricyanide solution, otherwise ruinous blue stains are sure to appear. I attach little, if any, importance to the danger of yellow stains from the toning solution if its action be not protracted beyond a few minutes. In my trials some opals, with plenty of virginal margin, came out of the treatment quite immaculate, although only ordinary precautions were adopted to preserve their whiteness.—THOMAS BEDDING, in *Br. Jour. of Photo.*

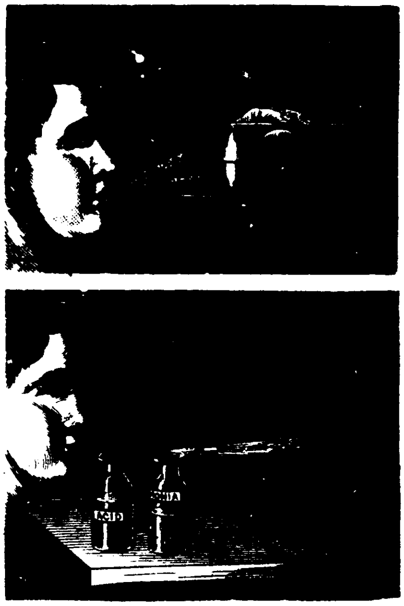
HOW A BONE BUTTON IS MADE.

From human bones? No. From ivory? No. From bone of dog or cattle? No. The other day, writes a correspondent, I happened to call on Mr. Church, who is the master of a small button factory at Birmingham, and was greatly interested in seeing a tailor's bone button made, just such a one as you would find on your ulster or a tweed coat. It was a queer little factory, made out of two or three cottages rolled into one. First of all, I was introduced to the raw material, which lay on the floor of a dark and dingy little workshop, in which a solitary workman was standing at his bench. "There," said Mr. Church, pointing to what I took to be potatoes, "there you see what we call vegetable ivory. It comes from South America and grows in clusters of half a dozen nuts. That is the first state of the button." We then went up to the workman, who was cutting up the kernels of the nuts at a swiftly revolving circular saw, an operation requiring great dexterity, for a slip might cost him a finger. This is the first process. The kernel is easily extracted, the shell in which it is enclosed being very thin and fragile. Although the kernel is a nut, it would take a very strong pair of jaws to crack it, and the teeth cannot touch it. The little white slabs which are cut out by the saws are taken to the next department, where the button is really formed in the series of lathes through which it is passed. The tool-maker, whose office is very important, works at one end of the room. The first lathe cuts out the button with the desired circumference, regulated by a series of gauges, the work being passed on to the others for the rim, and so on. Two women were drilling the four holes of the button, this being done by taking up each one and subjecting it to the action of the four-pronged horizontal drills, doing their work with remarkable deftness and rapidity. The button, so far as its form goes, is finished. It now remains to do the polishing and dyeing. In another room are half-a-dozen hexagonal boxes revolving in an atmosphere of dust. They contain the buttons, which are now being polished by the action of some hard powder, which is placed with them in the boxes. There is a secret in every trade, and I fancy that the contents of the mixture with which the buttons are eventually stained are not divulged to the world. Down below I was taken into another room, in which there were scores of tins containing dyes and many buckets holding chemical solutions. When the buttons are ready for receiving the dye they are placed on a tin tray holding, I think, a gross. The dye is then blown on to them by a spray, which causes the liquid to fall very naturally. The trays are then put into a gas-heated oven, and the buttons are afterwards put on to the cards ready for the market. Such is the interesting history of a bone button, one of the many wonders of Birmingham, that town of magicians.—*Pall Mall Gazette.*

REMOVAL OF RUST.

A method of removing rust from iron consists in immersing the articles in a bath consisting of a nearly saturated solution of chloride of tin. The length of time during which the objects are allowed to remain in the bath depends on the thickness of the coating of rust; but in ordinary cases twelve to twenty four hours is sufficient. The solution ought not to contain a great excess of acid if the iron itself is not to be attacked. On taking them from the bath, the articles are rinsed in water and afterward in ammonia. The iron, when thus treated, has the appearance of dull silver; but a simple polishing will give it is normal appearance.





SIMPLE SCIENTIFIC EXPERIMENTS.

EXPERIMENTS WITH EGGS.

Some of the phenomena of fluid friction may be beautifully shown by very simple experiments devised by Sir William Thomson. The materials necessary are two eggs—one raw, the other hard boiled; two rubber bands of such a size as to clasp an egg firmly when slipped on lengthwise; two thin steel wires, about the size of those sometimes used as E strings on guitars; and a mirror or a large plate, or other smooth surface with a ledge around it to prevent the eggs rolling off.

From a gas fixture, or other convenient support, the two wires are hung, and to the lower end of each one is fastened one of the rubber loops. Into these loops the eggs are slipped, with their long axes vertical, as shown in the figure. Grasping one egg in the fingers of each hand, they are gently turned once or twice round and then let go. The eggs show a surprising difference in behavior. The boiled egg keeps twisting to and fro, after the manner of a torsion pendulum, while the raw one comes almost immediately to rest. The explanation is easy. The hard boiled egg, being rigid throughout, turns as a whole, while the raw egg, being soft inside, has only its shell moved by the torsion of the wire, the contents remaining stationary, because of their greater inertia. The shell is thus made to rub to and fro on its contents, and being very light, is soon brought to rest.

Sir William Thomson has used this experiment to illustrate one of the proofs that the interior of the earth is solid. If the earth consisted of a thin shell or crust of hard rocks surrounding a fluid or pasty nucleus, as has been until recently generally taught, he says that the observed swinging and swaying motions of the earth's axis in precession and nutation would be impossible. Any such motion would soon be stopped by interior friction.

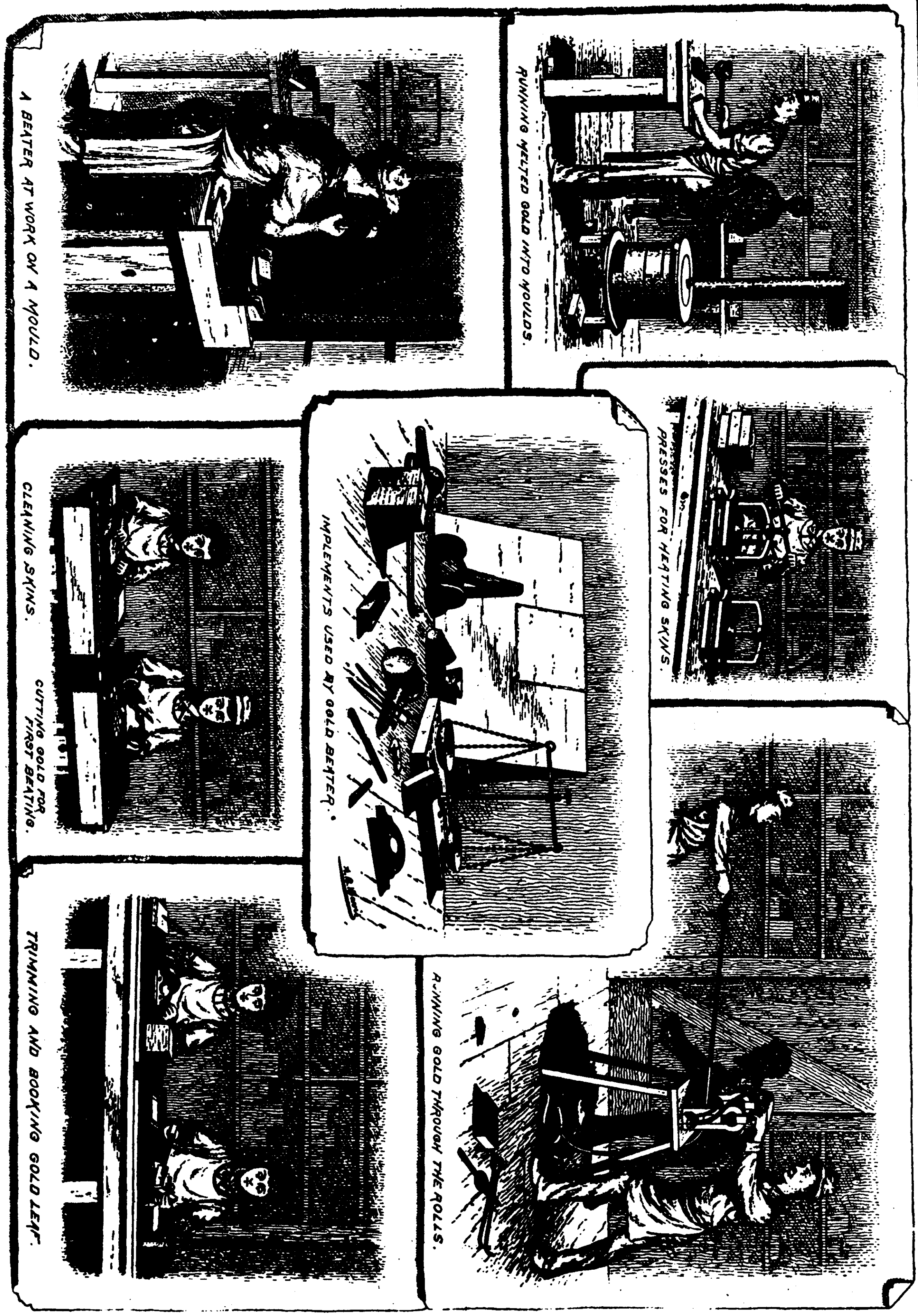
Place the eggs on the mirror or plate and try by a sudden twist with the fingers to spin them on end like tops. With the boiled egg one readily succeeds, but the raw egg will hardly make a single rotation before it falls on its side. The finger twist has merely moved the shell, the inside remaining at rest. Professor Mendenhall has remarked that this experiment furnishes a solution to Columbus' problem—how to make an egg stand on end: first boil the egg hard, and then spin it.

The third experiment is the one that occasions greatest surprise. The boiled egg is spun on its side on the glass, and the palm of the hand is then gently brought down upon it for an instant. The rotation, of course, stops at once. But when the same thing is tried with the raw egg, as soon as the hand that stops it is removed, its rotation begins again. In this case, when the shell is stopped, its fluid contents remain in motion, and, rubbing against it, set it in motion when the hand is taken away. It astonishes one to find how long the egg may be held still before this effect stops!

SMOKING AN EMPTY PIPE.

A neat adaptation of a familiar chemical experiment is now being shown by travelling conjurers. The performer comes forward with a common clay tobacco pipe in each hand, and after exhibiting them and blowing through them one at a time, to show that they are empty, puts them mouth to mouth, as in the figure, and at once proceeds to draw volumes of smoke from them. The merest tyro in chemistry will at once rightly guess that one of the pipes is slightly moistened inside with hydrochloric acid and the other with ammonia, and that the clouds of smoke are merely fumes of the salt ammonium chloride formed by the combination of the vapors of two chemicals.

An effective way to show the same experiment to a class is to blow across the mouths of two bottles containing strong ammonia and hydrochloric acid, and placed in line with the lips. A large room may thus be filled with dense fumes in a few minutes.—A. B. P., in *Scientific American*.



GOLD BEATING.

GOLD BEATING.

The rough gold is put in to a stone crucible, melted, and poured into a mould which gives it the right width for rolling. One hundred dollars' worth of gold is generally moulded at a time, the weight being about 5 ounces. It is then run through the rollers, the pressure of which is so great that the little bar of gold that is 1 inch in width and about 3 inches in length, after being run through several times, becomes a strip about 14 yards in length and about the thickness of a hair. The strip is then cut into 1 inch squares. These squares are put into what is called a cutch. This cutch is composed of 180 skins 3½ inches square. The material that these skins are made of is an invention of French origin, and is kept secret. Formerly vellum was used. A gold square is placed between each skin, one directly over the other, until the cutch is filled. Two parchment bands are put over them in opposite directions to keep them from shifting. The cutch is then beaten for 15 or 20 minutes with a 16 pound hammer. The gold is then taken out of the skins, quartered by a skewer, and put into what is called the shoder. The number of skins in a shoder is 680. These skins come from what is called the bung gut of an ox, one animal furnishing but two skins. The shoder skins are 4 inches square. They are put between the skins in the same manner as in the cutch. They are then beaten for 1½ hours with a 10 pound hammer, taken out, and again quartered with a piece of reed. They are then put into the mould one over the other, as before, until the 900 skins which the mould contains are filled. This is beaten with a hammer weighing 7 pounds for three or four hours. The leaf is then ready to be trimmed and booked. Before the beating process the skins are heated and primed to prevent the leaf from sticking. Heated presses are used to take the moisture from the skins. Each skin is rubbed with a hare's foot with plaster of Paris on both sides before beating. Each one of the first squares of gold beaten out makes 25 leaves, or one book. The trimming of the leaves before they are put intc books is done by a sled-shaped machine called a wagon. The trimming and booking is done mostly by girls. The trimmings that are left from the leaves are scraped together and melted over. A little salt added makes it thoroughly clean. The granite block that the beating is done on is about 3 feet in height, the top surface being ground down perfectly smooth, so as to prevent the blows of the hammer from cutting the under side of the mould.—*Scientific American.*

USE THE KNOWLEDGE YOU HAVE.

The greatest educators are those who not only impart knowledge but teach the correct use of that already acquired. Knowledge of whatever character is valueless if not properly employed. Individuals are often informed of subjects, but the neglect to use that information is ignorance without any excuse. Most men, in matters of business and daily transactions, employ their knowledge to the best possible advantage. They are careful to investigate closely, systematise their efforts, and follow the best business rules and maxims known to them. In almost every relation this care is observed, yet they are indifferent and careless regarding the simple laws of health known to almost every one. The little things which, being neglected, gradually and surely undermine health, shorten life, and render it less useful, are often wholly disregarded. We are all too apt to rely on some evidence of good health until the neglect of the simpler laws of hygiene has wrought debilities which seldom find remedies. We become careless regarding food, air, and drink. The health-sustaining agencies which nature has so abundantly supplied are ignored, tempted every d y.

If any one will take the trouble to note each day the violation of health laws which he has knowingly committed—those plain and simple laws known to average intelligence—he will soon begin to wonder that he is alive. The poisons inhaled, intemperance in food and drink, want of exercise, cleanliness, sleep, and proper rest, keep nature busy repairing the waste, and her forces are exhausted before middle life is reached, and decay begins its work when health should be robust. This results not from want of medical aid or advice, but from wilful violations of health axioms known to everyone almost intuitively, which could be observed and more work accomplished and more pleasure enjoyed than by their neglect, whatever time or opportunities may be gained.

The allurements of business, with the consequent rush and employment of every available moment, is a great temptation to late hours, hasty and irregular meals, excitement, mental strain, and overwork. Yet there is nothing saved in this. Anyone can easily demonstrate the fact that more can be accomplished by regular and temperate habits and proper rest than by continual labour and the violation of the first principles of the rules of health. The so-called demands of society work, also, their evils, and have broken down many strong constitutions. All this is known, and but the simple need of inducing people to use properly the knowledge they have exists. It will pay in the enjoyment of good health and the prolonged life that will follow.—*Sanitary News.*

HOW TO SHARPEN A PLANE IRON.

The simple art of sharpening a plane iron is supposed to be understood by every mechanic, remarks a writer in a contemporary, but there are hundreds of men who cannot do a creditable job in this respect. The common tendency is to round off the edge of the tool until it gets so stunted that under a part of the cutting the tool strikes the work back of the cutting edge. To do the job correctly, we will begin at the beginning and grind the tool properly. First, the kind of wood to be cut must be taken into consideration. Common white pine can best be worked with a very thin tool, ground down even to an angle of 30 degrees, provided the make of the tool will allow it. Some planes will not, for the iron stands so "stunt," or nearly perpendicular, that its grinding causes a severe scraping action, which soon wears away the tool. In such cases, from 45 degrees to 60 degrees is the proper angle for plane irons, and this, too, is about right for hard wood planing.

Determine the angle you want on the plane iron, and then grind to that angle, taking care to grind one flat bevel, and not work up a dozen facets. If the stone be small, say 12 in. to 18 in. in diameter, the bevel will be slightly concave like the side of a razor, and this is a quality highly prized by many good workmen. In grinding, take good care to avoid a "feather edge." If the tool already possesses the right shape, grind carefully right up to this edge, but not grinding it entirely off. The time to stop grinding a tool is just before the old bevel is ground off.

Should the tool need any change of shape, such as the grinding out of a nick or a broken place, then put the edge of the tool against the stone, and bring the tool to the desired shape before touching the bevel.

Let the iron lay perfectly flat upon the stone, with a tendency only to bear harder upon the edge of the bevel than upon the heel. Move the iron back and forth on the stone as fast as your skill will allow, taking care that the heel of the bevel is not lifted from the stone. As you become proficient in whetting an iron, the heel may be lifted from the stone about the thickness of a sheet of paper, or just enough to prevent it from touching. The reason why many carpenters cannot set an edge is because they raise their hand too much, and perhaps rock the tool, thus forming a rounding bevel, the sure mark of a poor edge-setter.

The proper way to oil-stone a tool is to continue the grinding by rubbing on the oil-stone until the bevel left by the grindstone is entirely moved, and the edge keen and sharp. If this be properly done, the tool need not be touched upon its face to the stone, but among a dozen good edge-setters not more than one can do it. It is a delicate operation, and can only be acquired by long practice. Nine times out of ten the average workman is obliged to turn the plane iron over and wet the face thereof, and here is where many men fail who have done the other things well. By raising the back of the tool only a very little, the edge is "dubbed off," and regrinding of the face becomes an immediate necessity. A good stone should "set" an edge on a tool which will shave off the hair on a person's wrist, without cutting the skin or missing a single hair.—*Mining and Scientific Press.*

MEDICINAL PROPERTIES OF VEGETABLES.

The following information may be useful to some at this season of the year, if not new to many :—

Spinach has a direct effect upon the kidneys.

The common dandelion, used as greens, is excellent for the same trouble.

Asparagus purges the blood.

Celery acts admirably upon the nervous system, and is a cure for rheumatism and neuralgia.

Tomatoes act upon the liver.

Beets and turnips are excellent appetizers.

Lettuce and cucumbers are cooling in their effects upon the system.

Onions, garlic, leeks, olives, and shalots, all of which are similar, possess medicinal virtues of a marked character, stimulating the circulatory system and the consequent increase of the saliva and the gastric juice promoting digestion.

Red onions are an excellent diuretic, and the white ones are recommended to be eaten raw as a remedy for insomnia. They are a tonic and nutritious.

A soup made from onions is regarded by the French as an excellent restorative in debility of the digestive organs.

CALIFORNIA BORAX.

New borax works have recently been started in Saline valley, Inyo county. They have eighteen crystallizing tanks, each of a capacity of 1,000 gallons. Three of these tanks are emptied daily, yielding about two tons of borax. The crude material from the borax marsh is first boiled in a boiler of 3,000 gallons capacity, and the solution is then run off into the tanks, where it is allowed to cool off and crystallize for about six days. The borax accumulates on the zinc sides of the tanks, and on plates of that metal hung in them, seven plates being used to each tank. The works are about fifty-five miles from Alvord station, and are close to the great Inyo mountains, which rise like a wall to a height of 11,000 feet above the sea level.

THE SCIENTIFIC LANTERN.*

In lantern projection, as in all other scientific work, the best results can be obtained only by employing the best means. While a cheap lantern may have considerable utility, it cannot fully satisfy modern requirements in the line of scientific projection. In Fig. 1 is illustrated a lantern which is adapted to all kinds of projection, and which may be readily shifted from one kind of work to another. It is provided with an oxyhydrogen burner and with an electric lamp, either of which may be used at pleasure. It may be very quickly arranged as a vertical lantern, and all of the attachments are constructed so that they may be placed at once in the position of use without the necessity of alignment and adjustment in each case.

The frame of the lantern consists of cast iron end pieces having rectangular legs attached to the base. To the sheet iron top is attached a tall chimney, having a cowl at the upper end for confining the light. Opposite sides of the upper portion of the frame are provided with hinged sheet iron doors. The lower part of the lantern frame is provided with hinged removable doors, which may be used to close in the light.

The front is furnished with a plate hinged to swing in a vertical plane, and provided with a cell for containing the outer lens of the condenser. The axis of this lens cell coincides with that of a similar cell supported by the front end piece of the frame and containing the inner lenses of the condenser. The inner lens of the condenser is a plano-convex 4 inches in diameter and of 8 inch focus, arranged with its plane side toward the light. The two outer lenses are plano-convex 5 inches in diameter and 8 inches focus, arranged with the convex faces adjoining. The distance between the lenses is $\frac{1}{8}$th inch. The combined focal length is about 2 inches, measured from the plane face of the rear lens.

Prof. A. K. Eaton, of Brooklyn, has devised a condenser in which the inner lens is a meniscus and the outer and larger ones are crossed lenses. It is used in many scientific lanterns and is very effective.

The outer or movable lens cell projects beyond the hinged plate, and receives a split ring provided with a shallow internal groove, which fits over a corresponding circumferential rib on the lens cell. This split ring has a tangent screw for drawing it together, so as to cause it to clamp the lens cell. It is also furnished with an ear, into which is screwed a bar parallel with the axis of the lens cell. To this bar are fitted the slide support, the supports of the projecting lenses, the apparatus for microscopic projection, the polariscope, the adjustable table for holding tanks, pieces of apparatus, etc.

As represented in Fig. 1, the lantern is arranged for the projection of pictures, diagrams, and such pieces of apparatus as will go in the place of an ordinary lantern slide. The objective is a one-quarter portrait lens of good quality. For the support of tanks and other vessels for projection, the table shown in Fig. 2 is used in place of the slide holder.

The attachments shown in Fig. 2 are employed for the projection of microscopic objects. The engraving shows the polariscope in place; but this may be removed by simply taking the short tubes which contain the prisms of the polarizer and analyzer out of the sleeves, *g*, *f*. The stage is arranged so that it may be revolved either with or independently of the polarizer, and the latter may be revolved independently of the stage. The objectives are supported by a

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* From "Experimental Science," by Geo. M. Hopkins, in press Munn & Co., publishers, New York.

movable plate, which swings so as to bring either of the objectives into the position of use. A small conically-pointed spring bolt locks the plate in either of its three positions. When it is desired to use a larger objective, the plate may be swung below the supporting bar, when the objective may be inserted in the sleeve, *f*. This arrangement admits of applying a system of lenses for wide-angled crystals.

In the projection of microscopic or polariscopic objects it is advisable to always interpose the alum cell or water tank, *h*, between the condenser and the Nicol prism or the object, to intercept the heat, and thus prevent injury to the prism or object.

The table, *i*, which supports the tank, *h*, is made adjustable as to height to accommodate different objects or pieces of apparatus. In front of the microscope attachment is supported a centrally apertured disk, which prevents stray light from reaching the screen.

The sleeve that supports the objective holder and the sleeve, *f*, slides on the tube, *a*, fitted to the support bar, and is provided with a pinion which meshes into the rack on the tube *a*. By means of this pinion the objectives, together with the sleeve, *f*, are moved out or in for focusing.

In Fig. 3 is represented a polariscope for large objects, which is constructed according to the plan of Delezenne, but modified by the writer so as to utilize a right-angled totally reflecting prism, such as is used for presenting objects right side up on the screen; also for throwing the beam horizontally from the vertical attachment, as will be described later on.

The black glass polarizing mirror, *d*, is arranged at the polarizing angle in the path of the cone of light proceeding from the condenser. Below the mirror, *d*, is supported the right-angled prism with its reflecting side parallel with the mirror, *d*. The beam of light thrown downward by the black glass is thrown forward by the prism. A revoluble stage, *c*, and a tube, *d*, containing an objective and analyzing prism, are supported with their axes coincident with that of the light beam proceeding from the prism, *e*. Focusing is effected as in the other case. This arrangement is particularly adapted to the projection of designs in selenite or mica, mica cones, semi-cylinders, and specimens of stained glass.

There is an inappreciable loss resulting from the angle formed by the 90° sides of the prism with the incident and emergent beams. The polarizer works very perfectly, and costs only a

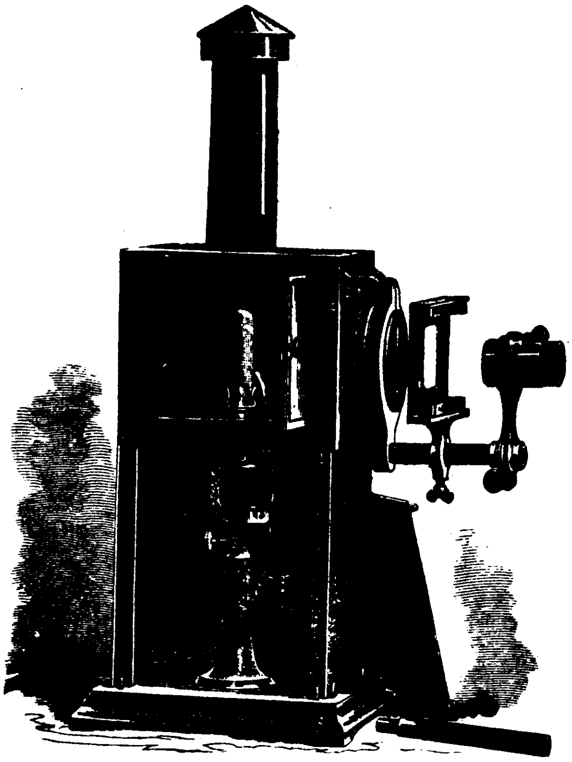

FIG. 1.—SCIENTIFIC LANTERN.

small fraction of the amount required to purchase a Nicol prism of the same capacity. It cannot, of course, be revolved; but the object and the analyzer can be turned, which is sufficient. Very good results can be secured by employing a plane mirror in place of the reflecting prism. The bar which projects from the front of the lantern is made in two sections, connected by a close-fitting bayonet joint.

For such objects as must lie in a horizontal position when projected, the hinged plate which supports the outer half of the condenser is raised into a horizontal position, and a triangular casing containing a mirror is placed underneath it. The attachment is provided with short studs, which enter the

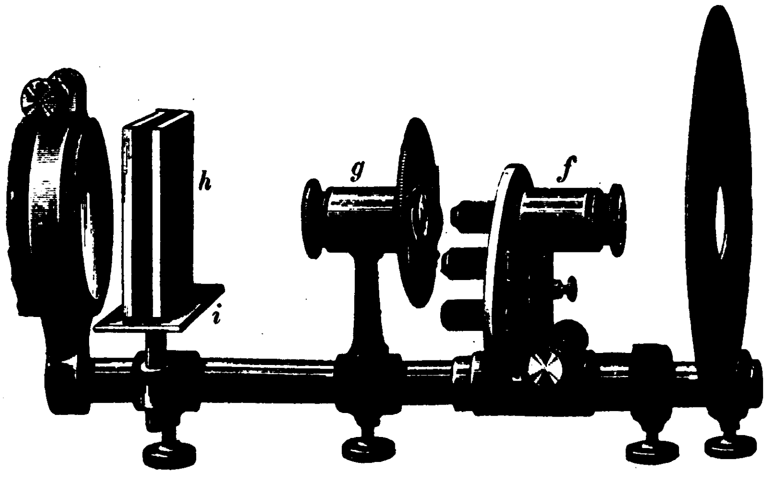

FIG. 2.—MICROSCOPE ATTACHMENT.

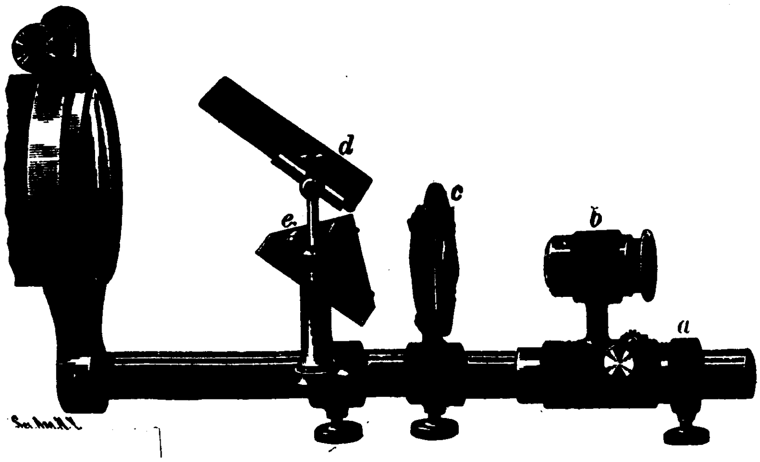

FIG. 3.—LANTERN POLARISCOPE.

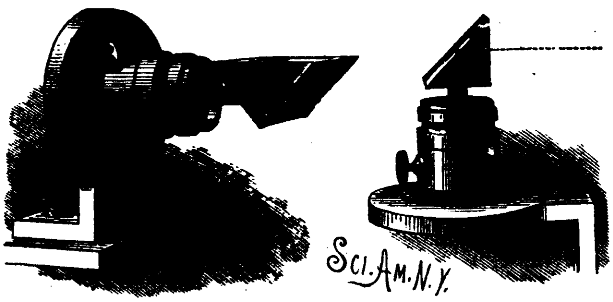

FIG. 5. FIG. 4.

APPLICATION OF THE 90 DEGREE PRISM.

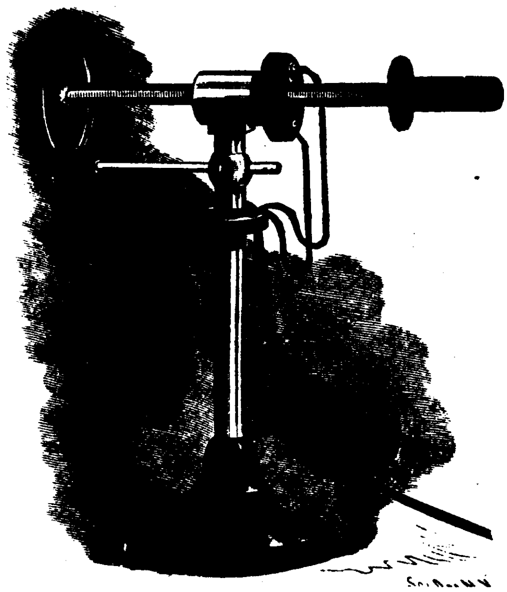

FIG. 7.—ARRANGEMENT OF ELECTRIC CANDLE FOR LANTERN USE.

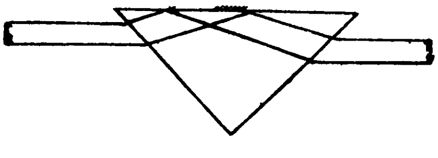

FIG. 6.—COURSE OF THE RAYS THROUGH THE ERECTING PRISM.

front of the lantern and the hinged plate, and hold it in position. The reflecting prism (Fig. 5), or a plane mirror, is placed over the object to direct the light to the screen.

The improvements in the lantern and the attachments thus described are the result of a long experience with lanterns of various kinds. It is believed that it fulfils most requirements. It can readily be adapted to all the uses for which a scientific lantern is required.

To prevent the escape of stray light a wire frame is attached to the body of the lantern, so as to support a black cloth canopy, which covers the entire front of the lantern and extends downward below the support bar. It is provided with an aperture in front for the passage of the projected beam. In addition to this protection, the larger objectives may be provided with disks like that shown in Fig. 2. These precautions in regard to the escape of light are particularly necessary in microscopic and polariscopic projection, which require a thoroughly darkened room. In the projection of plain microscopic objects, it is found advantageous to place a plano-convex lens of three-fourths inch focus behind the stage.

An analyzer, formed of a series of three glass plates, and arranged to show both transmitted and reflected beams, is desirable. By a second reflection of the reflected beam it may be combined with the transmitted beam, showing that the reunion of the complementary colored beams produces white light.

In Figs. 4 and 5 are shown two applications of the 90° prism. In Fig. 4 it is shown in position for erecting the image produced by the lantern. The course of the rays is clearly indicated in Fig. 6.

The totally reflecting prism, when used to render the beam horizontal in a vertical lantern, is arranged as shown in Fig. 5; *i.e.*, with one of its faces at right angles to the beam, and with its reflecting face at an angle of 45° with the beam, or approximately so.

Probably the most desirable source of light for all purposes is the oxyhydrogen or calcium light. The burner shown in Fig. 1 is an excellent one. It is provided with a platinum-tipped jet and is arranged for every adjustment. The lime cylinder can be revolved and raised or lowered. The jet may be adjusted relatively to the lime so as to secure the best results. As the gases are mixed inside the burner, they should be taken from tanks or cylinders in which considerable pressure is maintained. Gas bags are unsafe when used in connection with a burner of this kind.

In the electric lamp shown in Fig. 7, a Jablochkoff candle is employed. It is superior to the calcium light, and gives very little trouble when an alternating current is available. The carbons being presented end on to the object yield nearly all their light in one direction, so that the loss of light is less than in the case of the ordinary arc lamp. The candle is coincident with the prolongation of the axis of a helix supported near the luminous point. The current that supplies the candle passes through the helix. In consequence of this the arc is drawn to the end of the candle in opposition to its tendency to follow the carbon rods. The candle can be moved forward as it is consumed by grasping the insulating handle at the rear end. Electrical contact is established with the rods by two copper springs contained in the revoluble support of the candle. When a direct current is used, a quick-acting current-reversing switch is required, as in this case the current must be reversed frequently to cause the carbons to burn evenly.—*Scientific American.*

MIXTURE FOR WRITING ON GLASS.

The preparation for writing on glass called "diamond ink," says the *American Druggist*, is to be used with a common pen, and at once etches a rough surface on the parts of the glass it comes in contact with. It proves to be a very useful article for labeling bottles which are to contain liquids that will destroy common labels.

At the request of Professor Maisch an analysis was made, which proved it to be prepared ammonium fluoride, barium sulphate, and sulphuric acid. The barium sulphate seems to act as an absorbing medium, and when the semi-fluid mass is used, it makes a white mark, and prevents the spreading of the watery liquid; it also seems to make the acid etch a rougher surface.

It is made by mixing barium sulphate three parts, ammonium fluoride one part, and sulphuric acid a quantity sufficient for decomposing the ammonium fluoride and making the mixture of a semi-fluid consistency.

The sample examined was contained in a glass bottle holding nearly two fluid drachms, and which was thickly coated on the outside with asphaltum, on the inside with a thick stratum of beeswax, and was stoppered with a rubber stopper.

It is claimed by the manufacturer that the mixture contains no hydrofluoric acid and does not corrode a pen; but of course it does corrode a pen, and hydrofluoric acid is the one thing that does the etching. Any one making this mixture and wishing to keep it in a glass, may coat the bottle inside with paraffine, beeswax, or rubber. It should be prepared in a leaden dish, and is preferably kept in a gutta-percha or leaden bottle.

PATENTS.*

The earliest laws of which we have any knowledge, that granted privileges and favors to persons who had made valuable improvements or inventions to relieve suffering and benefit humanity, were enacted in England less than one hundred years ago.

There was a system established during the reign of Elizabeth and the Stuarts that became odious. It was not a legal right, but a royal favor, and related to other things besides inventions, and extended to many articles in common use.

In the reign of James the First a law was passed known as the Statute of Monopolies, declaring all monopolies illegal and void, except copyrights and patents, which were granted for fourteen years.

This system, though somewhat modified, has become the established policy in this country, and is substantially a copy of the English law, in order to secure reward to the inventor.

There are some persons in our profession who think it is unprofessional to take out patents, but what would have been the status of dentistry to-day without the stimulus of reward for useful and improved appliances in the dental art?

Our country is a new world, and the American dentist is comparatively a new man; and the sooner he learns to do business on a plan that corresponds to the age in which he lives, the better it will be for himself and those who seek his services.

The men who invent are thinkers; they are persons of adaptation and consecration; they are, and have been, benefactors to their brethren, and, as a rule, they suggest and give away to their co-workers little suggestions without money and without price, to make dental operations easy, more than all the money they receive for their patents.

Inventions are the products of the brain, and they are just as legitimate as the labor of the hands. A certain orator was once asked how long it had taken him to prepare his oration? he replied, "Just forty-four years, for I am just forty-four years old, and I have given my whole life to this work."

I do not wish to be understood as advocating the giving patents away, for it is never best to give something for nothing, and the Creator does not deal in that way with His children in the various departments of nature. Everything is dual, and inventors are seers in mechanics, their minds become illuminated with visions of uses for the benefit of their fellows, and usually the whole working of the improvement is wrought out in the night, when the body is at rest, and we commune with ourselves without interruptions.

Almost all the improvements that have benefited the race have been first thought out and then wrought out to make us great as individuals or a nation.

It is the function of the brain to think, and the hands to execute the thought. The older men of the profession will recollect the ridicule that was hurled upon Dr. Atkinson and the use of the mallet in impacting gold in filling teeth some thirty years ago, and now we bring to its aid the various machines and electricity.

The unprecedented growth of our profession over either of the older professions is due largely to our freedom from the conventionalities that bind all professions to the past. Any innovations to long-time usages are almost certain to prove disastrous to those who discover the "new and more excellent

* Extracts from an article by J. A. Robinson, D.D.S., in the "Archives of Dentistry."

way." The things we invent are children of the intellect and the affections. Man has no power to make or improve a thing without a love manifested toward the thing he desires to make better. The man who invents sees the improvement he wishes to make as we see the solar light before the sun makes his appearance in the morning.

One of the hindrances to our free use of improvements is that they have been bought up and laid aside by monopolies because they interfered with the sale of goods already in the market, and that has discouraged men of genius from trying to make appliances that would benefit the profession.

TELEMETER SYSTEM.

The uses to which the telemeter may be applied are so numerous and so varied as to render it impossible to describe them all in detail within the limits of a single newspaper article. Some of the more prominent uses to which this instrument is applied are the transmission to one or more distant points of the indications of thermometers, barometers, and pressure gauges ; also for indicating at a distant point the height of water or oil in open or closed tanks, or the height of gas holders.

To accomplish the transmission of these indications two instruments are required, one for transmitting and the other for receiving and recording, the two instruments being connected by wires so as to form complete electrical circuits, which are supplied with a current from a suitable open circuit battery. A number of receiving instruments may be used in the same circuit.

The telemeter system has been in practical operation for a number of years, proving itself to be accurate and reliable in all of its applications. It has recently been much simplified and improved, both mechanically and electrically.

One of the uses to which the telemeter has been applied is that of transmitting time from a master clock to a series of dials. In this particular application its merits have been shown to the best advantage. As a time system, it has proved accurate and in every way desirable.

The transmitting instrument is substantially the same for all uses, and the receiving instrument is, in part, a copy of the transmitter, with the addition in some cases of apparatus for making a permanent record. The receiver is also provided with an alarm for giving notice when the prescribed maximum or minimum indication is reached. As indicated by the illustrations, the mechanism of the instrument is very simple and of such a character as to require no attention after being placed in position for use.

Without going minutely into detail, the operation of the apparatus may be briefly described as follows :—

The transmitter has a step-by-step motion, which is provided with two magnets, one for turning the step-by-step motion in one direction and the other for turning it in the opposite direction. These magnets are in separate local circuits, each of which is provided with an auxiliary armature and contact closer, so that when the current is supplied to the magnet its armature will be attracted, and through the medium of the pallets and motor wheel will rotate the index arbor. The transmitting instrument with the dial removed is represented in Fig. 1.

The apparatus thus described appears on the front of the base plate beneath the glass of the case. The complete mechanism is here shown, with its electrical connections. The thermometer, pressure gauge, or other primary instrument whose indications are required is placed back of the transmitting mechanism in such relation to the latter that the movements of its hand will close the circuit-controlling devices.

The receiver is provided with step-by-step mechanism like that of the transmitter, but the contact makers are omitted. Each magnet of the receiver is connected by a line wire with the circuit closer of the corresponding magnet of the transmitter, the latter acting as a relay for closing the circuit through the receiver, so that every impulse of either of the magnets of the transmitter is repeated by the corresponding magnet of the receiver, thus turning the index arbor of the receiver synchronously with the index arbor of the transmitter. By this action of either of the magnets of the receiver the circuit is broken and the mechanism of both transmitter and receiver is moved one step, and the instruments are both ready for a new impulse in either direction from the primary instrument.

When it is desired to preserve a record of the indications of the receiving instrument, a toothed sector is attached to a shaft journaled in the frame of the instrument and arranged to be engaged by a pinion on the index arbor. This toothed sector carries an arm provided at its free end with a pen which rests upon a graduated paper dial carried by a clock movement arranged in the lower part of the receiver case, as shown in Fig. 2. These graduated dials and the clocks to which they are attached are adapted to either daily or weekly records, as desired. A part of a day's record is shown in Fig. 3. The circuits are shown diagrammatically in Fig. 5.

These are described as follows :—

a, hand carried by thermometer, and arranged to give the initial contact. a', a'', insulated spring-supported contact points. a^1, wire connecting contact point, a', to screw, 2, and magnet, M^2. a^2, wire connecting contact point, a'', to screw, 1, and magnet, M. 1, 2, contact screws insulated from the base of the transmitter. 3, 4, contact springs fastened to initial armature. 5, 6, light armatures connected together, pivoted between the plates of the transmitter, and normally held in the central position, so as to bear on the faces of their respective magnets. 7, 8, insulated contact screws. 9, 10, contact springs fastened to the driving armatures and electrically connected to the base of the transmitter. 11, 12, armatures carried by the pallet lever for driving the machinery of the instrument. 13, circuit-breaking lever connected electrically with the plates of the instrument. 14, spring of the circuit-breaker insulated from the base of the receiver and connected electrically to one pole of the battery, B. 15, lever for holding the pallets in the central position. 16, pawl for holding the driving wheel, W, in its normal position. 17, 18, pins in the fork to act upon the incline of the lever, 15. W, driving wheel pivoted between the plates and used in all instruments. L^1, line connecting magnets, M^1 and M^2, of the transmitter to the base of the receiver. L^2, line connecting insulated part, 7, of transmitter with magnet No. 3 of the receiver. L^3, line connecting insulated part 8 of transmitter with magnet No. 4 of the receiver. 4 B, line connecting the base of the transmitter with one pole of the battery, B. M^5, M^6, magnets of intermediate receiver connected to lines connected with corresponding magnets of the receivers. The operation of the apparatus is as follows :—The hand, *a*, which is always in connection with the battery, moves and makes contact with the commutator point, a'', thus closing the circuit. The current passes through the line, 4 B, thermometer hand, *a*, commutator, a'', wire, a', and magnet, M', then from the transmitter through line, L', to the base of the receiver ; from thence

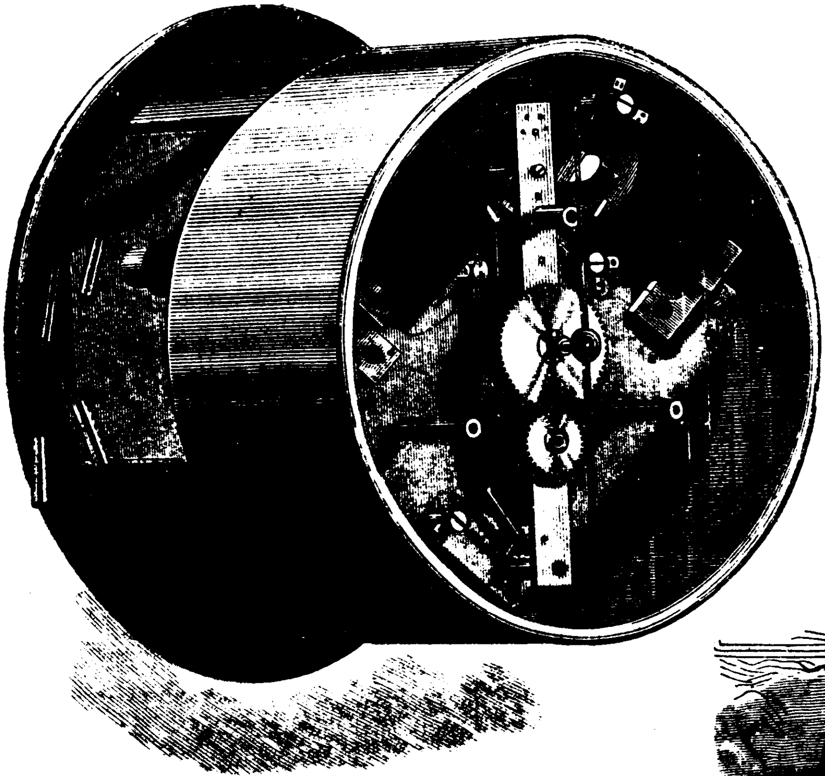

Fig. 1.—Telemeter System—The Transmitter.

Fig. 9.—Tele-Thermometer —a Mine.

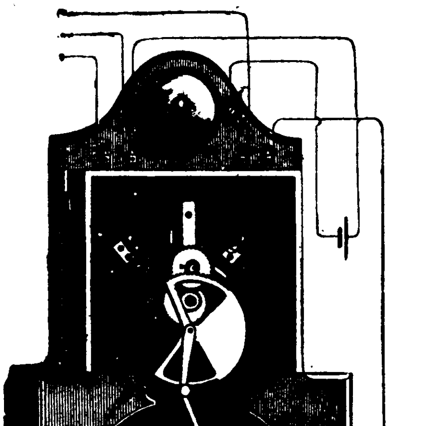

Fig. 2.—Recording Receiver.

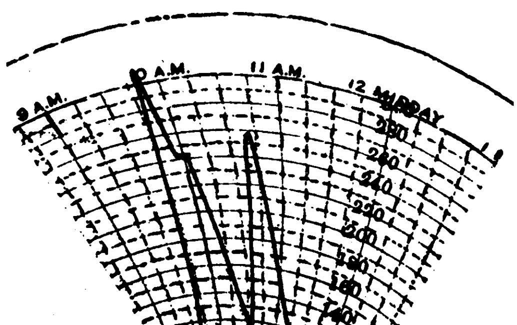

Fig. 3.—Part of a Day's Record.

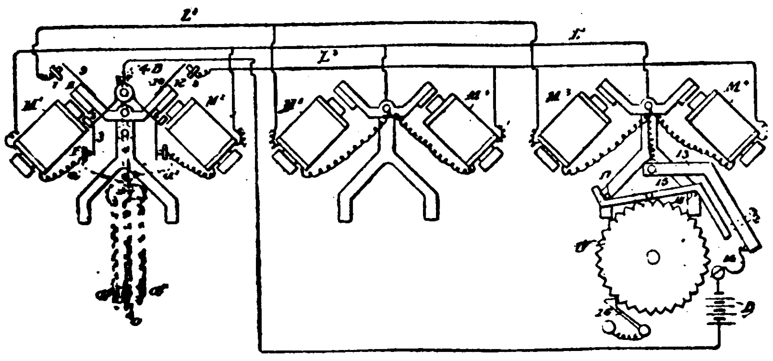

Fig. 5.—Diagram of Circuits.

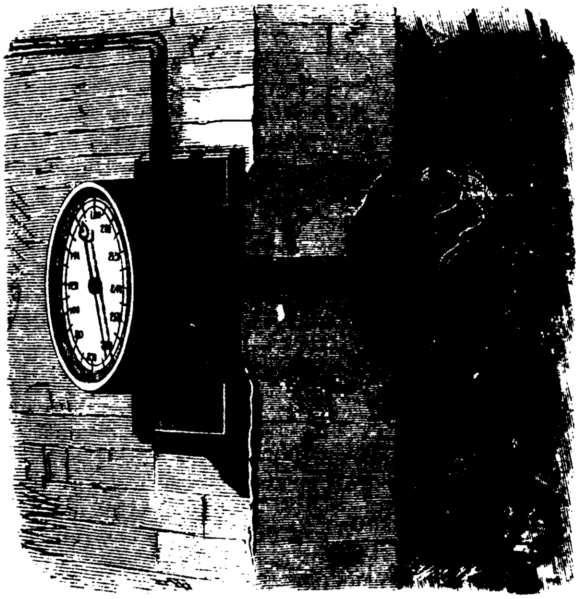

Fig. 6.—Tele-Thermometer.

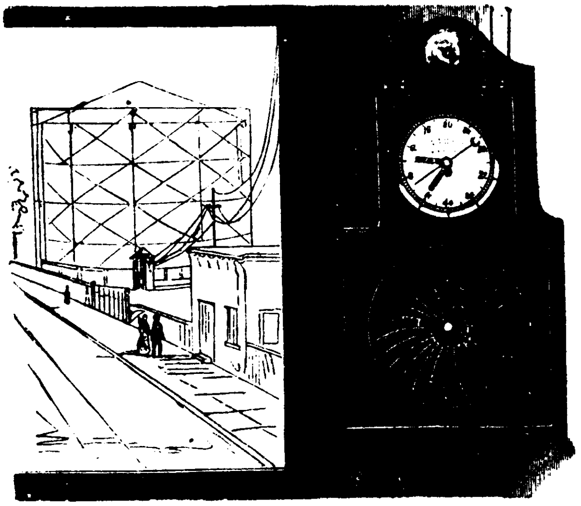

Fig. 8.—Telemeter Applied to Gas Holder.

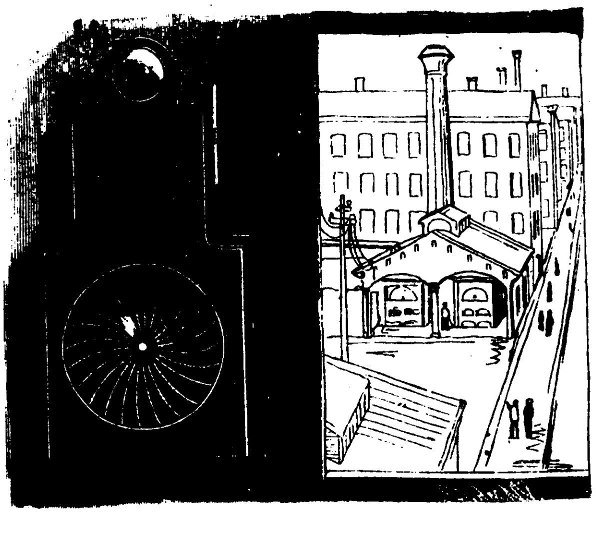

Fig. 7.—Tele-Manometer.

Fig. 10.—Tele-Hydrobarometer.

through lever, 13, and spring, 14, to the battery. The light armature, 5, will be attracted by a feeble current, bringing the spring, 3, in contact with screw, 1 ; shunting the commutator, which will be moved away from its contact with the hand by the mechanism of the instrument. The armature, 11, being attracted by magnet, M′, brings the spring, 9, in contact with the screw, 7, dividing the current which passes through the line, L^2, magnets, M^5, of the intermediate magnet, M^6, of the receiver to the base of both instruments; through the lever, 13, and spring, 14, to the battery. The armature of the magnet, M^3, is attracted, carrying the fork or pallets which propel the wheel, W, and also by means of the pin, 18, pushes lever, 15, so that it strikes the adjustable screw in the lever, 13, throwing it away from its contact with spring, 14, breaking the circuit and allowing the instruments to return to their normal position.

In Fig. 6 is shown the application of the tele-thermometer to a japanning oven. The thermometer spiral extends into the oven, and its shaft passes through a tube to a transmitting instrument attached to the outer surface of the oven wall. This tele-thermometer with ordinary pipe fittings can be attached to any boiler tank or pipe to show the temperature of the liquid, gas, or steam contained therein. Wires leading out of the top of the instrument extend to a receiver at a distant station.

In Fig. 7 is shown one of the important applications of the telemeter. The transmitting steam gauge upon the boiler in the distant boiler house sends its indications through the wires to the receiving instrument, where it indicates the boiler pressure, and also makes a continuous and accurate record, the receiver being removed to a safe distance from the boiler house, where the records will be out of danger of destruction by an explosion, should one occur. It will be noticed that in this, as in the other receiving instruments, an alarm bell is shown which is set in operation by an extreme movement of the index in one direction or the other.

A similar application of the telemeter is shown in Fig. 8. In this case the transmitting instrument is connected with a gas holder, and the indications of the height of the gas holder are transmitted to the receiver at the distant station. Here, also, a record is made from which at any time the cubical contents of the holder may be determined.

In Fig. 9 is shown a tele-thermometer located in a mine, the receiver being above ground; and in Fig. 10 is represented a water level indicator capable of giving the height of the water in reservoirs, dams, and streams, and showing the rise and fall of tides at distant points. This application of the telemeter will be readily understood from the illustrations.

It is obvious that there are various other uses to which these instruments may be applied. For instance, they will prove of great value in connection with meteorological instruments, transmitting dynamo-meters, speed indicators, etc. They may also be utilized to advantage for indicating the height of water or oil in boilers or tanks under pressure. They may also be employed as deep-sea thermometers and for indicating the temperature of the sea in the track of sea-going vessels, keeping a record of the temperature during their voyage.—*Scientific American.*

THE NEW PROCESS FOR SOFTENING STEEL.

The new process for softening steel known as Dalzell's process, has recently been brought into practical use, and seems to be attracting much attention because of the remarkable softness produced. It is said that by this process any of the ordinary steels, of the usual lengths and shapes, for making machine tools, punches, and dies, will, when treated, become so soft as to effect a most material saving in the cost of making the desired tool. After having been softened and cut to the required form, the steel is handled in precisely the same way as any of the well-known brands, such as Jessup or Black Diamond. It is claimed that the process, which is kept secret, affects in no way the chemical composition of the metal, but so alters its physical structure as to impart the qualities mentioned. A piece of Jessup steel which had been softened by this method was taken to the Stiles and Parker Press Co., who made a punch to cut a five pointed star seven-eighths inch in diameter and unusually sharp at the points. According to the instructions given, the punch was to be made and then tested by the Stiles and Parker people. In the making of this punch they saved about 20 per cent in the cost, owing solely to the softness of the metal. After having cut it, they tempered it in the usual way in water. The punch was then forced through German silver 3.32 inch thick, and through wrought iron 3 16 inch thick, and as a final test was forced through metal which cut only a part of the star, thus giving an unbalanced pressure tending to bend the punch. It was given a series of tests, not only unusual, but which would not be tried except under like conditions, where the manufacturer is instructed to give the tool the severest trial possible, and where, as is natural, he passes from one test to another more severe. The tool came out at last as perfect as when it left the makers' hands.

According to this it seems evident that the process while softening the steel, at the same time so changes it that when tempered it possesses greater strength than the same quality of metal untreated. The process is particularly applicable to die-sinking, where the hub, being of softened steel, can be made in much less time, while the die, also being softened, can be sunk cold instead of hot, as is now the common practice, thus saving time and labor. The die is then tempered and hardened in the usual way. It is claimed that this process changes what we might name the final quality of the metal, so that its strength in high grades is increased at least 25 per cent. In handling the steel during the making of any tool, it is absolutely necessary to perform all operations cold, as the heating of the metal destroys the qualities imparted to it in the softening process. After having been treated, the steel can be forged cold, can be twisted or bent in a way it would not stand before treatment, and can finally be tempered as desired. Any of the well-known brands of tool steel can be subjected to this process, and can afterward be treated in the usual way.—*Mining and Scientific Press.*

THE LUSTER OF METALS.

Dove was the first to attempt an investigation of the causes of metallic luster. He had examined, by the aid of a stereoscope, two images of a pyramid, one being colored blue and the other yellow, expecting to find a relief image of a green color. He was, however, astonished to find that the mixture of colors gave a reflection like that of a polished metallic surface. Having repeated the experiment, using a black and a white image, he obtained the metallic gray of lead and tin. Dove concluded that metallic luster is due to two reflections from superposed surfaces, and that the accommodation of the eye being different for each color, a perfect coincidence of the images of different colors was impossible. The luster of metals would thus be caused by a reflection from the actual surface and another from beneath the surface. This explanation attributes a considerable degree of transparence to the metals, more indeed than seems consistent with fact. Brück offered another theory, according to which the color of light reflected from bodies not possessing the metallic luster should be independent of the local color—that is, the color of the reflecting body—while in the case of metals the color of the reflected light is that attributed to the substance, the incident light being white. Brücke also considered that a certain intensity of reflection was a necessary condition for metallic luster, this intensity resulting from the opacity of the metals, and he mentions the phenomenon of total reflection as producing a perfect imitation of metallic luster. The theories of Dove and Brücke represent opposing views of the transparency of the metals; the one considers them as opaque, the other as transparent. Herr W. Spring (*Bul. Soc. Chim.*, 50, 219) endeavors to reconcile these views by a study of the nature of the surfaces of the solids he has obtained during his experiments on the compression of solids within polished steel cylinders. He finds that substances which in the form of powder are opaque produce solids that have a metallic luster, whatever the nature of the substance, while such substances as yield powders more or less transparent formed cylinders having vitreous surfaces, looking as if varnished.—*Scientific American.*

NICKEL BROMIDE.

Nickel bromide has been employed medicinally as a hypnotic and a sedative. According to Mr. A. Drew (*Amer. Jour. Pharm.*), it may be prepared conveniently by treating granulated nickel with bromine under water, and carefully evaporating the dark green solution, when the salt is obtained in deep green deliquescent crystals, freely soluble in water, but much less soluble in alcohol. The salt is conveniently administered in the form of a sirup, which may be prepared by placing 377 grains of bromine and 137 grains of nickel in a flask containing 12 ounces of water, digesting at a gentle heat until the reaction has ceased, filtering, and then adding 24 ounces of sugar and sufficient water to make 32 fluid ounces. The sirup, which is of a beautiful green color, contains in each fluid drachm 5 grains of crystallized nickel bromide, which is an average dose.

TO RESTORE THE FRESHNESS OF WORN CLOTHING.

The mystery to many people how the scourers of old clothes can make them almost as good as new is explained in the *American Analyst* as follows :—

Take, for instance, a shiny old coat, vest, or pair of pants of broadcloth, cassimere, or diagonal. The scourer makes a strong, warm soapsuds, and plunges the garment into it, souses it up and down, rubs the dirty places, if necessary puts it through a second suds, then rinses it through several waters, and hangs it to dry on the line. When nearly dry, he takes it in, rolls it up for an hour or two, and then presses it. An old cotton cloth is laid on the outside of the coat, and the iron passed over that until the wrinkles are out; but the iron is removed before the steam ceases to rise from the goods, else they would be shiny. Wrinkles that are obstinate are removed by laying a wet cloth over them, and passing the iron over that. If any shiny places are seen, they are treated as the wrinkles are; the iron is lifted, while the full cloud of steam rises, and brings the nap up with it. Cloth should always have a suds made specially for it, as if that which has been used for white cotton or woolen clothes, lint will be left in the water, and cling to the cloth. In this manner we have known the same coat and pantaloons to be renewed time and again, and have all the look and feel of new garments. Good broadcloth and its fellow cloths will bear many washings, and look better every time because of them.

THE JOHNSTOWN HORROR.

Though the Johnstown disaster occurred more than two months since, the interest of the public in so remarkable an event has not ceased to be active. H. S. Goodspeed & Co., of New York, have just issued a very complete and richly pictorial history of the event, which is a work of the deepest interest and power. No reader will care to lay aside this thrilling narrative unfinished. In the world's horrible records of evil wrought by the untamed forces of nature, few catastrophes have been more heart sickening. The fearful loss of life, the vast waste of property, the great interruption to business, destroying the complex machinery which fed so many thousands and contributed to the interests of the whole land, are hard to match. Death and ruin take a thousand shapes, but rarely have they assumed a guise so horrible as that in which they rushed down on the people of Conemaugh Valley. The record cannot fail to be of perennial interest, and to stir the hearts of all who read it for the next generation to come, for such a catastrophe, mercifully, comes but once in a century, if so often. Enough time has now elapsed to enable the proper verification of the facts to be made, and a careful and studied statement to be given to the public worthy of so startling a subject. Any hurried and hap-hazard narrative of an event which stands so unique in our history, is far from doing it even partial justice. The author has given us in this book a record both vigorous and accurate, and every reader should have the work in his hands. The book is an octavo handsomely printed and bound, and contains 522 pages, embellished with forty-eight fine full page illustrations. Agents are wanted. H. S. Goodspeed & Co. pay all the duty.

AN EARTHQUAKE.

On Wednesday, at about 4.45 a.m., we experienced here the heaviest earthquake since the memorable one of 1868. One occurred May 19th which was quite sharp, but that of Wednesday was more severe, though it only lasted about 14 seconds. It was felt at Napa, Oakland, Benicia, San Leandro, Petaluma, Santa Cruz, Mt. Hamilton and elsewhere. No special damage was done, though a few buildings and chimneys were cracked. Prof. Geo. Davidson says: "At my residence, Hyde, near California, the shock lasted 14 seconds. There was nearly at the middle of the oscillations a second shock. About 4h. 56m. there was a tremor of less than half a second's duration, up and down, and at 5h. 5m. a second tremor, slightly stronger, but of the same length.

"The main shock was east and west and gradually fell into oscillations running east-north-east and west-south-west.

"The amplitude of this earthquake shock is one-half greater than that of May 19th."

Astronomer Burckhalter, of the Chabot Observatory, Oakland, in speaking of the shock, said: "There is a great mistake as to the actual amount of movement of the earth in an earthquake. In the Chabot Observatory this morning the earth moved a little less than a quarter of an inch, and in

East Oakland, where the shock was heavier, it moved about 5-16 of an inch. An earthquake in which the motion was a half-inch would prove very disastrous, and yet people do not hesitate to say that they saw the earth move at least a foot. This earthquake was by far the heaviest ever recorded at the Chabot Observatory. It was at least 50 per cent heavier than that of May 19th, and that had been the heaviest up to that time."

Prof. E. S. Holden, director of the Lick Observatory, says: "Mr. Keeler, in charge of the earthquake instrument, has just measured the intensity of the shock of this morning. It recorded that the shock occurred here at 4h. 46m. and 45s., and lasted for 30 seconds. The extreme motion was from north to south. It was equal to 2-100 of an inch, and the east and west motion was about the same. The vertical motion was very small. The period of the wave was about 3·10 of a second, and its intensity is estimated at five."

At the students' observatory at Berkeley the shock was registered as occuring at 4.47 o'clock in the morning and lasting 15 seconds. The vibration was from north of west to south of east. It was followed by three slight ones at short intervals. Prof. Frank Soule says that this was the most severe earthquake that he has experienced since he came to California in 1869. He classes it as sixth in the Rossi-Forel scale—that is, one that throws down chimneys and small articles.

SEISMOGRAPH TRACING.

Prof. Davidson expresses the opinion that the quake is in no way connected with the Japanese catastrophe, but is of local origin, very probably linked with the phenomena of subterranean activity at Susanville.

Mr. F. G. Blinn, of Highland Park, East Oakland, has given us a tracing from his seismograph, which is reproduced herewith. The figure magnifies the motion four and eight-tenths times. According to his instrument, the actual motion of the earth was ·53 of an inch—a little over half an inch. The centre of the shock appears to have been near that locality; it was more severe in Fruitvale, to the eastward, where some chimneys were thrown down and glass broken. The shock was felt some seven seconds later in San Francisco than in East Oakland, and appears to have been lighter outside of the latter point.

Mr. Adley H. Cummins, a scientist, who has lectured several times before the California Academy of Sciences, was so startled by the earthquake shock that he died. Mr. Cummins had been suffering from heart disease.—*Mining and Scientific Press.*

RADIATOR OF NEW DESIGN.

The accompanying engravings represent a radiator adapted for warming buildings by means of either hot water or steam. The exterior appearance, Fig. 1, shows a marked departure in general design that commends itself for its unique and novel character; Fig. 2 shows the interior construction, how circulation is conducted, and the way of connecting the tiers of sections. To this sectional view special attention is called, as it illustrates very clearly the general arrangement of the different parts. It will be seen that the water circulates through radiators of this construction horizontally, going first to the top section, and thence right and left to the bottom one, where it reaches the return pipe. It is claimed that this circulation has less interruption and less friction to overcome than any other. When the pipes or conduits in a radiator are set perpendicularly, the circulation (which is caused by gravity, or the tendency of the colder and therefore denser and heavier water to flow downward), must be interfered with when its course lies upward, as it does in a portion of the pipes or sections of such a radiator. Besides, as air rises to the highest point in a radiator, each section, when set perpendicularly, affords opportunity for the collection and confinement of air, to the great detriment of the circulation, and would require an air valve for each section, besides the trouble of letting the air out of all of them. In this radiator a single air valve in the top section suffices.

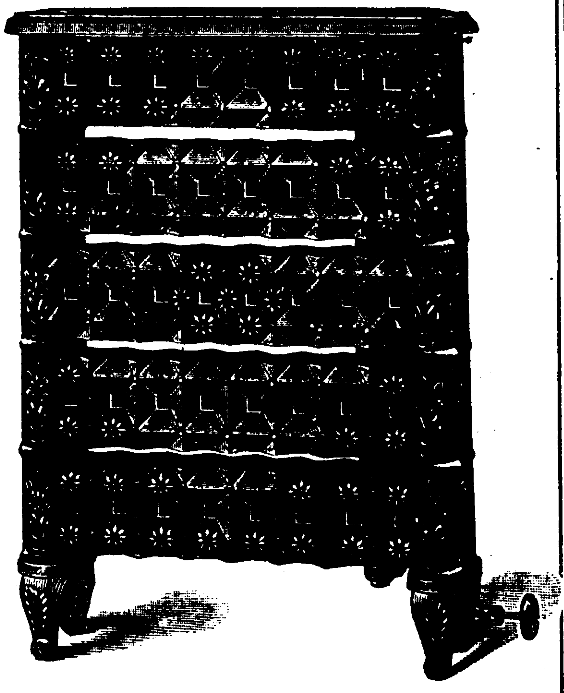

FIG. 1.

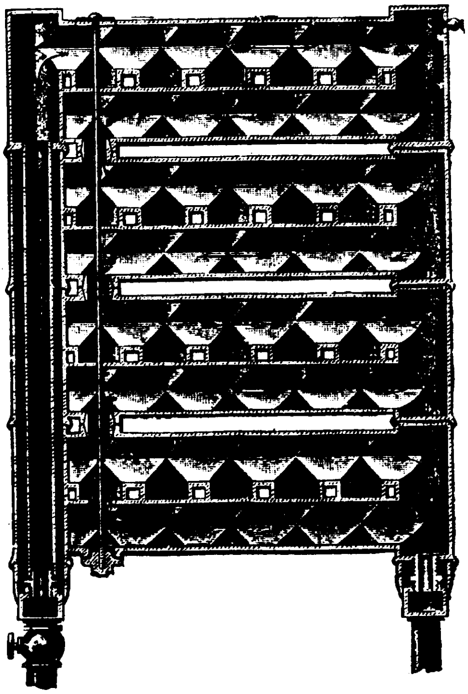

FIG. 2.

The radiator sections are connected with each other at one point only, therefore no straining of the joints and consequent leakage is possible, from unequal expansion, as is often the case when sections are connected at two or more points. This is a very valuable feature, which overcomes one of the troubles that frequently occurs.

A leaky radiator becomes a troublesome nuisance and the leak is almost always traceable to the excessive strain upon the joints, caused by the unequal expansion and contraction of the metal sections, where they are joined at two or more points, as above mentioned.

On reference to Fig. 2 it will be seen that the point of connection between sections is at one end of the sections, leaving the other or free end to expand or contract, as the case may be, without strain upon or detriment to the joints.

The polyhedral, or many sided, contour of these radiator sections gives more heating surface within a given space than can be had with plain surfaces. This economizes space and is very advantageous in confined situations, as under windows, etc.

The openings through the sections, and the manner of putting the double and triple radiators together, whereby an air space is left between the tiers of sections, makes excellent provision for the circulation of air through and between them.

These radiators are perfectly adapted for use with steam, their construction being such that no pockets or dips can fill with water, from the condensation of steam, therefore, when properly piped, no "pounding" is heard, as a result of intercepted steam circulation.

The prominent exterior lines of the sections can be drawn in squares or diamonds, which renders it possible, when the radiators are made up, to ornament them in an almost endless variety of designs.

The radiator has been named the "Packer" and is constructed in various sizes by the David Bradley Manufacturing Company of Chicago, from whom all further information can be obtained.—*American Engineer.*

A NEW CEMENT.

London *Industries* describes a new cement which has recently been devised, and which is said to harden very quickly, and has been found to be of great strength. That journal says that this cement, by which many stone buildings in Paris have lately been renovated, is likely to prove useful also in repairing the foundations of machinery. The powder which forms the basis of the cement is composed of two parts oxide of zinc, two of crushed hard limestone, and one of pulverized grit, together with a certain proportion of ochre as a coloring agent. The liquid with which this powder is to be mixed consists of a saturated solution of six parts of zinc in commercial muriatic acid, to which is added one part of sal-ammoniac; this solution is diluted with two-thirds of its volume of water. A mixture of one pound of the powder to 2½ pints of the liquid forms a cement which hardens very quickly and is of great strength.

INCREASING THE DENSITY OF STEEL.

In working steel by hammering, or drawing it down by the process of rolling, it is a well-known fact that the steel forming the corners becomes more dense by the operation, or has the appearance of being refined, for where drills for cutting stone are used they are found to work much better by having the bit or cutting edge come in line with these compressed edges. In rolling eight-square steel, the line of dense metal comes in the form of a Maltese cross, and as the bit of a rock drill, where power drilling is made use of, is something of the same form, care is taken to have them coincide. The etching process must show this action of steel to perfection, if a section could be worked off true and even, and polished. After hardening, the etching fluid will take hold of the softer metal with greater freedom, and bring out all the features that can be contributed to the action of the hammering or the refining from the rolling operation.

WHAT SALT WILL DO.

Salt in whitewash will make it stick better.

Wash the mica of the stove doors with salt and vinegar.

Brasswork can be kept beautifully bright by occasionally rubbing with salt and vinegar.

Damp salt will remove the discoloration of cups and saucers caused by tea and careless washing.

When broiling a steak, throw a little salt on the coals and the blaze from dripping fat will not annoy.

To clean willow furniture, use salt and water. Apply it with a nail-brush, scrub well and dry thoroughly.

If, after having a tooth pulled, the mouth is filled with salt and water, it will allay the danger of having a hemorrhage.

Salt as a tooth-powder is better than almost anything that can be bought. It keeps the teeth brilliantly white and the gums hard and rosy.

Carpets may be greatly brightened by first sweeping thoroughly and then going over them with a clean cloth and clear salt and water. Use a cupful of coarse salt to a large basin of water.

If the feet are tender or painful after long standing or walking, great relief can be had by bathing them in salt and water. A handful of salt to a gallon of water is the right proportion. Have the water as hot as can comfortably be borne.—*Exchange.*