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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 345,

For the Week ending August 12, 1882.

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MANUAL DEXTERITY.

From Boston on the east to St. Louis on the west, the changes are being rung on the necessity of teaching the fingers as well as the minds of school children. No well conducted teachers' institute fails to take a vote on it, and no educational magazine neglects to publish a paper on "Manual Education in the Public Schools." The great public sentiment seems to have, at last, come to the conclusion that not every free born American citizen can live by his wits, and a few must be content to turn their attention to manual labor, at least the more delicate kinds, and not, of course, such as shall raise big blisters on the finger and coarse calluses on the hands. The jack knife with which the typical school boy has been wont to carve rude characters on his desk and bench, is to be exchanged for a kit of tools, and the native instinct of "cutting" cultivated, instead of being repressed as it long has been—with what success a visit to any district schoolhouse will show. Those fingers which schoolmasters have been wont to look upon as of no other use but be cracked with an oaken ruler are to be dignified and exalted to a first place in our educational system; they are to be trained and taught to follow deftly the dictates of the brain, obedient to its every wish.

What better example of a perfect machine have we than the human hand! Remove the skin and the few little lumps of adipose tissue, and examine its intricate mechanism; its system of levers and pulleys, the economy of space achieved by one muscle passing through another, and the union of cords and tendons whereby one finger is given the power to move totally independently of the rest, and then attempt to calculate the number of movements imparted to the fingers by these few muscles. Watch the movements executed by the fingers of a musician, whether he plays the bass viol, the zither, or the piano; follow the hand of the compositor as he sets these very lines, of the type writer, the telegrapher, the rapid knitter, or a blind man reading raised characters, and tell us whether the hand is capable of being trained, or the fingers of being educated.

How many of the graduates who have this summer left their alma maters feeling that their education was completed, knew all the uses of their fingers, we are unable to say; but it is safe to assume that not one in ten had acquired more digital skill than was needed to write a letter, tie a necktie, button a lady's glove, and conceal "a crib" in his coat sleeve. It is a notorious fact that in every chemical laboratory, in every dissecting room, and every other place where young men of liberal education are compelled to handle tools, they soon find that their "fingers are all thumbs."

One of the first questions that is always discussed by every school board or institute before whom the question of manual teaching comes up is, Shall we teach only the use of tools, or shall we attempt to teach a trade and turn out finished mechanics? Do both, do either, do anything you like, only give the boys a chance, and leave the rest to time. If it has any vitality in it, it will develop into something. The useless members will wither and fall off, those most fit to survive will assuredly prosper, for the law of "the survival of the fittest" is not limited in its field to the growth of plants and animals. Cities and towns, trade and commerce, manufacturing industries, churches and schools, have their development conditioned thereby.

Boston, as usual, claims to lead in this movement. The Massachusetts Institute of Technology has been, under the late Professor Rogers, a remarkable success. Fightingits way against poverty and want, it has conquered all opposition, and Boston feels encouraged to try the experiment of incorporating manual education on her public school system. At the Dwight School a classroom has been sacrificed to the hammer and saw. Carpenters' benches have been put in, and tools provided for eighteen boys. It is needless to say that the boys need no coaxing, that it is more popular than military drill, and that even the time taken from study does not retard their progress.

There is probably no reader of this paper, certainly no inventor, who, if he is not familiar with the use of tools, does not feel that a few such lessons as that class get in sharpening, handling, and taking care of tools would not have been of as much use to him as all the Latin he learned in school, or that his time would not have been as well employed at that as in memorizing all the mountains in Asia or the rivers in Africa. This experiment may not prove a *financial* success in Boston, but we are satisfied that the idea will yet be made practical, and become in time a success.

Grant the desirability of such a modification of the school system, and practical difficulties will present themselves—have done so already. There is a lack of teachers: normal schools do not produce them, nor can they be found in the shops, although the latter can do more than the former. The number of good, thorough, enthusiastic teachers is small, because a good teacher, like a poet, is born, not manufactured in a normal school, and of this little band too few know aught about tools, or could lead and instruct a class in carpentry, while our best carpenters have as little conception of how to preserve discipline among school boys. Another difficulty is the expense; tools cost money, much more than books; wood must be used, and a fresh supply kept up. The pupils must not be asked to bear this expense, and tax payers object. This obstacle is a serious one in the free schools, where it is most needed.

It was not our intention to pass by the girls, but at present they are better provided for than boys. In Boston sewing is a regular part of the school curriculum, and they not only learn to sew but do it well. This is something that can be done at slight expense, and teachers that know how to sew are not so scarce. Mr. L. H. Marvel, in his paper on "Manual Education in the Public Schools," which appeared in the June number of *Education*, says that in schools where sewing is taught the sewing does not detract from the efficiency of the other work of the school. The same writer adds: "Sewing was taught in all elementary schools half a century ago, and to boys and girls alike." It is unfortunate that this has not been kept up; it is better that a school boy should sew or knit, than that his fingers should get no training beyond that of clumsily grasping a penholder, while his body is twisted into some painful position to conform to the unhygienic law of the writing master. In the kindergarten, which too few of our children enjoy the advantages of, efforts are made to train the eye, voice, ear, and hand, but the training stops when the child enters the school, and its effects are soon dissipated. One point must, of course, be guarded against, that the occupation of the fingers be not such as to *strain* the eye or produce nearsightedness.

An ingenious teacher would have no difficulty in arranging a series of exercises equal to any of the "finger gymnastics" of the music teacher, without being half so stupid, which should embrace the use of knitting, crocheting, and sewing needles, of stilettos and bodkins, of awls and gimlets, of scissors and penknife; braiding, plaiting, tatting, netting, tying knots, and splicing small ropes, are among the operations adapted to teaching boys and girls what their fingers are good for. One of our very skillful surgeons boasts of his skill in sewing, and the ability to hem the finest cambric handkerchief; and it would not injure any boy to be able to work a button hole, nor any girl to be able to tie up a bundle.

The sense of feeling, since it resides in the fingers, could be cultivated at the same time, and while the skin is young and soft is the best time to learn to distinguish things by touch; the difference between wool and cotton, silk and linen, kid and dog skin, sheep and calf, between flour and meal, between pure sugars and mixed, between silver and lead—these are distinctions a knowledge of which will be of practical value.

EARLY HISTORY OF GAS LIGHTING.

The city of Chaumont has taken the initiative in the erection of a statue in honor of Philippe Lebon, a native of Brachay (Haute-Marne), France, who, so the French claim, was the inventor of gas lighting.

Many managers and directors of gas works, and a number of scientific men throughout France, have promised the town of Chaumont their support. A provisory committee has been formed, with the mayor of Chaumont as an honorary president, and M. Foucart, president of the Technical Society of Gas Industry in France, as the active president.

In order to place before our readers the correct idea of Lebon's relations with this wonderful invention, we give the following brief sketch of the early history of gas making.

As early as 1726, Stephen Hales, in his "Vegetable Statics," states that he obtained 180 cubic inches of an inflammable gas from the distillation of 128 grains of Newcastle coal. Bishop Watson, in his "Chemical Essays," describes experiments made on coal gas, and says that it does not lose its illuminating power when passed through water. Lord Dundonald, of Scotland, took out a patent in 1787 for making coal tar, and erected ovens for this purpose. He obtained, besides the coal tar, a quantity of coal gas, which was burnt in Culcross Abbey and considered a great curiosity.

About the year 1792, William Murdoch, a Scotchman, living in Redruth, Cornwall, began making experiments, and found that when coal was heated in an iron retort an inflammable gas was given off, and with this gas he lighted his residence. Murdoch, possessing the characteristic slowness of his people, made no further use of the gas than burning it for the amusement of his friends, and it was nearly ten years before his invention was published abroad. In the meantime Philippe Lebon, mentioned at the beginning of this article, who was then engineer of bridges and roads, began making experiments by heating wood, peat, etc., in retorts, and found that these bodies, by the action of heat, yielded an inflammable gas, which could be used not only for illumination, but also for the production of heat and power. His apparatus he called a thermolamp.

According to French authors he lighted his residence in Paris in 1796. In 1798 he read a paper before the French Academy describing his thermolamp, and this paper was translated into English and German by Winsor. In 1799 he obtained a patent in France for producing gas from peat, etc., and applying it to purposes of illumination and heating.

Two years later the brother of James Watt, being in Paris, wrote to England, saying "that if anything were to be done with Mr. Murdoch's gas, it must be done at once, as there was a Frenchman in Paris who had similar ideas, and proposed to illuminate that city by these means." Even after receiving this broad hint, Mr. Murdoch took no steps toward securing his invention by a patent, little realizing that this simple invention, in less than a century, would be developed into one of the greatest industries in the world.

Lebon had received a theoretical education, and although his theories were good, there were practical difficulties in the way which he was unable to overcome, while, on the other hand, Murdoch was more of a practical man, and, therefore, was not hindered so much with practical difficulties, and for this reason he is considered the inventor of *practical* gas lighting, for, previous to his experiments, illuminating gas was only a curiosity, and by rendering its manufacturing practical he made it an everyday necessity.

In 1792 Murdoch lighted his workshop in Redruth with gas. The first more extensive gas work was established by him in 1802, at the Soho Foundry, near Birmingham, and in 1804 a spinning mill in Manchester was lighted with gas.

It was first introduced in this country in Baltimore in 1821, in Boston in 1822, and New York in 1827.

The reason why wood gas made by Lebon was inferior to coal gas, was afterward explained by Dumas, who proved that under the conditions of the distillation of wood employed by Lebon, the gas consisted largely of marsh gas and carbonic oxide.

Dr. Pettenkofer found that where the vapors of tar and empyreumatic oils, given off by the carbonization of wood at a comparatively low temperature, are further heated by passing through a red hot retort, a very large quantity of heavy hydrocarbon gas remains among the products, thereby greatly increasing its illuminating power.

One of the large gas companies in this city, the Mutual Gas Light Company, is at present engaged in the manufacture of gas from wood. All the other gas companies in the city, except two, are manufacturing gas from coal very similar to the manner pursued by Murdoch. The principal improvements which have been made have been in respect to its purification.

Lightning Rods.

During a recent thunder storm at Carrollton, Ill., the lightning struck the house of Mr. D. H. Gillespie, a resident of that city. The course of the electricity was as follows: Striking the lightning rod, on the top of the main part of the house, this conductor was followed until a point was reached about the middle of the peak; here, it is stated, was a bad connection which opposed the further passage of the electricity. It, therefore, here branched off down a tin gutter until arriving at the edge of the roof all conducting material ceased. The electricity then made its way across the wall, tearing off the weather boards *en route*, until another conductor was reached, this time a good one—a telephone wire connected with good earth; after reaching this wire the current passed harmlessly away into the earth.

We may here note that the house referred to was protected first, by a lightning-rod, and second, by a telephone line. It appears also that the lightning-rod, as usual, was not a well constructed one; while the telephone line (we are afraid *not* as usual), was well constructed, and, wonderful to relate, had a good and serviceable ground termination.

So long as irresponsible parties are suffered to carry on the lightning-rod business, so long must trouble and disaster be expected to ensue.

In the present case, the damage is ascribed to the defective connection at the middle of the roof. Partly, no doubt, such was the case; other elements, we think, had their share in the matter.

In the absence of a detailed description, we may assume that the lightning conductor had an imperfect ground connection, was fastened to the house with insulators, and probably did not extend to a sufficient height above the roof to be an efficient protection.

Also from the fact that the electricity left the conductor at a point on the ridge, it would appear that the said conductor extended for some distance horizontally; a position which for lightning rods is to be deprecated.

A lightning conductor fulfills two functions it facilitates the discharge of the electricity to the earth, so as to carry it off harmlessly; and it tends to prevent disruptive discharge by silently neutralizing the conditions which determine such discharge in the neighborhood of the conductor.

To effect these objects, the rod should extend to a sufficient height, to be the most salient feature of the building, no matter from which direction the storm may come. The size of the rod, if copper, should not be less than three-eighths of an inch, or if iron, not less on any consideration than nine-tenths of an inch. (We are aware that such a size will be considered preposterous by lightning-rod manufacturers, but such a size is the minimum of absolute safety.) The connection with the earth should be electrically perfect, should be branched in all possible directions, and if possible should be both soldered to gas or water mains, and to a plate sunk in moist earth. All joints should be soldered; and in no case should any portion of the rod run horizontally for more than four feet, unless ground connections are provided; where corners are to be turned they ought always to be turned with a gentle curve, and finally, lightning-rods should never be insulated from the building. Is it conceivable that a stream of electricity can jump from a cloud to earth, and can then be kept on an iron rod by half an inch of glass? We may rest satisfied that if a rod is otherwise properly constructed, atmospheric electricity will never leave a good metallic conductor for a poor wooden one.

Having noted these points, telephone men can appropriate to themselves a few lessons from them: First, that it is not safe to rely upon a lightning conductor for a ground. Second, always to be particular in constructing such a good ground wire, that a telephone ground wire shall be a synonym for a good one, as a lightning-rod ground is a bad one. Third, to have our ground wire large enough for the escape of heavy currents; this refers especially to the lightning arrester ground. Fourth, to run our ground wire to as many different points of communication with the earth as possible. Fifth, let your lightning arresters always be in good order, and your ground wires attached thereto, as straight as convenient. Finally, let us be particular in soldering joints, but if we never solder any other, let us never fail to solder the earth connection.

A telephone line is always a protection, but much more so, when properly installed, than when carelessly constructed.—*Review of Teleg. and Teleph.*

Impurities in Glycerine.

Under the title of "Adulteration of Glycerine," F. Jean contributes an article to the *Journal de Pharmacie d'Alsace-Lorraine*, in which he considers not merely adulterations intentionally added, but impurities due to carelessness in its manufacture or purification. Among them are oxide of lead, lime, and butyric acid. French perfumers and manufacturers of cosmetics test their glycerine with nitrate of silver. If no turbidity or change of color takes place in 24 hours, it is considered good.

The chloroform test for glycerine consists in mixing equal volumes of chloroform and glycerine, shaking thoroughly and then letting them stand. The upper strata is pure glycerine, while the lower one is chloroform containing all the impurities. If there were no impurities in the glycerine the chloroform remains unchanged, otherwise there will be a turbid layer just beneath the glycerine.

On adding a few drops of dilute sulphuric acid to a mixture of equal parts of glycerine and distilled water, and then a little alcohol, the presence of lime or lead will be shown by a white precipitate. The latter is reorganized by sulphydric acid, which turns the precipitate black.

Butyric acid is detected by mixing the glycerine with absolute alcohol and sulphuric acid of 66° B. On gently heating the mixture, the butyric ether is easily recognized by its agreeable odor.

Formic and oxalic acids are also found in glycerine, impurities which are of special importance to pharmacists.

They are detected as follows: Equal volumes of glycerine and sulphuric acid, specific gravity 1·83, are mixed together. Pure glycerine does not give off any carbonic oxide gas, but if either of the acids mentioned is present, an evolution of that gas will be observed. To decide whether both acids are present, and if not which one, some alcohol of 40° B. and one drop of sulphuric acid are added, and then gently heated. Formic ether (used in making essence of peaches) will be recognized at once by its characteristic odor, and proves the presence of formic acid. To another sample of the glycerine add a little solution of chloride of calcium (free from carbonate), when it will give a precipitate of oxalate of lime, if oxalic acid is present.

Sugar, glucose, dextrine, and gum are often used as intentional adulterations of glycerine, and are tested for as follows: The glycerine is mixed with 150 or 200 drops of distilled water, and 3 or 4 centigrammes of molybdate of ammonia is added, and one drop of pure nitric acid. It is boiled about 30 seconds. If sugar or dextrine is present, the mixture will be blue.

Glycerine adulterated with cane sugar or sirup acquires a brownish-black color when boiled with sulphuric acid. Glucose is detected by boiling it with caustic soda, which turns it brown.

If detected qualitatively, the quantity may be estimated by the following method: 5 grammes of glycerine are weighed out and mixed with 5 c. c. of distilled water. It is boiled in a little flask, with Barreswil's alkaline solution of tartrate of copper. The suboxide of copper is precipitated, and the precipitate dissolved again in hydrochloric acid. An excess of ammonia is added, and it is poured into a vessel containing an excess of nitrate of silver. A precipitate of metallic silver is formed and filtered out. It is washed with warm water and ammonia, calcined at a red heat, and weighed; 109·6 parts of metallic silver represent 100 of glucose.

If cane sugar or dextrine are found, it is boiled for half an hour with acidified water to convert these substances into glucose.

If none of these impurities are present, the amount of water is found by Vogel's well known method.

Elementary Composition of Starch.

The exact chemical formula for the molecule of starch is still a matter of doubt, all that is known with certainty being its percentage composition. In a communication to the *Journal fuer praktische Chemie*, F. Salomon gives some experiments of his that go to prove that pure potato starch has the empyrical formula $C_6H_{10}O_5$, or some multiple of it, $x(C_6H_{10}O_5)$, and that Naegeli's formula of $C_{36}H_{62}O_{31}$ must be rejected. Of the two formulas given by Tollens and Pfeiffer, only those which correspond to the composition $C_{24}H_{40}O_{20}$ have any claim to probability.

Salomon arrives at a very positive confirmation of the formula $C_6H_{10}O_5$, which was first given by Mulder, and based on different elementary analyses, by inverting the starch. Its accuracy was controlled by three different methods of determining the grape sugar. Salomon starts with the elementary composition of starch and the formation of dextrose—starch-sugar, grape-sugar, amylose—according to the equation $C_6H_{10}O_5+H_2O=C_6H_{12}O_6$, namely, that 100 parts of anhydrous starch yields 111·11 parts of anhydrous dextrose, while according to the equation $C_{36}H_{62}O_{31}+5H_2O=6C_6H_{12}O_6$, based on Naegeli's formula, we should expect 109·09 parts of anhydrous dextrose. The figures 111·11 and 109·09 lie so close together that it was necessary to determine the sugar formed by the copper solution, by specific gravity, and by polarization. The starch used was very carefully dried at 120° C., and its composition was, pure starch, 76·50; residue, insoluble in dilute acid, 0·247; ash, 0·273; water, 22·98.

Conversion into Sugar.—The most complete and reliable method of converting starch into sugar is that of Sachse, in which 3 grammes of air-dried starch is rinsed into a flask and mixed with 200 c. c. of water and 20 c. c. of hydrochloric acid, sp. gr. 1·125, and heated for three hours in boiling water. The solution was then neutralized with enough caustic potash to leave it just slightly acid, and diluted to a definite volume. The sugar was estimated—(1.) By Allihn's method with alkaline copper solution, the suboxide of copper filtered out on asbestos, etc. (*Jour. pr. Ch.*, xxii., p. 53). Three experiments give respectively 110·98, 111·31, 111·10 per cent dextrose, and three determinations made by Allihn, and calculated to the same quantity, gave 111·5, 110·95, and 111·2 per cent of starch-sugar. The average of these six analyses was 111·16, which is very close to that required by the formula $C_6H_{10}O_5+H_2O=C_6H_{12}O_6$.

(2.) The estimation of sugar by specific gravity was made with 130·72 grammes of air dried, corresponding to 100 grammes of pure starch, mixed with dilute sulphuric acid in such a way that 100 c. c. of liquid contained 10 grammes of pure starch. It was heated on a boiling salt water bath, and the flask had a return condenser so as to avoid loss by evaporation. The boiling was continued until there was no increase in its rotating power. To determine its specific gravity and circular polarization, a 10 per cent. solution of dextrose was previously found by numerous experiments to have a density of 1·0420. In the present experiments a gravity of 1·0424 was found, and this also corresponds to 111·11 grammes from 100 of starch. (3.) The optical experiments gave 11·12, 11·06, and 11·12 grammes, corresponding to 111·2, 110·6, and 111·2 grammes for 100 of starch, confirming the formula $C_6H_{10}O_5$.

A Curious Torpedo.

This latest offspring of Australian destructive ingenuity promises to be a distinct success. Its motive power is not compressed air, neither is it contained in the body of the torpedo. To propel the weapon through the water at a speed of from 15 knots to 20 knots an hour for 1,000 yards, a separate engine, or at least a special connection with an existing one, is necessary. This engine drives two drums, about 3 feet in diameter, with a velocity at their peripheries of 100 feet per second. Their duty is to wind in two fine steel wires, No. 18 gauge, of the same sort as that used in the deep sea sounding apparatus of Sir William Thomson. The rapid uncoiling of these wires from two small corresponding reels in the belly of the fish imparts to them, as may readily be conceived, an extremely high velocity. The reels are connected with the shafts of the two propellers which drive the torpedo through the water. The propellers work, as has long been known to be necessary to insure straight running, in opposite directions and both in one line, the shaft of one being hollow and containing the shaft of the other. Now, at first sight it would seem as if hauling a torpedo backward by two wires was a sufficiently curious way of speeding it "full speed a-head," but it is found in practice that the amount of "drag" is so small, as compared with the power utilized in spinning the reels that give motion to the propellers, that it may be left out of calculation altogether. Of course it is at once seen that this method of propulsion does away with the necessity for air-compressing engines and reservoirs pressed to 1,500 lb. on the square inch, which, however carefully constructed, must always involve a certain element of danger, however small. Neither are any delicate little engines, controlled and stopped by complicated, though exquisite mechanism, required. But these advantages, great as they may be, are as naught compared with the power possessed by the user of the Brennan torpedo to guide and govern its course and movements.

Many experiments have been recently made at Woolwich, and more especially at Chatham, and there seems little doubt, as far as can be seen at present, that the new torpedo will prove most valuable for the defense of harbors.—*Standard.*

Binoxide of Hydrogen as a Toilet Article.

When diluted with an equal volume of water, the binoxide of hydrogen can be used as a cosmetic on tender skin and for a mouth wash. For cleansing the teeth, take some prepared chalk and put it on the tooth brush, then pour the peroxide over it. The result is excellent, and it is only necessary to use the peroxide once or twice a week to keep the teeth white and free from injurious deposits.

For a wash, a little aqua ammonia is added to the diluted binoxide of hydrogen shortly before it is used; one or two drops to the tablespoonful, not more! Wherever it comes into contact with the skin, little bubbles of oxygen will be seen to be given off, while at the same time the dead and rough surface of the skin will be changed into a white soapy mass. As the binoxide only discovers the dead portion, it exposes the fresh and smooth surface, which, not being at all injured, soon gets strong and able to resist external influences. When used on hair, the hair must first be washed with soap, and then with strong alcohol to remove all the grease, then moistened with the peroxide and allowed to dry slowly.

Photography of the Billows.

When crossing the Atlantic I was desirous of obtaining some instantaneous photographs which should convey a true idea of the billows. When studying the contour of the waves with the intention of drawing the trigger upon a group of them suitable for my purpose, I was compelled to give up in despair all hope of securing anything which would at all convey a faithful idea of the scene. The strict scientific reality could easily be secured, for the photographing of waves is a very easy matter if one has rapid plates and a quick shutter, but I felt that realism in such a case would not be truth.

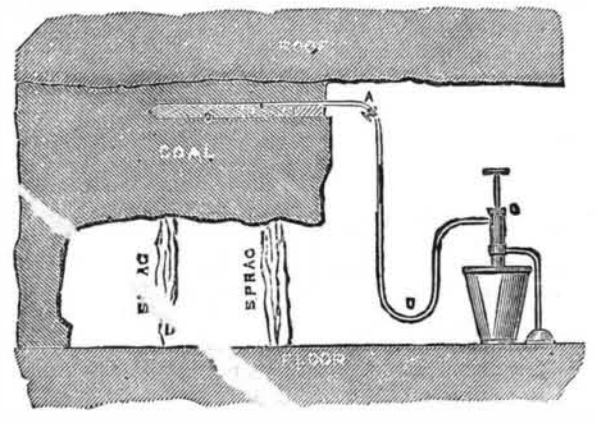
Mentioning this difficulty to Mr. Moran, the artist, with whom I conversed on that apparently paradoxical topic—the untruthfulness of real truth—he observed that artists fully realized this difficulty, and that with reference to the present case he could by a few strokes of the brush on the canvas convey a far more accurate idea of the Atlantic billows than could be obtained by any series of the most perfect realistic views that could be taken by the camera. I thought at the time what a wonderfully effective picture could be obtained if a series of instantaneous photographs of Atlantic waves, consisting of about thirty, and taken at intervals of a quarter of a second, were printed in such order as to be capable of being viewed by one of that now numerous class of thaumatropic instruments known by every kind of name from the "phenakistoscope" down to the "wheel of life," or "praxiscope." Think of such a picture being projected on the screen of the lantern and showing an Atlantic wave in actual motion!—*J. T. Taylor, in Photo Times.*

BLASTING WITH LIME.

At a recent meeting of the Iron and Steel Institute a paper by Mr. Moseley on a new system of bringing down coal was read. This was a short and useful paper, describing a system of getting coal by the aid of quicklime and water, of which something has recently been heard. The accompanying diagram shows the method in question, which is used with great success in Messrs. Smith & Moore's Shipley Collieries, Derbyshire.

The mode of operating is to employ lime in a specially caustic state made from mountain limestone. This is ground to a fine powder, and consolidated by a pressure of about forty tons into the form of cartridges, two and a half inches in diameter, having a groove along the side. These are then packed into airtight boxes to protect them from damp, and are ready to be conveyed to the mine for use. The shot holes are first drilled by means of a light boring machine, and an iron tube, about one half inch in diameter, having a small external channel or groove on the upper side, and provided also with perforations, is then inserted along the whole length of the bore hole. This tube is inclosed in a bag of calico, covering the perforations and one end, and has a tap, A, fitted on to the other end. The cartridges, B, are then inserted and lightly rammed, so as to insure their filling the bore hole.

After the cartridges have been inclosed by tamping, in the same way as with gunpowder, a small force pump, C, is connected with the tap at the end of the tube by means of a short flexible pipe, D, and a quantity of water, equal in bulk to the quantity of lime used, is forced in. The water, being



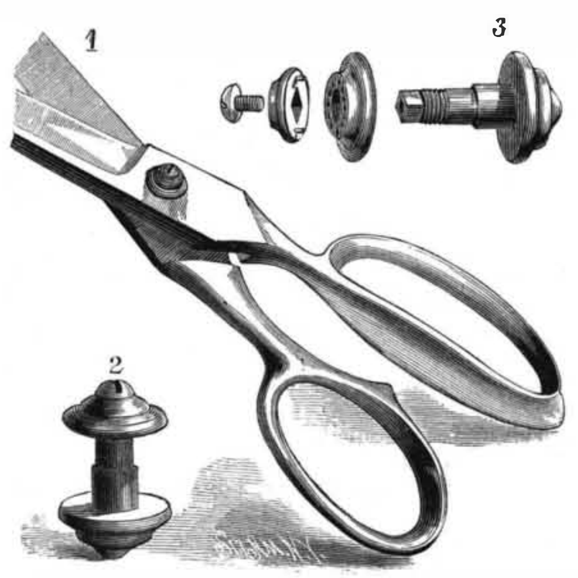
BLASTING WITH LIME.

driven to the far end of the shot hole through the tube, escapes along the groove and through the perforations and the calico, flowing toward the tamping into the lime, saturating the whole of the charge, and driving out the air before it. The tap is then closed, so as to prevent the escape of the steam generated by the action of the water on the lime, and the flexible pipe attached to the pump is disconnected. The action of the steam first takes place, cracking the coal away from the roof, and this is followed by the expansive force of the lime. The sprags are left in under the coal so as to allow the force to exert itself as far back as possible, and in many instances the coal is forced off and falls for a distance of several inches behind the end of the drilled holes. In ten to fifteen minutes, on the removal of the sprags, the coal falls clean from the roof, in large masses ready for loading, practically making no small. This system, says the *Engineer*, has the great advantage of doing away with all danger of igniting gas and causing an explosion.

NEW NUT LOCK.

The engraving shows a novel and very effective nut lock for the screw pivots of shears, scissors, and many other purposes. By this device the loosening of the retaining nut is prevented, and it does not materially differ in appearance from the common screw nut of the pivots of shears, scissors, and similar articles, while it can be applied in all cases in which absolute security against the loosening of a screw is desirable, thus making it a perfect nut lock or safety screw.

The screw pivot has a fixed head and a nut screwed on the threaded shank of the pivot, the nut having a number of



KEMMLER'S NUT LOCK FOR SCREWS.

socket holes arranged in a circle, into which the projecting pins of a cap plate enter. The cap plate has a square center opening, which fits on the square end of the screw pivot. A screw entering the end of the screw pivot holds the cap plate in place.

Fig. 1 shows the pivot screw with the improved nut lock applied to a pair of shears; Fig. 2 shows the pivot screw separated from the shears; and Fig. 3 shows the several parts separately in the order in which they go together.

Further information in regard to this useful invention may be obtained by addressing Mr. W. C. Kemmler, Columbus, Ohio.

The Poisonous Constituents of Tobacco-smoke.

A series of experiments has been recently conducted by Herr Kissling, of Bremen, with the view of ascertaining the proportions of nicotine and other poisonous substances in the smoke of cigars. His paper, in *Dingler's Polytechnisches Journal*, gives a useful *résumé* of the work of previous observers. He specifies, as strongly poisonous constituents, carbonic oxide, sulphureted hydrogen, prussic acid, picoline-bases, and nicotine. The first three occur, however, in such small proportion, and their volatility is so great, that their share in the action of tobacco-smoke on the system may be neglected. The picoline-bases, too, are present in comparatively small quantity; so that the poisonous character of the smoke may be almost exclusively attributed to the large proportion of nicotine present. Only a small part of the nicotine in a cigar is destroyed by the process of smoking, and a relatively large portion passes off with the smoke. The proportion of nicotine in the smoke depends, of course, essentially on the kind of tobacco; but the relative amount of nicotine which passes from a cigar into smoke depends chiefly on how far the cigar has been smoked, as the nicotine content of the unsmoked part of a cigar is in inverse ratio to the size of this part —*i. e.*, more nicotine the shorter the part. Evidently, in a burning cigar, the slowly-advancing zone of glow drives before it the distillable matters, so that in the yet unburnt portion a constant accumulation of these takes place. It would appear that in the case of cigars that are poor in nicotine, more of this substance relatively passes into smoke than in the case of cigars with much nicotine; also that nicotine, notwithstanding its high boiling point, has remarkable volatility.

Anhydro-sulphamin-benzoic Acid.

Anhydro-sulphamin-benzoic acid, the recent addition to the list of chemical products, is described as a white crystalline substance, very soluble in alcohol, but sparingly soluble in water, and characterized by a sweetness so great that the merest trace of the alcoholic solution in water gives it a distinctly sweet taste. Its discoverer, Dr. Constantine Falberg, estimates that it has from twenty to thirty times the sweetness of cane sugar. Should it prove wholesome and producible in quantity, with comparative cheapness, it may play an important part in the future social and industrial history of the world.

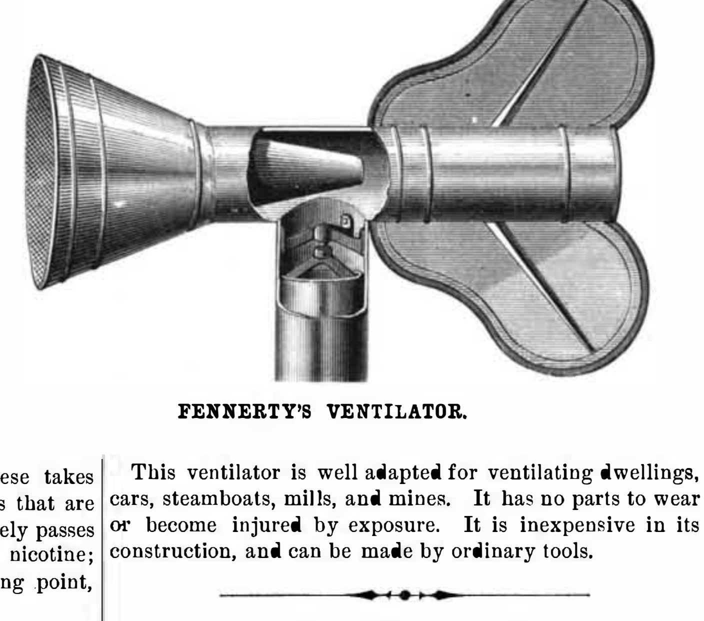
A Submarine Detecter.

The importance of being able readily to discover the locality of a submerged torpedo or a metallic obstruction in time of war, or of lost anchors, chains, or electric cables in time of peace can hardly be over-estimated, and hence the value of a submarine detecter, the working of which we have recently seen demonstrated. This instrument is the invention of Captain McEvoy, who is well known in connection with submarine engineering and torpedoes, in which he has from time to time introduced some very marked improvements. The apparatus consists of a small mahogany box, in which there is a pair of coils or bobbins, a vibrator similar to that employed in electric bells for making and breaking contact, and a telephone. To this box is attached a given length of flexible cable, with four conducting wires in it. To the other end of this cable is attached a flat wooden case, in which there are two coils. This case is weighted so that it will readily sink when placed in the water. There are also terminals on the box for attaching battery wires, and an arrangement for putting on and cutting off the current is provided. There are two complete circuits through the box, cable, and wooden case, the one primary and the other secondary. The battery, the vibrator, one coil in the box, and one coil in the wooden case are in the primary circuit, while the telephone, one coil in the box, and one coil in the wooden case are in the secondary circuit. When the battery is on, the coils in the box are adjusted so that little or no noise from the make-and-break action of the vibrator is heard in the telephone. When thus adjusted the instrument is ready for work, and if the wooden case is then brought near a metallic body a loud noise is heard in the telephone, thus indicating the proximity and locality of such a body. The principle upon which this invention is based is that of the induction balance of Professor Hughes. In Captain McEvoy's apparatus the application of the principle to the detection of the presence of metallic bodies through the sense of hearing has been worked out in a very ingenious and equally practical manner. The instrument cannot fail to prove invaluable in discovering and locating the position of the objects we have mentioned, as well as in indicating the whereabouts of sunken ships, helping to recover treasures, and in assisting generally the operations of divers.

NEW VENTILATOR.

We give herewith an engraving of a novel ventilator, patented by Mr. J. M Fennerty, and manufactured by the Fennerty Siphon Ventilator Co., of Memphis, Tenn. This ventilator, as will be seen by reference to the engraving, is made on the ejector principle, a winged horizontal tube, having on its end facing the wind a funnel projecting into it, and beyond the vertical pipe with which the horizontal pipe communicates, and over which it is pivoted. The vertical pipe is provided with a valve which prevents any possibility of a downward draught.

The wind blowing in the funnel creates a partial vacuum at the upper end of the vertical pipe, which insures a continual upward draught in the pipe. The vanes are sufficiently large to keep the funnel always facing the wind, so that the slightest breeze concentrates a stream of air at the smaller end of the funnel, and creates an upward movement of the air to the vertical pipe.



FENNERTY'S VENTILATOR.

This ventilator is well adapted for ventilating dwellings, cars, steamboats, mills, and mines. It has no parts to wear or become injured by exposure. It is inexpensive in its construction, and can be made by ordinary tools.

Examination of Glasses.

The author applies the known blowpipe reactions. Lead in glass or enamel is detected by heating for a minute or two a bead of the sample fused to the end of a small glass rod. Glass free from lead shows no change. Specimens containing much lead blacken, and the bead becomes opaque. Green cupriferous glass, if heated in the reduction flame, is colored in parts an intense purple red. The simultaneous presence of lead masks this reaction. If a fragment which is to be tested for copper or gold is heated in a glass tube, and if both are drawn out a little while soft, the color due to gold remains unchanged, while red copper-glass becomes perfectly colorless.—*Max Müller.*