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THE AUTOPHONE.

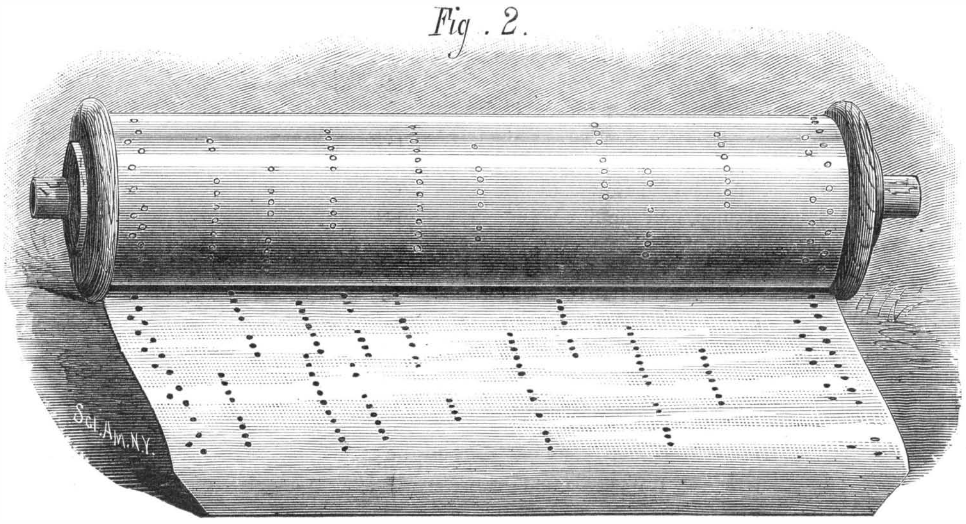
The instrument illustrated by the accompanying engravings is the autophone, for which letters patent have been issued in the United States and Europe to Professor Merritt Gally, of New York city. This instrument is claimed by the inventor to be both original in its conception and fundamental in principle, and it is believed to be the first successful invasion of the domain of music by automatic mechanism.

The autophone is operated by a thin sheet of paper only three and seven eighths inches in width, punctured with small holes. The instrument is provided with any number of stops, and, if a reed or pipe instrument, with any number of sets of reeds or pipes. The invention is applicable to instruments of any quality, from the cheapest piano or cabinet organ to a grand church organ. The music sheet is prepared to represent not only the notes, but also the entire expression required to render the music in the most perfect and artistic manner. The perforations in the sheet, which correspond with the stops, occupy such positions as to operate any stop, or number of stops for any passage, or note or part of a note, that will secure the best effect. It will readily be seen by a musician, says Professor Gally, that this is more than can be accomplished by the hands of the most expert performer. The hands being occupied in fingering the keys, prevents the possibility of manipulating the stops when it would often be desirable to do so.

The mechanism, which is operated by the music sheet for the stops, is as sensitive and rapid in its action as that for the note keys, rendering it possible to produce an unlimited variety of "expression."

Fig. 1 represents a cabinet organ to which the invention is applied. The woman represented at the organ is placing into its bearings the small spool containing the strip of perforated paper which is to produce the music. The mechanism by which this sheet operates is connected with the ordinary pedals of the instrument, and therefore requires no skill except to operate the bellows. To give the reader an accurate idea of the dimensions of this sheet, and the punctures, notes, stops, and "expression," we show the spool partially unwound, full size, in Fig. 2, representing the entire range of notes, six stops, and the "expression" devices. The size of the perforations, as will be seen, are exceedingly small, but sufficiently large for the perfect operation of the instrument. The mechanism is operated pneumatically, but these small openings in the sheet are not for the passage of air to the pipes or reeds of the instrument for producing the sound. The air passing through these small punctures simply trips sensitive devices that operate the valves which, in manual performing, are operated by the ordinary finger keys. The lines of punctures in the edges of the sheet represent the stops and "expression" devices. The air through these punctures operates the stops by means of a similar mechanism to that which opens the valves to the reeds or pipes.

Fig. 2.



Although the music with its "expression" is prepared according to the rendering of the best artists, the instrument is not limited to this or any set "expression" for the piece to be performed. For those without musical skill the "expression" prepared in the music sheet enables them to produce perfect music without requiring instruction or practice. The instrument, however, is not limited to the "expression" prepared in the music sheet, but affords to the accomplished musician the widest scope for the exercise of his personal taste and skill, the stops being absolutely under the control of the performer, so that he may vary the "expression" at pleasure. This is done with greater facility than by any ordinary arrangement of stops, being controlled by sensitive finger keys. Four of these finger keys are represented in Figs. 1 and 3, each side of the receptacle of the punctured strip in connection with button stops. Otherwise than the fact that these button stops turn to the right and left to bring in or shut off the parts of the instrument which they represent, instead of being drawn and pushed, they operate in a manner similar to ordinary draw stops.

In Fig. 4 one of the finger keys and its corresponding button stop is represented full size. Turning the button with the lettered portion toward the operator accomplishes the same result as drawing an ordinary stop, or

[Continued on page 354.]

Fig. 1.—GALLY'S AUTOPHONE OR SELF-PLAYING MUSICAL INSTRUMENT.

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Contents.

(Illustrated articles are marked with an asterisk.)

Angora goats turned to profit	359	May meetings	361
American mutton	361	Medal for Peter Cooper, a	352
Amyl nitrite in ague	360	Molecular chemistry	353
Autophone, the	351	New York Academy of Sciences	357
Beds, insulated	362	Notes and Queries	363
Chloral a poison antidote	362	Noumeite	362
Chloride of magnesia in meters	360	Oldest mine map, the	361
Clothing in its relation to health	355	Patents	364
Coating iron with copper	355	Phonograph, a sixpenny	356
Compressed air for blasting	356	Plain talk to Southern idlers	359
Communications, rapid	357	Quick work with wool	361
Cotton mills for China	362	Recent mechanical inventions	357
Dentistry, early	362	Recent American patents	358
Drainage*	360	Reciprocating pump, Donnadieu	355
Electric light, the	358	Refrigerating liquid from beets	352
Electric light in a fish market	354	Science as a detective	352
Gold medals won at Paris	354	Some aspects of labor	361
Girdling the grape vine	362	Specimens of Turkish pottery*	361
Hyposulphite as a therapeutic	357	Steam hammer, a new*	358
Imp. attach. for feed pumps*	359	Stool of inlaid wood*	361
International Canal Congress	352	Swift, Captain W. H	354
Large farming—precarious	357	Telescopes, American made	354
Localizing telephone calls	353	Terrestrial gasteropods*	359
London Inter. Agri. show	354	Trajectory of molecules, the	352
Magnetic motors	352	Underground telegraph wires	352

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 179,

For the Week ending June 7, 1879.

Price 10 cents. For sale by all by all newsdealers.

I. ENGINEERING AND MECHANICS.—H. M. S. Comus. The first of the six steel corvettes built at Glasgow for the British Navy. 1 illus.

A Light Draught Stern Wheel Steam Yacht. Detail drawings of the fast river yacht, built at Rock Island, Ill., for government use, and described in SUPPLEMENT No. 172. 3 figures. Table of measurements.

Watt's Single-Acting Simple and Compound Engines. 6 illustrations of small and light engines for steam launches, torpedo boats, and similar uses.

War Manufactures in Woolwich Arsenal, England. The casting of 700 lb. shells. 1 illustration. The finishing of Palliser shells.

End of the Age of Brass. The discarding of locomotive ornaments. Economy of plain engines.

Standard Meters. By Prof. J. E. HILGARD. Bronze, iron, and platinum standards and their behavior. The International Bureau of Weights and Measures.

Locomotive Electric Light. Description of an English portable electric light apparatus. 1 illustration.

II. TECHNOLOGY.—Iron and Steel at the Paris Exhibition. New uses of iron. Allotropy of metals. Schutzenberger's investigations. Cooling hot journals. Von Heren's method.

III. ELECTRICITY, LIGHT, ETC.—Electricity in air. Electrified dust.

A Mirror Barometer. De Bort's optical improvement in barometers. 1 illustration.

The Japanese Magic Mirror. Professor Ayrton's explanation of its magic quality. Friday evening discourse at the British Royal Institute, London, January 24. 1 illustration.

Newtonian Telescope for Amateurs. How to make a light, cheap, yet powerful and accurate instrument. 1 illustration.

IV. ARCHITECTURE AND SANITARY ENGINEERING.—An English Convalescent Home. The Hunstanton retreat for the sick poor of the Eastern counties, 1 illustration.

Common Defects in House Drains. By ELIOT C. CLARKE, C. E., engineer in charge of sewerage work, Boston, Massachusetts. An exceptionally valuable paper, from the 11th annual report of the State Board of Health, 34 figures, showing a great variety of defects in house drains and sewer connections, and the necessity of thorough and intelligent sanitary supervision of house drainage.

V. NATURAL HISTORY.—Plant and Animal Life. By A. R. GROTE, A.M., 7 illustrations. Relations of life and structure. The development of life. Protoplasm, bathybius, protomœba. Multiplication of fresh water amœba. Growth of the red snow. Bryopis. Growth of engloona agilis. Egg of the dog in different stages. Life inseparable from motion, and motion the result of material relationships.

On the Queen Bee, with Especial Reference to the Fertilization of her Eggs. By JOHN HUNTER. The nature and development of the queen bee. The impregnation of the queen bee. A difficult problem solved.

Insect Powder. Superiority of Dalmatian to Persian powder. Effect of pyrethrum powder upon house flies, aphis, etc.

Chrystalogenesis. Investigations of M. LECOQ DE BOISBAUDRAN.

A New Element. L. F Nilson's discovery of "scandium."

THE TRAJECTORY OF MOLECULES.

In "The Fourth State of Matter," SCIENTIFIC AMERICAN, January 25, last, an account was given of the experiments made by Mr. William Crookes, showing the high probability of a fourth state of matter, more ethereal than the gaseous, in which matter take on an entirely new set of properties. At a social meeting of the British Royal Society, April 30, Mr. Crookes exhibited a series of experiments illustrating still further the curious behavior of electrified molecules in extremely rare media.

By the improvements made in the Sprengel pump by Mr. C. H. Gimingham it is now possible to produce vacua in which the pressure is measured in millionths of an atmosphere. It is with vacua so produced, in the more perfect of which the pressure is as low as one millionth of an atmosphere, that Mr. Crookes' investigations were conducted.

It will be remembered that the discoveries in question were made in the dark space around the negative pole within a vacuum tube and separating it from the luminous glow. This dark space was found to be a region of molecular activity similar to that in front of the vanes of a radiometer, by which activity the negative pole, when free to move, is set in motion.

The phenomena exhibited in his first published experiments—the phosphorescent effects produced by molecular impact, the illumination of lines of pressure, the casting of molecular shadows, the magnetic deflection of molecular streams, and the like—were shown anew, and supplemented by even more beautiful effects, though nothing absolutely new was developed.

In some of the experiments variously-shaped poles were used, causing the molecular streams to converge to a focus, to diverge, or to move in parallel lines. By one apparatus the four principal phenomena of molecular physics in high vacua—namely, the phosphorescent light of molecular impact, the projection of molecular shadows, the magnetic deflection of the trajectory of molecules, and the mechanical action of molecules projected from the negative pole—were beautifully illustrated.

The vacuum tube inclosed a circular concave negative electrode, and at its center of curvature a light wheel was pivoted upon a horizontal axis. The wheel was a disk of thin mica, carrying around its periphery a number of equidistant radial vanes of aluminum, making the wheel look like a water-wheel. When the tube was placed in connection with an induction coil, the stream of molecules concentrated upon the wheel fell in line with its axis, in which case no motion resulted. But on bending the stream of molecules up or down by magnetic action the focus of impact would fall above or below the axis, and the wheel would be set to spinning at a lively rate.

Very brilliant effects were also produced by causing the molecular stream to fall on naturally phosphorescent substances, as, for example, diamonds. At such times different sorts of diamonds were distinguished by different colors—blue, pale blue, orange, red, green, and pale green—African diamonds emitting a blue phosphorescence. Rubies, on the other hand, whatever their normal tint, all assumed under the molecular hail the deep "pigeon's blood" red, characteristic of a fine ruby. Even white precipitated alumina gave under the molecular stream the same ruby color, though normally without a trace of color.

Thus far these researches of Mr. Crookes seem to be brilliant rather than instructive in their results; but it is altogether too early to pronounce upon their possible value.

THE INTERNATIONAL CANAL CONGRESS.

An international canal congress, for discussing projects for the construction of an interoceanic ship canal across the American isthmus, met in Paris May 15. M. Ferdinand de Lesseps was fitly chosen president. Since the main object of the convention was to compare routes and decide upon the one to be recommended as a practical enterprise, the principal interest naturally centered in the Committee on Technique.

Up to this writing, May 22, six routes have been under examination and discussion, namely, the Nicaragua route, the Panama route, the San Blas route, the Tiati-tolo route, the Tuyra-Caquirri-Atrato route, and the Atrato-Napipi route. At first the Tiati-tolo route, known as Lieutenant Wyse's lockless canal and tunnel route, seemed to have the brightest prospects, from the strong party and personal influence known to be working in its favor. The Sub-Committee on Tunnels, however, found that its probable cost had been greatly underrated, and that under the most favorable conditions it would cost $160,000,000. This discouraging blow was followed by such an able presentation of the impracticability of the scheme by the English engineer, Sir John Hawkshaw, that the project was abandoned.

Already the choice seems to be narrowed to two projects, the Nicaragua route and the Panama route, and a decision will probably be reached in the course of a week.

A Medal for Peter Cooper.

At the late meeting of the British Iron and Steel Institute in London, the Bessemer Medal of the institute was presented to the venerable Peter Cooper as "the father of the iron trade in America." In his presentation speech the President spoke of Mr. Cooper's half-century connection with the iron trade, his Baltimore rolling mill in 1830, his building and running the first American locomotive, his extensive iron works at Trenton, and especially the founding and direction of the great Cooper Institute in this city. In view of the fact that it is through the efforts of Mr. Cooper and other leaders in the American iron trade that England's greatest rival in iron production has almost reached supremacy, this recognition of his labors by the English iron and steel producers is particularly handsome.

SCIENCE AS A DETECTIVE.

A correspondent tells at greater length than we have space for the story of an attempted fraud which was exposed by chemistry.

An emery wheel guaranteed to stand 600 revolutions was run at the speed, of 1000 revolutions, and burst, doing a large amount of damage. A suit to recover was instituted, based on a letter written by the seller of the wheel, in which the strength of the wheel was rated at 1,600 revolutions. While in the office of the prosecutor endeavoring to effect a settlement, the defendant observed that a certain make of ink was used, and he learned by a casual inquiry that the same ink was used exclusively by the prosecutor. The defendant had for several years used another ink. Taking samples of the two inks to a chemist, he was able after analysis to secure a solvent for the one which would not affect the other.

The case came to trial. Evidence was taken as to the kind of ink each party employed. Then the chemist was called, and in the presence of the jury applied the solvent, which removed the interpolated "1," and left the rest of the writing untouched. The proof of the forgery was sufficient, and the case was dismissed, leaving the dishonest prosecutor to defend himself from a criminal charge.

A NEW REFRIGERATING LIQUID FROM BEETS.

In Europe the principal supply of sugar is derived from beets; the annual production of beet sugar being now seven hundred thousand tons. Besides this a large quantity of beet molasses is produced, a portion of which is distilled and a coarse sort of whisky made; the stuff remaining in the retort yields potassium salts, which are employed as fertilizers. Sugar, spirits, and potash have heretofore been the chief products manufactured from beets. But Mr. Vincent has now succeeded in realizing from the refuse that remains after the beet molasses distillation, a combustible gaseous body, which is easily condensed into liquid form, and is called chloride of methyl.

This liquid, obtained as stated from beets, is used in the preparation of some of the aniline colors; but it is now found to be especially valuable as a refrigerating agent. By its rapid evaporation a temperature of—55° C., or 67° F. below zero, may be maintained, which is far below the freezing point of mercury. Prof. Huxley says that by this means mercury (which freezes at 39° F. below zero) may be frozen by the pound. For the manufacture of ice this new beet root product promises to become of much importance.

MAGNETIC MOTORS.

Is there an available source of energy in magnetism? There are very many inventors who believe that there is, and every year many attempts are made to produce economical magnetic motors. A short comparison between the force of magnetism and other natural forces will answer our question.

An iron steamship plies between New York and Liverpool; it is more or less a magnet under the influence of the earth. Yet the helmsman does not allow for the attraction of the north or south poles of the earth upon this magnetic matter. This attraction is immensely inferior, even if the steamship were made of steel and been magnetized to saturation, to the drift of the tides, or even to the effect of the gentlest breeze. The force of gravitation, however, sinks the heavy vessel deep in the water, and is ready to draw it with all on board to the very bottom of the ocean. While the force of magnetism decreases or remains constant when the masses of the attracting magnetic bodies are increased, the attracting force of gravity steadily increases with the masses of the two bodies, between which this attraction acts.

It is sometimes proposed to utilize the magnetism of the earth in magnetic motors by supplying any waste in the energy of a permanent magnet from the store in the earth. Let us see how much this force of the earth's magnetism is in comparison with the force of gravity, which is our universal measuring force, so to speak. Suspend in a vertical position from one end a cylindrical bar of iron which is about one foot in length. It should be hung by a very short wire or thread from its north pole. Hang beside it a brass rod of the same dimensions, and provide it with the same length of suspension. Then set the two rods to swinging, and count the number of swings which each makes in a given number of seconds. It will be found that the two rods will accomplish very nearly the same number of swings in the same time. The rods will differ very little in weight, and their moments of inertia will be very nearly alike. The vertical force of the earth's magnetism, therefore, must be small in comparison with the force of gravitation; for the iron bar is acted upon by both gravity and the earth's magnetism, and yet it vibrates at nearly the same rate as the brass bar. An iron bar, such as we have used in the above experiments, will be rendered feebly magnetic by the earth's magnetism, and could hold a light cambric needle at its extremity; but nothing more. This is the force from the earth which we can count upon to renew the magnetism of steel when it has been deprived of it.

It has been said that it is possible to lower the energy of a magnet by vibrating an armature composed of a thin plate of iron in front of the magnet. An experiment will speedily convince those who have no theoretical convictions upon the subject that it is not possible to do this. Having measured in any way the lifting effect of a magnet or its action upon a compass needle placed at a fixed distance, cause a thin plate of iron to vibrate by any automatic arrangement very rapidly in front of the magnet: and after some time has elapsed examine the strength of the magnet: it will be found as strong as before. The rate of vibration can be carried as high as 3,000 vibrations per minute, and still the magnet will be unaffected. If one endeavors to use the magnetic energy of the earth as a source of motive power, disappointment will surely result; for the earth's magnetism is too feeble to do an appreciable amount of work. Moreover the energy stored up in permanent magnets is feeble, compared with that of other forces. A horseshoe permanent magnet, the strongest that can be made, will not lift 200 pounds; and the lifting force does not increase with the size of the magnet, except to a very limited degree. Very strong electric magnets, however, can be made. Prof. Henry succeeded in lifting 640 pounds by one that he constructed. It might be supposed that there is no limit to the amount that an electro-magnet can lift; for we can increase the strength of the current which circulates about the iron to a very great amount. There is a limit, however, to the amount of magnetism which can be imparted to soft iron. This limit has been placed at a lifting power of 354 pounds to the square inch.

Let us now inquire into the expense of producing this effect. One pound of coal yields 7·200 thermal units; one pound of zinc yields 1·200 thermal units. One pound of zinc costs ten times as much as a pound of coal. It will be seen, therefore, that any magnetic motor will be sixty times as expensive as a steam motor of the same horse power; for we have no better agent for producing electricity in batteries than zinc. The inventors of magnetic motors should therefore turn their attention to the discovery of a cheaper source of electricity than zinc. The modern dynamo-electric machine affords another source of magnetism. This machine, however, requires a powerful steam engine to run it, and its useful effect is necessarily less than that of the steam motor which is employed to generate the current of electricity. If the useful effect of such a machine for producing electric currents was greater than the work of the steam motor, we should have perpetual motion.

Let us now turn our attention to other agents which we can use as sources of power. A pound of water converted into steam occupies about 1,250 times its former volume at the ordinary pressure of the atmosphere. This would give over 18,000 pounds pressure on the square inch, if the water when converted into steam was not allowed to expand. Liquid carbonic acid at 86° C. in assuming the gaseous form exerts over 1,000 pounds on the square inch. The explosion of gunpowder can exert pressures from 5,000 to 20,000 pounds on the square inch, and the explosive force of nitro-glycerine has not even been estimated with any precision, so tremendous is the energy developed. It can readily be seen that a motor which is driven by the expansion of steam, by the explosion of gas and common air, or by the explosion of gunpowder or nitro-glycerine affords with the feeblest of these agencies work which far surpasses what the most sanguine inventor of magnetic motors can even dream of.

Electro-magnetism is a swift and nimble servitor ready to convey ideas from mind to mind around the world in an instant. The attempt to yoke Pegasus to a plow and to make him perform the work of oxen has often been delineated by artists. We remember to have seen a series of cartoons which represented the mournful attempt. There was the delicate, highly-strung steed beside the sturdy beasts whose true province was to drag the heavy weight, and the various stages of the agony of Pegasus were vividly depicted. The cartoons could have been called "Electricity in Harness," and would equally well have illustrated the attempts of the inventors of magnetic motors.

UNDERGROUND TELEGRAPH WIRES.

In a late issue of the SCIENTIFIC AMERICAN notice was taken of the difficulties experienced in England in the use of telegraph wires underground. Notwithstanding the apparent success of the system in Germany, the electrician of the British telegraphs pronounced decidedly against underground wires as less efficient, less durable, and much more costly than the ordinary system. The system of insulating underground wires patented by Mr. David Brooks, of Philadelphia, is said to be open to none of the usual objections, being at once cheap, durable, and efficient. This plan is substantially as follows: The wires are wrapped in cotton and bundled together in a tight netting, to the number of 50 or less, then inclosed in a pipe and laid in the ground. Insulation is effected by oil which is poured into the pipe after it is laid, and the pipe is kept full by having the source of supply in an elevated vessel. A mile of line was thus laid about two years ago in West Philadelphia, with complete success. A line across the Schuylkill, in 35 feet of water, has been in operation since April, 1877, with increasing insulation. It is said that a line on this system will be laid between New York and Philadelphia this summer, and that the system will soon be generally adopted in this city. The exclusive right to construct telegraph lines in the United States under Mr. Brooks' patent was purchased a short time since by General Stager, of Chicago, one of the vice-presidents of the Western Union Telegraph Company, and president of the Western Electric Manufacturing Company. The purchase was made, however, for General Stager's personal benefit, and not on account of the Western Union Telegraph Company, as first reported.

LOCALIZING TELEPHONE CALLS.

The district telephone companies employ various kinds of alarms by which attention can be called to messages about to be sent. Vibrating reeds and magneto-call bells of many patterns are found to be most efficient devices. A summons, however, sent to one house will necessarily be heard in all the houses or offices on the same circuit. In some localities this has been found to be very objectionable. There are many theoretical ways in which a call can be localized, so to speak. The most obvious way is to employ a set of reeds or tuning forks which will only respond to definite notes. At the sending office the proper reed or other vibrating means is set in action, and the reed or tuning fork at one station responds only. There are, however, certain practical difficulties in the use of this method: it is comparatively costly and requires accurate adjustment. Niemoller, in a late article in Wiedemann's *Annalen der Physik und Chemie*, describes a simple method of setting a wire in vibration, which might be also turned to account in localizing calls on telephone circuits.

A steel wire stretched between two points is provided with a platinum point at its middle; this point dips into a vessel containing mercury. A current of electricity is passed over the half length of the wire, and a magnet placed above the middle point of the half length through which the current passes serves to maintain the vibration of the wire. The application of this simple interrupter to telephone circuits is obvious. At the sending office a wire could be stretched with definite weights over a long channel of mercury, and the length of the wire could be readily altered by simple bridges. In each office or station wires could be stretched on suitable sounding boards, provided with electro-magnets placed above their quarter lengths, and tuned to respond to the note of the wire at the central office. Only the wire which is of the proper length and tension would respond to the same length and tension of the wire at the central office. The wires could vibrate between bells or could strike when their amplitude of swing was at its greatest upon some sounding substance. This method also requires careful adjustment, but it is much cheaper than any system of reeds.

MOLECULAR CHEMISTRY.—NO. II.

The discovery that bodies combine in constant definite proportions by weight was followed by one of almost equal importance. At the beginning of the present century, Gay Lussac and Alexander von Humboldt found that one part by measure (one volume) of oxygen combines with exactly two parts by measure (two volumes) of hydrogen, and that the water so formed occupies two volumes when it is measured in a state of vapor. After numerous experiments, Gay Lussac announced that all gases and vapors combine in definite proportions by volume, and also that the combining volumes have simple numerical relations to each other as well as to the volume of the resulting compound, the latter being compared while in a state of vapor.

While the 100 grains of water in our last paper contained eight times as much oxygen as hydrogen by weight, this hydrogen takes up twice as much room as the oxygen. Still, we are not able to answer the question, How many atoms of each does it take to make the smallest possible quantity of water? At the first glance it would seem as though we needed to know either the number of atoms contained in a given volume, say a cubic inch, or else their size, and information on these points appears to be no more accessible than on the number or the size of the atoms contained in a given weight. Nevertheless the problem was most beautifully solved by the Italian physicist, Avogadro.

Reasoning on the remarkable fact that all gases undergo very nearly the same diminution of volume, when subjected to the same pressure, or to the same degree of cold, Avogadro concluded that this could be accounted for most simply by supposing that all gases have their particles separated by equal spaces, or, what is the same thing, that equal volumes contain the same number of particles.

Armed with this important deduction, we may now return to the study of the composition of water and reason as follows: The hydrogen in water occupies twice the space of the oxygen; therefore it contains twice as many particles, or in other words, water contains two particles of hydrogen for every particle of oxygen, and we may write H_2O as a formula representing its composition by weight and measure. The combining weight of H being taken as unity, that of oxygen will be 2×8, or more accurately, 15·960; for the O in H_2O was found to weigh eight times as much as two volumes of H, consequently it weighs sixteen times as much as one volume.

As equal volumes of different gases contain the same number of particles, the weights of these particles must be the same as the densities of the gases, when hydrogen is taken as the unit both of weight and volume. This follows directly from the definition that density is the amount of matter contained in a given space. The densities of a very great number of gases, as well as of vapors, have been determined by independent methods with the utmost care, and the correctness of Avogadro's deduction has been again and again corroborated.

Whenever, therefore, an element forms either gaseous combinations or such as may be reduced to a state of vapor, we have two trustworthy means of determining its atomic weight: we can ascertain the percentage composition by chemical analysis, and we can determine the density of the gas or vapor into whose composition it enters.

The atomic weights of elements that do not form gaseous combinations are ascertained from the results of chemical analyses, aided by two important laws, which need only be briefly stated here, as they are not essential to our chain of reasoning. The first, discovered by Dulong and Petit, is that all atoms have the same specific heat, a conclusion deduced from the fact that the products of the specific heats of the elements by their atomic weights differ very little from the number 6·4. The second law is that of Mitscherlich, that the crystalline form of substances furnishes an indication of their atomic structure. When two bodies are isomorphous, that is, when they have crystals of the same form, their composition may be expressed by analogous formulas. The latter law is true within certain limits only.

Let us now test our formula for the composition of water by the discovery of Gay Lussac, stated at the beginning of this paper. Suppose, for convenience of illustration, that the unit volume of hydrogen contains one thousand particles; then an equal volume of oxygen must contain one thousand particles, and so must one of water, vapor, or of any other gaseous substance. But two volumes of hydrogen containing two thousand particles combine with one volume of oxygen containing one thousand particles to form two volumes of water vapor containing two thousand particles, which is equivalent to saying that two particles of water vapor consist of two atoms of hydrogen plus one atom of oxygen. Now, what does one particle of water vapor consist of? We cannot divide by 2, or else we shall obtain a half atom, which is impossible. The only way out of the difficulty is to conclude that the particles of hydrogen and oxygen are all double, *i. e.*, that they consist of an undetermined but even number of atoms. Then we shall see that two volumes of hydrogen containing two thousand HH, combine with one volume of oxygen containing one thousand OO, to form two volumes of water vapor containing two thousand H_2O.

The combination of two atoms of hydrogen among themselves is called a molecule of hydrogen, that of two atoms of oxygen among themselves a molecule of oxygen, and the union of two molecules of hydrogen with one molecule of oxygen forms a molecule of water. To resume, one volume of water vapor occupies two volumes, consists of three double atoms, and weighs 17.960 times as much as one volume (= one double atom) of hydrogen.

Our standard of comparison for molecules is the hydrogen molecule H_2, whose density is 1, and whose molecular weight is 2. Hence we must multiply the densities of other gases by 2 to obtain molecular weights comparable to that of hydrogen. For example:

The density of arsenic vapor is about 150·2 times that of hydrogen. Its molecular weight is therefore $2 \times 150·2$, or 300·4. A study of its compounds shows that this molecule is composed of AS_4, or of 4 atoms each weighing $\frac{300·4}{4} =$ 75·1. The correctness of this atomic weight may be tested as follows, by the law of Dulong and Petit: The specific heat of arsenic ·0814 multiplied by 75 = 6·113, which is sufficiently near the average.

The density of chlorine is about 35·25 times that of hydrogen. Its molecule then weighs $2 \times 35·25$, or 70·5. A comparison of the analyses of its compounds shows this molecule to be composed of Cl_2, or of two atoms, each weighing 35·368.

The density of mercury vapor is about 100 times that of hydrogen; its molecule is, therefore, about 200 times as heavy as that of hydrogen. A comparative study of its compounds indicates that this molecule contains but a single atom; or, speaking more accurately, half as many atoms as the hydrogen molecule. This view satisfies the law of Dulong and Petit; for $200 \times ·03332$, the specific heat of mercury = 6·66.

A similar study of ozone assigns to it a molecule composed of three atoms of oxygen, O_3.

On the supposition that the hydrogen molecule contains only two atoms—the lowest even number—the other elements have molecules consisting of one, two, three, and four atoms. It is evidently of no consequence to our reasoning whether the hydrogen molecule contains two atoms or a multiple of two, because all our other molecular weights, being only ratios, are affected proportionally.

We are now prepared to begin the study of the relative sizes of the molecules of simple and compound bodies.

We have found that a given volume of oxygen contains as many particles as an equal volume of hydrogen, and that these particles weigh 16 times as much; therefore each particle of oxygen weighs 16 times as much as each particle of hydrogen. If these particles occupied the whole space, that is, if there were no interstices, we could conclude that the particles of oxygen and the particles of hydrogen are equally large.

As we have not, however, any means of knowing the real or absolute size of these particles, we shall be obliged, at the outset of our investigations, to define a molecular volume, or the volume of a molecule, as the cubical space of which, at a given moment, it occupies the center—a definition that involves no hypothesis. There is no difficulty in conceiving a given volume as divided up into equal cubes, each containing a molecule. C. F. K.

THE Fall River (Mass.) *News* relates the following as a fact: Two men were conversing about the anticipated strike the other day, when one of them, a mule spinner, remarked that he had been in 26 strikes during his lifetime. "Well," said the other, "did you ever make anything by it?" "Not once," was the reply; "lost every time."

GALLY'S AUTOPHONE.

[*Continued from first page.*]

turning the lettered portion at right angles, as shown in the engraving, accomplishes the same result as pushing in an ordinary stop.

The sheet or strip of music is marked at its head with the number of button stops which should be turned on before starting the mechanism. These stops, although turned on, are operative only when perforations in the edges of the sheet occur which indicate their action. Wherever these punctures do occur, even for a note or a part of a note, or an entire passage, the effect of the stop is produced. Thus far it will be seen that the effect of the stops is limited to the set expression indicated by the punctures of the sheet. The variety which may be given in the expression to accord with the judgment or taste of the performer differing from that represented in the music strip, is produced in the following manner: By the use of the finger keys, *a b*, Fig. 4, the performer renders inoperative at will any of the stops represented in the sheet, and substitutes others at pleasure. The key is double-acting, arranged to be depressed at either end. Depressed at *b* renders inoperative the stop that would otherwise come into action. Any stop that is turned off and not to come into action is thrown into action for the time desired by the pressure of the key at *a*. If the performer does not wish to use any of the stops indicated in the music strip, all the button stops are turned off before commencing the piece, and by pressing on the different keys at *a*, any variety of expression is given. These keys are very sensitive, requiring only a slight touch, but they perfectly and instantaneously control the stops of the instrument.

For example, a single note which for the best effect is to be begun softly, and would on an ordinary instrument be increased by the swell only, is in this instrument increased not only by the swell, but by an accumulation of stops commencing, if necessary, with only a single stop, and ending, if desirable, with an accumulation of ten.

Although the time in which the music is written is, by the mechanical motion, strictly adhered to, nevertheless, to avoid mechanical appearance in the rendering of the music and to divest it of every feature that might be in the least objectionable, or that in any way might fail to realize the most perfect conception of the artist, the instrument is provided with an ingenious mechanical device, by means of which the time may be instantly changed, accelerated, or retarded through any passage, note, or part of a note, or a "hold" made on a note, at the will of the performer, especially adapting the invention for rendering accompaniment for singing. The first key to the left of the receptacle for the sheet (see figure) operates a mechanism for retarding the movement of the sheet for retarding the time of a passage, producing a "hold" or a perfect rest, which is not indicated in the arrangement punctured in the strip. The degree and duration of the retard is controlled by the degree of pressure applied to the key. A positive hold on the key produces a "hold" on the tone. A positive hold between the notes produces a "rest," the length of time the key is thus held.

To repeat a passage or part of a passage not arranged in the sheet to be repeated as ordinarily performed, and to enable the operator to repeat any part at will, once or successively, without limitation, the key just described, in connection with the draw-knob at the right of the receptacle, recalls for repetition any desired part of the music-strip; the return being instantly made to prearranged limits, only so much of the strip being drawn as is desirable. The convenience of this device in singing, or in playing dance-music, will be seen at once, as comparatively short strips answer the purpose as well or even better than very long ones, besides lessening their cost.

The instrument may be arranged for any number of octaves; the music strip, however, need not necessarily be increased beyond the width already mentioned.

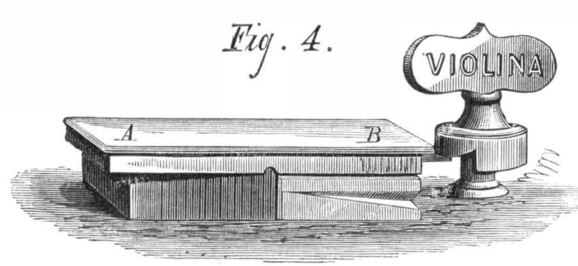
The autophone is not only adapted to organ music, but is equally well adapted to the piano. The "expression" produced upon the organ by the operation of the stops, in connection with the music sheet, is produced in a similar way upon the piano, the soft and loud pedals not only being acted upon on the music sheet, but the variety of touch required for the best effects is fully attained. This invention, as applied to the piano, as with the organ, is not limited to the set expression prepared in the music sheet, but allows of as great variety in the personal expression of the artist.

The autophone seems destined to prove invaluable in its application to orchestrions; the small, cheap music sheet accomplishing all, and even more, than the very expensive barrels of such instruments. The addition of variety in expression which this invention will impart to orchestrions, and which they have not heretofore possessed, will, it is claimed, increase their value.

The narrowness of the sheet, and the fact that it is not necessarily thick and cumbersome, but is light and cheap, are important qualifications. This music, we are informed, will be sold as cheaply as ordinary sheet music. It is made by machinery specially adapted to the purpose, and the perforations being so small, leaves it very strong and durable.

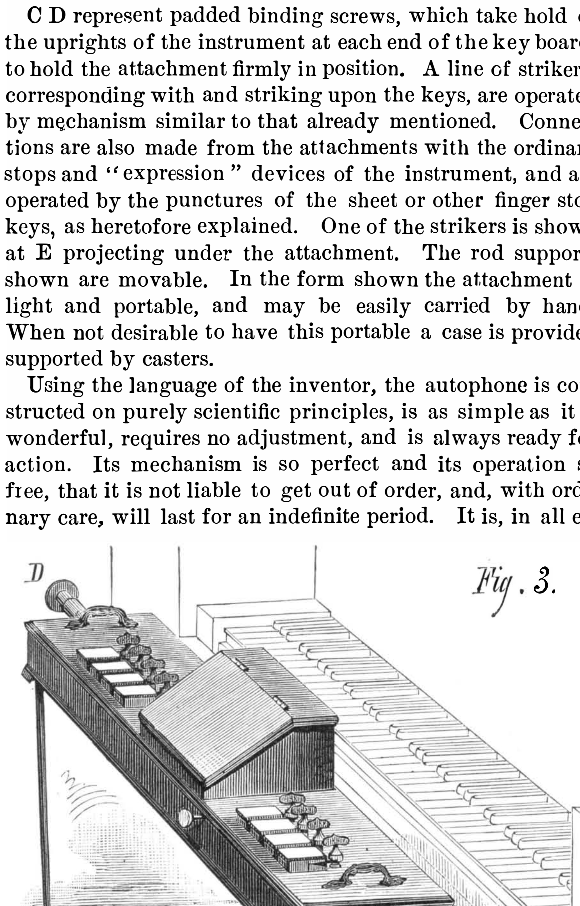
The autophone is adapted to instruments having a key board that may at pleasure be used for manual performing, as shown in Fig. 1; or it may form a part of an instrument not having finger keys, for use by those who are not musicians, and who do not desire the addition of the ordinary key board to the instrument. It is also made as an attachment to perform upon organs or pianos already in use, and may be readily placed upon or removed from the instrument.

The invention is represented in this form in Fig. 3, in which the ordinary key board of an instrument is shown, the attachment being moved toward it to be placed over the keys. If the instrument be a wind instrument, as an organ, the connecting rod, shown as attached to the foot pedals, is connected to the ordinary pedals of the organ, the pedals shown being used when the attachment is employed to perform upon a piano.



C D represent padded binding screws, which take hold of the uprights of the instrument at each end of the key board, to hold the attachment firmly in position. A line of strikers, corresponding with and striking upon the keys, are operated by mechanism similar to that already mentioned. Connections are also made from the attachments with the ordinary stops and "expression" devices of the instrument, and are operated by the punctures of the sheet or other finger stop keys, as heretofore explained. One of the strikers is shown at E projecting under the attachment. The rod supports shown are movable. In the form shown the attachment is light and portable, and may be easily carried by hand. When not desirable to have this portable a case is provided supported by casters.

Using the language of the inventor, the autophone is constructed on purely scientific principles, is as simple as it is wonderful, requires no adjustment, and is always ready for action. Its mechanism is so perfect and its operation so free, that it is not liable to get out of order, and, with ordinary care, will last for an indefinite period. It is, in all essential respects, unlike anything heretofore invented, either in structure, action, or musical results.



Professor Gally is better known to the public as the inventor and manufacturer of the Universal printing press. Further information regarding the autophone may be obtained by application to the inventor at his office, No. 9 Spruce Street, New York City.

The Electric Light in a Fish Market.

In the celebrated Billingsgate Fish Market in London, the electric light proved a complete failure, for the unexpected reason that it was too good. Business at Billingsgate begins at 3 o'clock in the morning, most of the bargains being struck by gaslight. When the searching electric candle was turned on, its brilliant whiteness literally showed the fish in such a new light that the trade was demoralized outright. Soles that would have fetched a shilling a pair by gaslight looked dear at sixpence, while turbot fresh from the sea looked a week old. The result was a general outcry. The copious and ornate dialect of the locality was enriched by a number of notable additions during the few days of the new light; and for fear of a revolt among the "bummarees," as the fish salesmen are called, the corporation was obliged to restore the familiar yellow gas lights.

Captain W. H. Swift.

By the death of Captain W. H. Swift, America has lost one of the pioneers of American engineering. While still a cadet of the United States Military Academy his service began with Major Long's expedition to the Rocky Mountains, 1818–21. During the next ten years he was employed on the early surveys for the Chesapeake and Ohio and (proposed) Florida canal, the Ithaca and Oswego and Catskill and Oswego railroads; and in 1831 in surveys for the Boston and Providence, Providence, Norwich and Worcester, and Providence and Stonington railroads. Appointed 1832 brevet captain and "assistant topographical engineer" (as the captains were then officially styled), he was among the pioneers in our coast survey work; being employed for the next ten years on the geodetic survey of the Atlantic coast. From 1836 to 1849 he was the resident and constructing engineer of the Massachusetts Western Railroad (now incorporated in the Boston and Albany). As an officer of topographical engineers, he, with ex-Governor John Davis of Massachusetts, was employed in making an examination of the Illinois and Michigan Canal, the completion of which had in 1841 been suspended for want of funds, resulting in his becoming one of three trustees into whose hands the work was committed and remained until its completion in 1848.

The work with which Captain Swift's name has been most intimately associated is the first Minot's Ledge Lighthouse, off the town of Cohassett, Mass. The erection of this iron skeleton tower—the first of its kind—was a work of great originality as well as difficulty. Resigning from the army in 1849, Captain Swift was president (1849–51) of the Philadelphia, Wilmington and Baltimore Railroad; of the Massachusetts Western Railroad (1851–4); continuing president of the board of trustees of the canal named till 1871; president of the Hannibal and St. Joseph Railroad since 1856. For the last fifteen years of his life he made his home in this city.

The Gold Medals Won at Paris.

The gold medals awarded to the United States exhibitors at the Paris Exhibition have been received and distributed by Commissioner-General McCormick. The medals weigh three ounces each. Each medal bears the name of the exhibitor to whom it was awarded, and is accompanied by a diploma with the signatures of the Ministers of Agriculture and Commerce and the French Commissioner-General, designating the group and class in which the award was made. The medals are one hundred and six in number. There are twenty-three "diplomas of honor," which are considered equal to gold medals, and were chiefly given for exhibits made by the government or by public institutions. The Commissioner-General has not yet been advised when the silver and bronze medals will reach this country.

American Made Telescopes.

The perfection of workmanship attained by American opticians in making telescopes and microscopes has often won high praise from scientific men both at home and abroad. In 1861 European astronomers may be said to have had their eyes opened by Clark's discovery of a minute companion to the brilliant Sirius, with the eighteen inch object glass made for the Chicago Observatory. The monster telescopes of Herschel and Lord Rosse, and the great achromatics in the chief European observatories, had given no hint of this star's existence, although there were mathematical reasons for believing that Sirius had a companion. Since its discovery this delicate star has been seen with comparatively small telescopes, and now Mr. Jay Harcourt, of Wappinger's Falls, announces to Admiral Rogers that one fine night in April he saw the companion of Sirius with a Byrne telescope of only four and a half inches aperture. Several other persons saw the star, and they certify to the correctness of the observation. The maker here alluded to is John Byrne, of New York city.

The London International Agricultural Show.

The International Agricultural Show, to open June 1, promises to be very successful. Six hundred and fifty-one exhibitors of implements and machinery have applied for space, some two hundred and fifty more than at Bristol last year. The sheds for these exhibits would form a line three miles long, if all the space asked for were conceded. An additional mile of sheds will be required for machinery in motion. A correspondent writes that American manufacturers are among the foremost applicants outside of England, and adds:

"There is some uncomfortable foreboding here as to the issue of certain firms with whom your makers of mowers and reapers especially come into competition; nevertheless a vigorous effort is being made in the hope that the English firms will be able to show a better front in London than in Paris."

THE report of the National Cotton Exchange shows that the cotton movement by rail routes this season is the largest ever known. There has been an increase of 186,651 bales in the direct shipments by rail from producers to Northern mills. The receipts of cotton at all United States ports for the year ending April 30, were 4,283,641, against 4,183,552 last year. These figures give gratifying evidence that the importance of this great staple to the industries of the country is to be still further increased.

PROF. RILEY, Entomologist of the Department of Agriculture, has resigned.

THE DONNADIEU RECIPROCATING PUMP.

This pump, which is represented in the accompanying engravings, works in exactly the reverse manner to that of ordinary pumps, the piston being fixed and the barrel movable. From this arrangement result several important advantages, namely, the suppression of the connecting rod and stuffing box, simple and easy erection, and greatly diminished friction.

In ordinary pumps with movable piston, friction is chiefly due to the packing of the piston in the barrel and of the piston rod in the stuffing box, and the working of the rod in its guides, to which must be added that of the water in the rising main. The usual cupped leather, forced against the interior of the barrel by the whole pressure of the water while being impelled upward, is in this pump superseded by superposed segments of leather, breaking joint with one another, clamped between washers, and pressed uniformly against the inside of the barrel by an internal spring. With this packing the influence of the pressure of water while being forced upward is *nil*, so that one great contingent in the total amount of friction is suppressed.

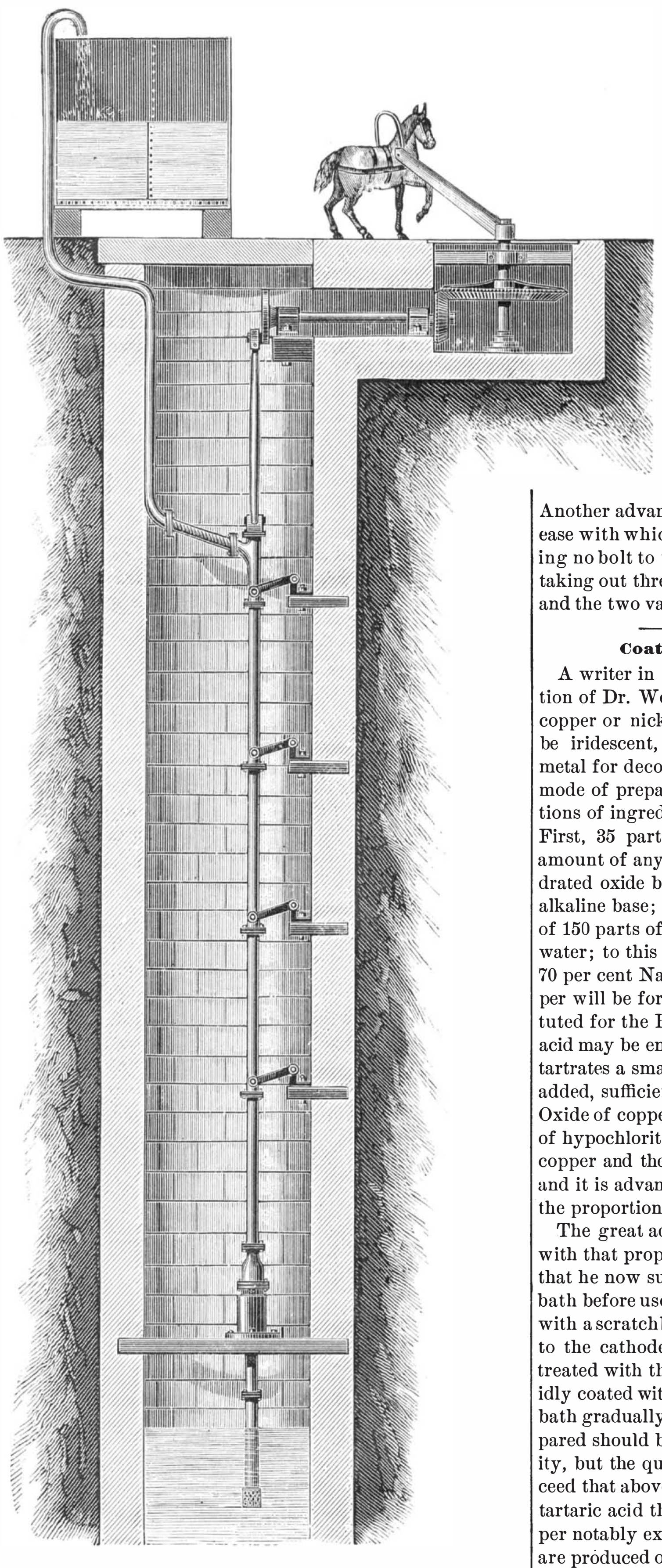


Fig. 1.—THE DONNADIEU PUMP.

Fig. 1 of the accompanying engravings shows the single barrel form of this pump, as applied to wells and arranged for being worked by a horse gear. The piston, fastened to the crossbearer, consists of a hollow rod serving for the suction, which is fitted with the packing above described, and contains in the center a clack valve opening upward. The movable barrel terminates at its upper extremity in a cap, which forms a box for the delivery valve, also opening upward. Both these valves are on the center line of the pump, so that no change of direction is given to the water. The cap is in communication with the rising main, which at the same time forms the pump rod, transmitting the reciprocal motion to the barrel. This combined rod and delivery pipe is guided by stays working on pins at each joint of the pipe. The delivery may take place through a spout inserted in the top of the hollow rod itself, or the hollow rod may be connected to a fixed delivery pipe by a flexible joint, while in large pumps this joint is rigid, working in a cylinder provided with a stuffing box.

It will thus be seen that the friction of the rods in their stuffing boxes, as it exists in ordinary pumps, is entirely suppressed, and that the friction of the guides is greatly diminished, since it is reduced to the simple and very slight oscillation of a pin in its bearing. There is also no friction in the rising main, because the water, instead of being forced by the piston up the delivery pipe, is merely raised with the rod and at the same speed. A still greater saving of friction, and consequently of power, is effected by the adoption of the double pump, as shown by Fig. 2; for the mass in motion may be so perfectly balanced as to reduce resistance to a minimum, and afford a very high delivery in proportion to the power employed. This is due, not merely to the great diminution of friction and the facility for balancing the parts in motion, but also to the position of the valves, which are in the direct line of the action; they occasion no change of direction to the water, which therefore rises naturally. This application of the pump is suitable for great depths, as in mines.

The single Donnadieu pump may be applied with advantage to removing the *débris* and keeping the drill cool in boring operations, as the water is delivered in the very center of the boring, and the pump works equally well above or under water. Another advantage which should not be lost sight of is the ease with which the pump is got at for inspection, there being no bolt to unscrew and no joints to break. By merely taking out three pins without the aid of any tool, the piston and the two valves are freely exposed.

Coating Iron with Iridescent Copper.

A writer in the London *Mining Journal* thinks the invention of Dr. Weil, of Paris, for coating iron and steel with copper or nickel in such a manner that the surfaces shall be iridescent, opens a large field for the employment of metal for decorative purposes. He has found that the best mode of preparing the metalizing bath and the best proportions of ingredients are indicated in the following directions: First, 35 parts of crystallized sulphate, or an equivalent amount of any other salt of copper, are precipitated as hydrated oxide by means of caustic soda or some other suitable alkaline base; this oxide of copper is to be added to a solution of 150 parts of Rochelle salt, and dissolved in 1,000 parts of water; to this 60 parts of best caustic soda, containing about 70 per cent NaO, is to be added, when a clear solution of copper will be formed. Other alkaline tartrates may be substituted for the Rochelle salt above mentioned, or even tartaric acid may be employed, but in the case of tartaric acid or acid tartrates a small additional quantity of caustic alkali must be added, sufficient to saturate the tartaric acid or acid tartrate. Oxide of copper may also be employed precipitated by means of hypochlorite, but in all cases the proportions between the copper and the tartaric acid should be maintained as above, and it is advantageous not to increase to any notable extent the proportion of the caustic soda.

The great advantage of the present process as compared with that proposed by the same inventor a few years ago, is that he now substitutes a Gramme machine for the alkaline bath before used. The object to be coppered is to be cleaned with a scratchbrush in an alkalino-organic bath, and attached to the cathode, and immersed in the coppering bath, and treated with the usual precautions, when it will become rapidly coated with an adherent film of metallic copper. As the bath gradually loses its copper, oxide of copper as above prepared should be added to maintain it in a condition of activity, but the quantity of copper introduced should never exceed that above prescribed as compared with the quantity of tartaric acid the bath may contain. If the quantity of copper notably exceeds this proportion certain metallic irisations are produced on the surface of the object. These effects may be employed for ornamental and artistic purposes. According to the time of the immersion, the strength of the current, and the proportion of copper to the tartaric acid, these iridescences may be produced of different shades and tints, which may be varied or intermingled by shielding certain parts of the object by an impermeable coating of paraffine or varnish, while the iridescent effect is being produced on the parts left exposed. All colors, from that of brass to bronze, scarlet, blue, and green, may be thus produced at will.

If it be desired to deposit nickel, the only modification of the above process requisite is the substitution of precipitated oxide of nickel for the oxide of copper, produced by precipitation as above mentioned. In the above process it will be observed that the introduction of sulphuric acid into the bath is avoided, at least except in such insignificant quantities as may still adhere to the precipitated metallic oxides. Now, I think it will occur to most of your readers that the amount of ornamentation that could be produced with metal work treated by the above process would justify a large outlay for providing the necessary plant. The ornamental iron castings made both in Great Britain and France are really beautiful in form and design, and by the judicious coloration of them with combinations of iridescent brass and scarlet, brass and blue, or brass and green, would produce effects which would insure their general adoption.

Clothing in its Relation to Health.

Approximately, the human body when clothed resembles a steam jacketed pipe; the clothing forms the outer covering, between which and the body there is a layer of steam and heat, and which are constantly ascending. The place where this current of hot air and steam passes out into the atmosphere is the narrow ring between the neck and the shirt collar. This opening plays, therefore, an important part in the maintenance of the temperature of the human body. If it is enlarged, the heat and steam escape more quickly, and the skin is soon cooled; if, on the contrary, it is wholly or partially closed, by being closely buttoned or by a muffler, then the loss of heat is stopped, and the temperature of the skin raised. Thus there is nothing more injudicious than the constant wearing of a muffler or the thick neckerchief of our forefathers, because it impedes the evaporation of the matter which ought to pass out of the skin; though, for the same reason, it is of great value in case of a cold.

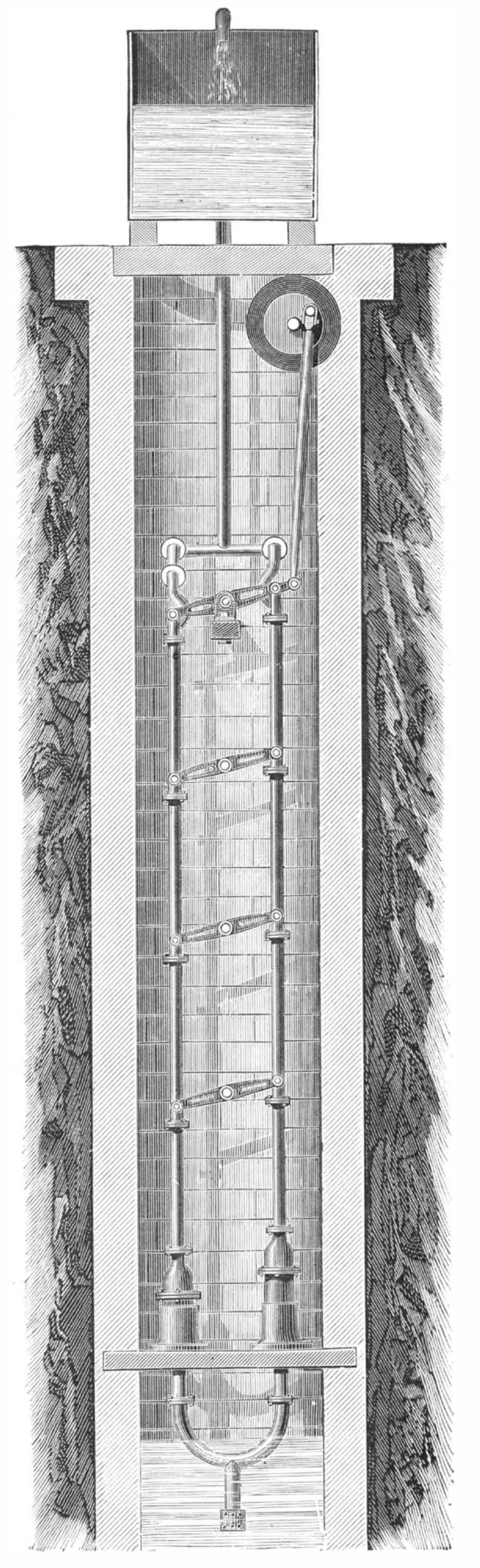


Fig. 2.—THE DONNADIEU PUMP.

While the dampness of the atmosphere affects the evaporation through the lungs as well as the skin, clothing, by night as well as by day, regulates that of the latter. All covering which impedes this evaporation acts injuriously. Though no material is quite faultless in this respect, there is still a great difference in their structure. The less they are impervious the more they are to be avoided. India rubber stands at the bottom of the list, for it does not admit of the passage of any water; leather comes next; less objectionable, but still repellent, is close linen, as an instance of which we may mention the blue linen blouses worn by the Belgians and Dutch, and also the French, over their other garments as a kind of waterproof. Cotton has a great advantage over the foregoing, as it is, to a certain extent, porous; but the best of all percolators is a woolen material. Thus a flannel shirt is more healthy than a cotton one, and a blanket a far better covering for the night than a linen sheet.

The action of the skin depends also upon the circulation of the blood under its surface, and the latter is promoted by outward friction; a material which induces the latter is therefore also more healthy, and rougher underclothing, such as woolen or coarse cotton, are preferable to the enervating finer linen or silk.

Another point to be observed is the keeping of the skin warm, because warmth keeps the pores open, while cold contracts and closes them; and here again woolen clothing stands first.

Thus it is proved that in point of porousness, friction, and warmth, woolen clothing is to be preferred to all others.

But not only the material of the clothing is of importance, but also its cut. In warm climates, where clothing is more a luxury than a necessity, the loosest garments are the best; but in those latitudes where a certain amount of warmth has to be obtained by clothing the garments must be worn more closely fitting. We have before likened the human body to a steam jacketed pipe, where this steam is constantly in an ascendant motion; the faster this circulation takes place, the more is the skin cooled; it follows, therefore, that the most regular and constant evaporation is maintained by closely fitting garments, and the soldier's uniform is therefore the healthiest of all.

We need not here enlarge upon the very extended use of flannel underclothing, especially as shirts, which has come in vogue since cotton clothing rose to such exorbitant prices during the American war, and which, once appreciated, has not been abandoned since. This has also led to the production of a great many textile fabrics containing more or less wool mixed with cotton or other fibers, in order to counteract the shrinkage of the latter and make the fabrics more adapted for washing, one of the products being the vigogne yarn, to which we have lately drawn attention.—*Textile Manufacturer.*

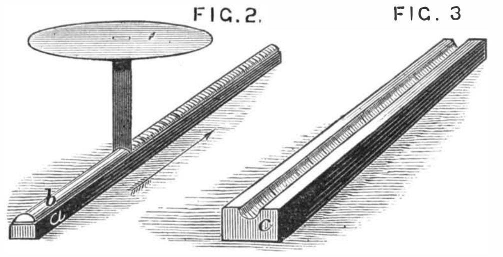
A SIXPENNY PHONOGRAPH.

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

The sixpenny phonograph, which is represented in Fig. 1, consists, first, of a hollow cone of pasteboard, about one inch and a half in diameter, whose apex is connected to the center of a similar sized pasteboard disk by means of a lead wire about sixteen inches long; and, second, of a small board or tablet, on which is fixed one or a larger number of short lengths of lead wire, each of which bears upon its upper surface a phonographic embossed record corresponding to a certain word or sentence, by which it was originally produced. The method is as follows: The upper surface of a rectangular prism of glass, or other hard and rigid material, is thickly coated with stearine wax, which is then scraped into a convex form, as shown in the diagram, Fig. 2, in which *a* represents the glass bar and *b* the convex coating of stearine. This bar is then fixed into a simple phonographic instrument, which, by means of a screw or other mechanical contrivance, traverses it at a suitable speed below a diaphragm. This diaphragm is rigidly held around its circumference by an annular framework (not shown in the diagram), and is in every respect exactly similar to the diaphragm of an ordinary phonograph. To the center of this diaphragm is attached a thin flat plate, whose lower end is cut out to a concave curve to fit the convex surface of the stearine, *b*. When all is properly adjusted, and the temperature is so arranged as to give to the stearine surface the proper degree of hardness to insure the best results, the handle of the instrument is turned, and at the same time words are spoken against the diaphragm, which immediately set up in it vibrations, which are communicated to the plate or style. While this is moving up and down, following the vibrations of the diaphragm caused by the voice, the stearine coating of the bar, *a b*, is steadily drawn in the direction of the arrow below the vibrating bar, receiving from it a phonogram similar to that produced on the tinfoil of an ordinary phonograph.

The stearine bar is then coated with a fine surface of plumbago, so as to give to it an electrically conducting surface, and it is then electro-plated with copper by the ordinary process. Out of the copper coating so formed the stearine is removed, and a rigid backing of lead or other metal having been run over the outside convex surface of the copper,

FIG. 2. FIG. 3



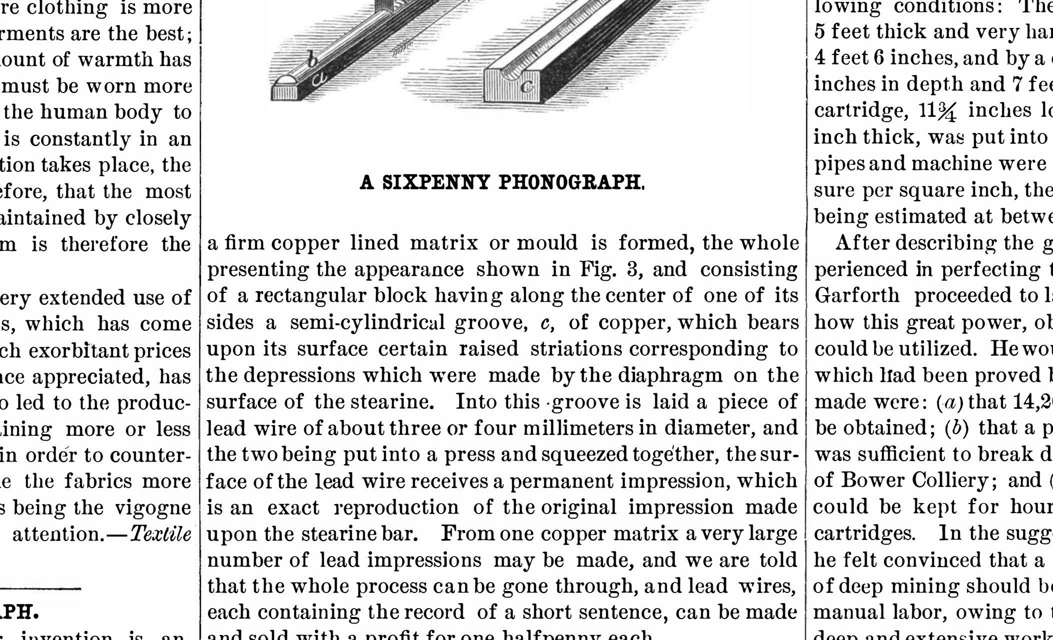
A SIXPENNY PHONOGRAPH.

a firm copper lined matrix or mould is formed, the whole presenting the appearance shown in Fig. 3, and consisting of a rectangular block having along the center of one of its sides a semi-cylindrical groove, *c*, of copper, which bears upon its surface certain raised striations corresponding to the depressions which were made by the diaphragm on the surface of the stearine. Into this groove is laid a piece of lead wire of about three or four millimeters in diameter, and the two being put into a press and squeezed together, the surface of the lead wire receives a permanent impression, which is an exact reproduction of the original impression made upon the stearine bar. From one copper matrix a very large number of lead impressions may be made, and we are told that the whole process can be gone through, and lead wires, each containing the record of a short sentence, can be made and sold with a profit for one halfpenny each.

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

It is only fair to Mr. Edison, the inventor of the phonograph itself, to point out that the plan of producing a phonogram on a stearine surface, and afterwards reproducing it in copper by the process of electrolysis, was suggested by him long ago, but we do not understand that M. Lambrigot claims any novelty for that portion of the invention, but more especially for having produced a little instrument at the cost of a few pence, which can demonstrate the action of the phonograph and illustrate some of the most beautiful phenomena connected with the science of acoustics.

The sixpenny phonograph described as above in *Engineering*, is a novel affair, but we doubt if it is, after all, as simple and effective as one described and illustrated in our columns some eight months since. Page 118, Vol. 39.



A SIXPENNY PHONOGRAPH.

Compressed Air for Blasting in Mines.

At a meeting held at Manchester, England, recently, Mr. Joseph Dickinson, H. M. Chief Inspector of Mines, in the chair, a paper "On the Advantages of Compressed Air at High Pressure (8,000 lb. and upward to the square inch) as compared with Blasting by means of Gunpowder or other Explosives," was read by Mr. W. E. Garforth, of Dukinfield. After referring to the various efforts which had been made to dispense with gunpowder for blasting in mines, Mr. Garforth stated that a machine had been invented by Messrs. Garforth, of Dukinfield, for bursting down coal by means of compressed air. The machine was portable, of small dimensions, so as to be suitable even for small mines, and could be worked by two men, and by it air had been compressed to 946 atmospheres, or 14,200 lb. per square inch. The compressed air was conveyed through wrought iron pipes to a cast iron cartridge 12 inches long, placed in a hole drilled in the coal, and the cartridge, when its known breaking strain was reached, burst and broke down the coal.

A machine had recently been made by Messrs. Garforth which was capable of giving 2,000 lb. pressure to the square inch, and by permission of Messrs. Morland, of Hollinwood, a trial was made at the Bower Colliery in the presence of some of the members of the Geological Society under the following conditions: The coal known as the Bower Mine was 5 feet thick and very hard. It was undercut to the depth of 4 feet 6 inches, and by a drilling machine a hole was cut 39½ inches in depth and 7 feet from the cut end of the coal. The cartridge, 11¾ inches long, 3 3-16 inch diameter, and 9-16 inch thick, was put into this hole and stemmed tight. The pipes and machine were then attached, and at 9,553 lb. pressure per square inch, the coal was broken down, the quantity being estimated at between 5 and 6 tons.

After describing the great difficulties which had been experienced in perfecting the machine and the cartridges, Mr. Garforth proceeded to lay before the members his ideas of how this great power, obtained by means of compressed air, could be utilized. He would first state that among other points which had been proved by the experiments which had been made were: (*a*) that 14,200 lb. pressure per square inch could be obtained; (*b*) that a pressure of 9,550 lb. per square inch was sufficient to break down the coal in a hard mine like that of Bower Colliery; and (*c*) that the pressure when obtained could be kept for hours both in the machine, pipes, and cartridges. In the suggestions which he was about to make he felt convinced that a machine to meet the requirements of deep mining should be such as not to require too much manual labor, owing to the high temperature experienced in deep and extensive workings.

What he proposed was to use a vessel or small receiver, made so very strong that the bursting point would be six or seven times the required pressure, proved beyond doubt to be perfectly safe in transit, also of such a capacity as would allow highly compressed air to expand into the pipes and cartridges without reducing the pressure below the known bursting point of the cartridge. The air compressing machine necessary to fill this receiver with highly compressed air might be fixed on the surface, or, if preferred, at the bottom of the shaft, and worked by steam in the ordinary way. These portable receivers should then be charged with air to the required pressure, sent into the various working places, attached by means of a valve and pipes to the cartridges with the coal, and then by simply opening the valve the air in the receiver would rush into the cartridge and explode it, the operations requiring little or no manual labor. Of course, it would be understood that the receiver could be placed at a sufficient distance away to obviate the use of pipes; the receiver could be placed near, and the valve opened by other means.

If the expansion of the air were found to be such as to make the receiver too large, a small hydraulic pump might be connected to it, and by forcing water through the valve opening upward, the water would thus occupy the place of the air, and by this means any pressure which had been lost through expansion could be recovered, or, if necessary, increased to more than the original pressure. As water was, comparatively speaking, incompressible, the time taken to effect this operation would not be long nor the labor very great. In the same way that machines were improved upon the original idea, so he felt convinced that in a short time this great force of ten, fifteen, or twenty thousand pounds pressure per square inch would be so utilized that they would be able to put into the hands of the miner a power that, when gunpowder and other explosives were prohibited, would enable him to get the coal with the same facilities as now, without the risks from blown out shots, explosions, or the production of deleterious gases.

It might appear strange to old miners when it was proposed to place a small machine in the hands of the workmen, but certainly not more strange than it did to engineers when men chipped and worked by hand what was now done by planing, riveting, or other machines. When they considered the great restrictions at present placed upon the use of gunpowder and other explosives in mines, and that every day the coal to be got lay at a greater depth, and the difficulties of getting increased more than *pro rata* with the depth, he thought there could be little doubt that in a few years the government would entirely prohibit the use of explosives in mines. He now proposed to compare the two systems of breaking down coal—by gunpowder and that by compressed air at 8,000 lb. pressure per square inch or upward. The undermining of the coal would in both cases be about the same, also the time taken to drill the hole, provided the machine drill was used. If the arrangement of the receiver as proposed in the foregoing remarks, with or without hydraulic pump, were carried out, then the time taken to fire the gunpowder or burst the cartridge by compressed air would be about the same. In stemming the hole there would be a gain in favor of gunpowder of about ten minutes, but at the same time it would be at greater risk. If instead of the portable receiver a machine had to compress the air to the required pressure, there would be a gain of about thirty minutes in favor of gunpowder; but, as they were aware, when a shot had been exploded by gunpowder the working place was filled with smoke for a quarter, half, and in some cases three quarters of an hour, so that the gain in time was more than counterbalanced.

Compressed air, however, possessed advantages ever gunpowder which could not be too highly estimated, above all as regarded safety. He thought there was no one connected with mining but would admit that the time had now arrived when some power ought to be found to supply the place of gunpowder when it was prohibited, to enable us to produce coal as economically then as now. Should gunpowder and other explosives be prohibited, what was the best means to supply their place? He thought for the reasons he had named in the foregoing paper that compressed air would stand foremost, especially for its safety. Although monetary considerations might, to a certain extent, weigh with people, no one could deny for a moment, after seeing the lavish expenditure made by colliery proprietors for the safety of their men, that safety was the main consideration with both mine owners and the managers.—*Colliery Guardian.*

THE NEW YORK ACADEMY OF SCIENCES.

A meeting of the New York Academy of Sciences was held Monday evening, May 12, Prof. Newberry in the chair.

COPPER AND SILVER IN MAINE.

At the request of the president, Dr. Hamlin, the author of a very interesting book on tourmalines, gave an account of the new mineralogical discoveries in Maine. Until very recently it was not known that either copper or silver existed in Maine. A copper belt, some two miles long and from 200 to 400 feet wide, has now been discovered about the middle of the southern part of Maine, directly on the coast; but it is impossible as yet to present any trustworthy information in regard to the richness of the deposit.

Some twenty miles to the northeast of this copper belt silver has been found in flakes, masses, and filaments, specimens of which have found their way to Boston for exhibition. A shaft has been sunk some hundred feet deep, and it is reported that the ore increases in richness with the depth.

GEOLOGICAL NOTES.

Dr. Newberry announced the receipt of a collection of fossils from Moosehead Lake, and also of one from Fort Bennet, Dakota, which latter appeared to the finders as of vegetable origin, resembling a species of nuts, but which on examination proved to consist of saurians' teeth, having some resemblance to the teeth of crocodiles, but not being as yet sufficiently investigated for identification.

Further geological investigation of the north shore of Long Island confirms the conclusion previously arrived at, that the micaceous sandstone found there in the glacial drift, and containing impressions of dicotyledonous leaves, belongs to the cretaceous period. Its source has not as yet been ascertained.

The paper of the evening was by Dr. Albert R. Leeds, of the Stevens Institute of Technology, on the presence of peroxide of hydrogen in the atmosphere.

PEROXIDE OF HYDROGEN IN THE ATMOSPHERE.

The existence of hydrogen peroxide in the atmosphere has been doubted by many investigators. The reason of this is to be found in the difficulty of ascertaining its presence, seeing that several other substances, such as ozone, nitrous acid, and nitric acid, give almost identical reactions. Numerous tests have been devised to distinguish these substances, but nearly all are liable to objections. A solution of iodide of potassium and starch is colored blue by ozone as well as by the peroxide. The addition of sulphate of iron, or of litmus, has been recommended, but the results have been questioned. Struve proposed a solution of oxide of lead in caustic potash, with the addition of a few drops of basic acetate of lead, in which the peroxide of hydrogen produces a precipitate of binoxide of lead. A freshly prepared solution of guaiacum that has not been exposed to the light, and to which a watery infusion of malt has been added, first turns pink and then blue by the action of the peroxide, and forms a test of such delicacy that one part in ten millions can easily be detected. Yet this test is also affected by ozone. The investigations in progress at the Institute seem to indicate, however, that ozone acts upon it much more slowly than peroxide of hydrogen does. The same remarks apply to the test of A. Levy, of Paris, who uses arsenious acid and arsenite of sodium, which are converted into arsenic acid and sodium arsenate by the action of ozone.

Reasoning from the analogy of the recomposition of nitrate of ammonia from nitrous oxide and water, our distinguished chemist, Sterry Hunt, threw out the ingenious suggestion that the nitrates in the atmosphere might be due to the combination of atmospheric nitrogen with evaporating water. Later, Schönbein, the discoverer of ozone, came to the same conclusion from different premises, and actually found nitrites in the air wherever water was evaporated. Bohlig, however, demonstrated that in these experiments the proper precautions had been neglected, and that the nitrites found pre-existed in every case in the atmosphere. When the air was previously purified from every trace of nitrites none could be detected in the results of the experiments. This was a fortunate fact, for if nitrites were formed by mere evaporation of water in the air, atmospheric tests would be of no value, as we could never determine to what agency our reactions were due. In another sense, however, it was unfortunate, as it deprived us of a very plausible explanation of nitrifaction in the atmosphere, on which plant life is in a great measure dependent.

The most extensive investigations of the presence of hydrogen peroxide are those of Schoene, of Moscow, who examined all the snow, hail, rain, and sleet that fell in Moscow for one year, beginning July 1, 1874, and ending June 30, 1875. He found peroxide present in 208 out of 215 specimens of hail and rain, and in 86 out of 172 specimens of snow and sleet. The average amount was 0·17 c.c. in 1,000 cubic meters of air. His method was to add his sample to a weak solution of iodide of potassium and starch, and to compare the coloration with that produced by standard peroxide solutions of different strength. He found among other interesting results that the equatorial winds were much richer in peroxide of hydrogen than the polar winds. Houzeau, of Paris, was unable to find any peroxide in the atmosphere of that city, and it is suggested that it may be absent in some localities. Prof. Leeds found none in Hoboken, although his processes are so delicate as to enable him to detect minute quantities like the following: 100,000,000 parts of air were found in one analysis to contain 16 parts of ammonia, 10 parts of nitrous acid, and 17 parts of nitric acid, equivalent to 15 parts of nitrite and 20 of nitrate of ammonia.

The influence of these substances may be of the utmost importance in relation to health and disease, as well as to vegetable life and growth. But the investigations made in reference to their determination, both qualitative and quantitative, will be of limited utility so long as any doubt is possible as to the reliability of the tests employed. When the New Jersey Board of Health desired Dr. Leeds to furnish them with trustworthy ozonometers to be used in systematic observations throughout the State, he was obliged to reply that there were none he could recommend.

INDUCED MAGNETISM.

Mr. Wolcott then exhibited an experiment to show that a wire, magnetized at its middle point by contact with the pole of a magnet, had the same polarity at both ends. Prof. Seeley then made some remarks on induced magnetism, which were discussed by Mr. Warner, and the Academy adjourned.

C. F. K.

Hyposulphite as a Therapeutic Agent.

Anthony's Bulletin contains a communication from a correspondent proclaiming the rare virtues of hyposulphite of soda as cure for erysipelas. Medical men are familiar with the use of hyposulphite as a somewhat active aperient, and it is regarded by some as very valuable in removing impurities of the blood; but it has not come much into use in medicine. We place the new claim for it on record, but would caution our readers against experimenting with disease. Erysipelas is too dangerous a malady to be tampered with, and should be placed under the treatment of a competent medical man. We subjoin the communication in question:

"I take pleasure in communicating the needed information concerning the virtues of hyposulphite of soda in erysipelas. Of course, when erysipelas proceeds from a wound, it is more delicate to manage, and requires the best surgical skill; but when it is of the milder form, on the outside skin in the face or any other part of the body, proceed as follows: Take of hyposulphite of soda any quantity, and make a saturated solution in a bottle of any convenient size—six, eight, or ten ounces. If the individual is a strong, hearty man, and the disease has a good start, give your patient one tablespoonful every hour for twelve hours; then decrease the dose, as the benefits become manifest, say once in three hours. It may cause diarrhea; but never mind, it will destroy any febrile symptoms. Twenty-four hours is generally sufficient to produce a decided change for the better, unless it has six or seven days' start, in which case it will take longer. The results are generally so wonderful that I have never known the remedy to fail. With an old person you may substitute a teaspoonful for tablespoonful, and once every two hours. You may put this down: that the sooner you can get a good quality of the soda solution into the body, the sooner the trouble will be over. Now, for an outward application: use equal parts of the soda solution and glycerine; saturate cotton flannel with the above, and lay on the part affected. Eat simple food—avoid all exciting food and drink; farinaceous diet is absolutely necessary. If you can bathe the part affected with the above solution, do so; then lay on the saturated cotton.

"Hypo is equally as efficacious in any poisons from insects or vegetables; old wounds in sores are soon healed by washing the parts in a solution of soda. It is also good in typhoid fever, carefully administered.

"Now, if a person has a form of erysipelas that is not so decided, but (say) chronic, let him take a teaspoonful every night of the solution, and the disease will be entirely removed, if kept up for a month. The disease seldom or never attacks a person the second time when eradicated by the soda treatment.

"If any other information is needed, I shall be very much pleased to communicate, for I consider the foregoing has saved my life, and it has cured fifty persons in succession without fail right under my own supervision."

RECENT MECHANICAL INVENTIONS.

An improved apparatus for automatically measuring and discharging grain has been patented by Mr. Robert H. Edmiston, of Loveland, Col. It is particularly intended for use in connection with thrashing machines to measure the grain as it is delivered from the thrasher.

Mr. Daniel D. McIntyre, of Sterling, Neb., has invented an improved washing machine, consisting of a semi-cylindrical suds box, having a slotted bottom, and having a pump barrel for creating a circulation of the suds, as the semi-cylindrical rubber is operated by means of a hand lever.

An improved press for compressing cotton and other similar materials has been patented by Mr. W. J. Butts, of Willow Green, N. C. It consists in a horizontal box mounted on wheels, and drawn forward by a screw, the ribbed bed at the end of the box being drawn forward by a screw toward a fixed ribbed platen, so as to compress cotton contained in the box.

Messrs. F. E. Cross and R. G. Speirs, of Waterbury, Conn., have patented an improved machine for straightening and cutting wire. It is arranged to work automatically, and it consists in an arrangement of clamps and a stopping device in connection with cutting mechanism, which cannot be described without an engraving.

An improved grain toller has been patented by Mr. David Waugh, of Willsburg, W. Va. It consists in a notched rotating disk arranged in the grain tube. It is contrived so that the grain that passes through the notch as the disk revolves is counted as toll.

An improvement in machines for dressing millstones has been patented by Mr. David L. Ellis, of Homer City, Pa. It consists in the combination of an adjustable slide provided with a rubber block or strip and set screw, and a peculiar arrangement of frame and feed screw.

Messrs. S. S. Black, of Fredericton, N. B., and Charles A. Black, of Chicago, Ill., have invented an improved machine for trimming the sole edges of boots and shoes. It consists in a combination of ingenious devices, whereby the sole is quickly and neatly trimmed.

Large Farming a Precarious Business.

The following figures are given by a San Francisco correspondent of a Philadelphia paper, as evidence that farming on a gigantic scale is profitable neither to the country nor to the farmer. He says: "The largest wheat producer in California, or in the world, is Dr. H. J. Glenn. He was formerly from Monroe County, Missouri. He is a man of great enterprise and energy. His ranche lies in Colusa county, and comprises 60,000 acres, nearly all arable land. He has this year 45,000 acres in wheat, which, at a low calculation, will produce 900,000 bushels. His wheat will sell for 85 cents per bushel, or $765,000. Dr. Glenn has been farming ten years, and one would suppose he ought to have a handsome sum to his credit in bank; but what with a failure of crops—which occurs two years in every five—and the enormous interest he pays on his loans, he is said to owe a round million of dollars. Last year his credit was bad, as he had no crop. Now, with his splendid crop in prospect he will probably get out. The Dalrimples of St. Paul, who, ten years ago, were the largest farmers of wheat in Minnesota, raising as much as 40,000 bushels in a single year, went to the wall. Another large wheat raiser is D. M. Reavis, whose land lies on the borders of Colusa and Butte counties. He is also from Monroe county, Missouri, and has an unpretending little estate of 15,000 acres, 13,000 of which are in wheat, which he thinks will average this year 30 bushels, or 390,000 bushels. He also is hard pressed, and I am told is paying 9 per cent on a couple of hundred thousand dollars of borrowed money. If farmers raising half a million to a million bushels of wheat cannot get out of debt, it might be well to inquire what is the use of having so much land? The truth is that from the frequent failure of crops in California and the waste that attends on large operations of that kind, farming on a gigantic scale in this portion of the Pacific coast must be considered a failure. North of this, in Oregon and Washington Territories, there is no failure of the harvest; farming operations are carried on on a smaller scale, and consequently the farmers, while not rolling in wealth, are all well to do."

Rapid Communication.

A merchant, sitting in his office in South St., New York, recently received an answer to his dispatch sent to Shanghai, six hours previously. Thirty thousand miles in six hours is good time, even for the telegraph. The charge to Shanghai is $2.80 per word; to Yokohama, $3.05; but the code, or cipher, is so well systematized by certain mercantile houses, that a single word serves for a dozen when transcribed.

The Electric Light.

Mr. W. H. Preece, the eminent electrician, recently delivered, at the Albert Hall, London, a lecture on the Exhibition of Electric Lighting Apparatus. The Prince of Wales, the Duke of Edinburgh, and a large assembly of ladies and gentlemen were present. The Werdermann light was one of the first shown, and while it lasted, was both bright and steady. Much attention was also excited by the light produced by iridium rendered incandescent by electricity, and much satisfaction was expressed at its extreme brightness, purity, and steadiness. The Lontin light also made a brilliant show, and the Rapieff was greatly admired on account of its steadiness. Then came the turn of the so-called "candles," constructed on the systems of Jablochkoff and Wilde. The former of these, ranged round the upper corridor, for an instant shone brightly, but afterward gave evidence of capriciousness. On the other hand, the Wilde lamps, from their being close together instead of distributed over a wide circuit, or from some other cause, burned very steadily and well. Mr. Preece then introduced the audience to the "holophote," a powerful lamp for "illuminating the depths of the sea," about to be introduced into the ports at Spithead, with a view to testing their value in detecting the advance of an enemy's torpedo. He next referred to the advantage of the "arc" over the "incandescent" system in economy of power, and the strength of the incandescent lamps in their great steadiness and durability. The Wallace-Farmer lamp was then tried, and with very satisfactory results; and the eyes of the audience were next directed upward toward the great Siemens light, or rather chandelier, hanging from the inside of the dome, and which made a noise far less agreeable to the ears than the light was to the eyes.

Mr. Preece dwelt upon the many short-comings of the electric light as at present produced—the noise, the flickering, the deep shadows, and the whiteness of a light which sets all calculations based upon the warm yellow of gaslight at a defiance. On the other hand may be set the absence of smoke and the purification instead of poisoning of the air in large buildings.

A NEW STEAM HAMMER.

The accompanying engraving illustrates an application of Mr. Wadsworth's steam controlling valve to a steam hammer having a rotating anvil, the valve and the anvil block being both under control of the same lever.

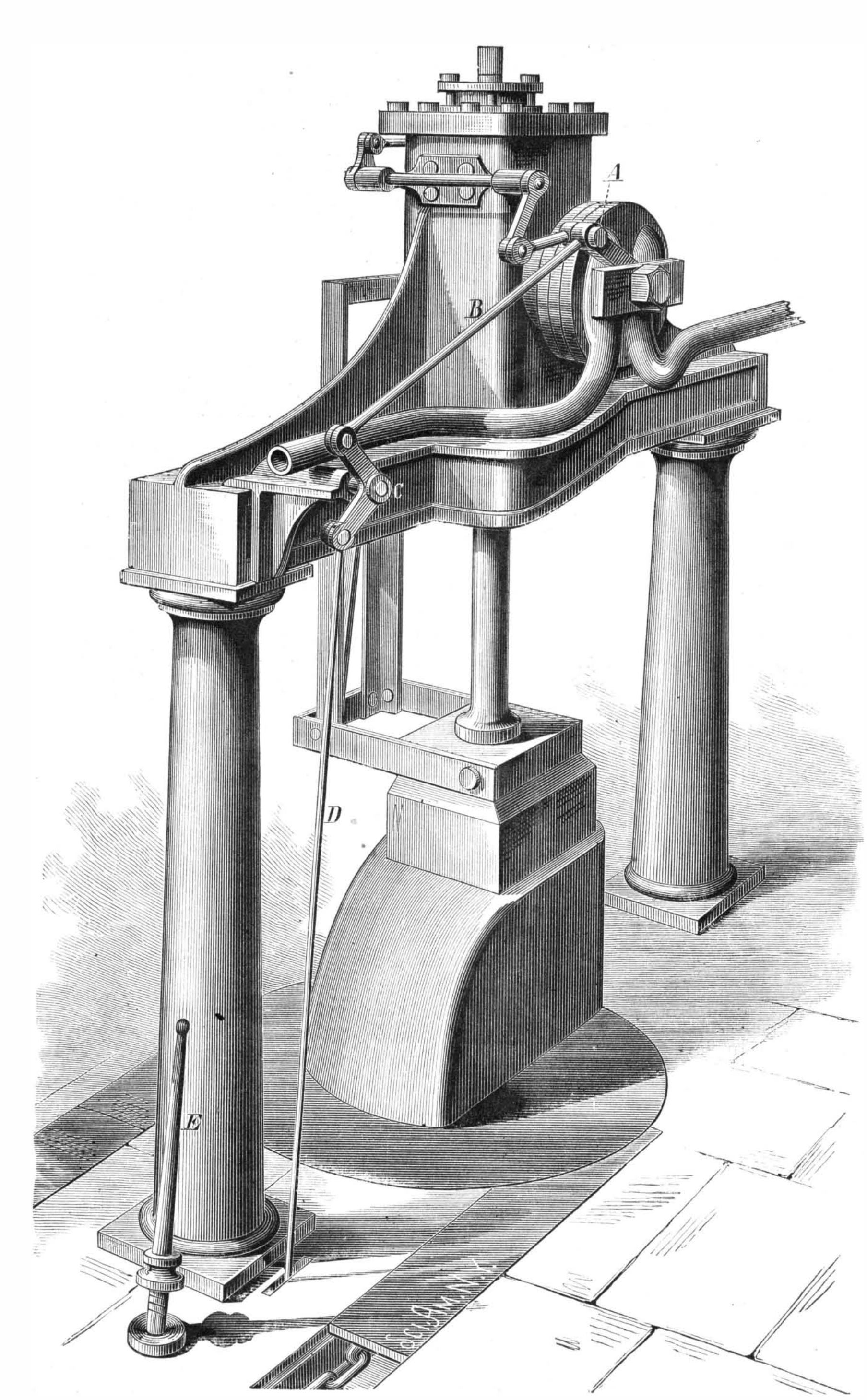
The valve, being substantially the same as that described in connection with the steering apparatus patented by the same inventor, and illustrated on page 191 of current volume of the SCIENTIFIC AMERICAN, will not be described in detail in this connection. It is perhaps enough to state that it is capable of perfectly controlling the admission of steam to opposite ends of the cylinder, so that a blow of any desired strength may be given.

The value of this valve as applied to the working of a steam hammer lies in the facility with which the ponderous machine may be controlled, and the exemption from the possibility of accidents, such as the striking of the piston on the cylinder head, in case of the moving of the anvil from below the hammer, the valve being so contrived as to admit steam at the proper point in the stroke to cushion the piston.

The lever, A, of the controlling valve is moved through the medium of the rod, B, bill crank lever, C, and rod, D, by the lever, E, which is fulcrumed in a ball and socket joint, and is capable of universal motion. The lower end of this lever extends through two slotted and pivoted sectors below the floor, which are arranged at right angles to each other, and are connected one with the controlling valve, and the other with the mechanism by which the anvil is turned. This construction admits of controlling all of the movements of the machine by a single lever. Moving the lever to the right or left effects the steam supply, and moving it forward or backward sets in operation the mechanism which turns the anvil. The anvil, as will be observed, is made convex on one of its sides; it has also a rounded corner and a square corner, all of which are found very convenient in forging irregular work.

Although this machine is intended for bending ships' ribs and performing other similar operations, the details of some of the parts by which this kind of work is done are omitted for the sake of giving a clearer idea of the other parts.

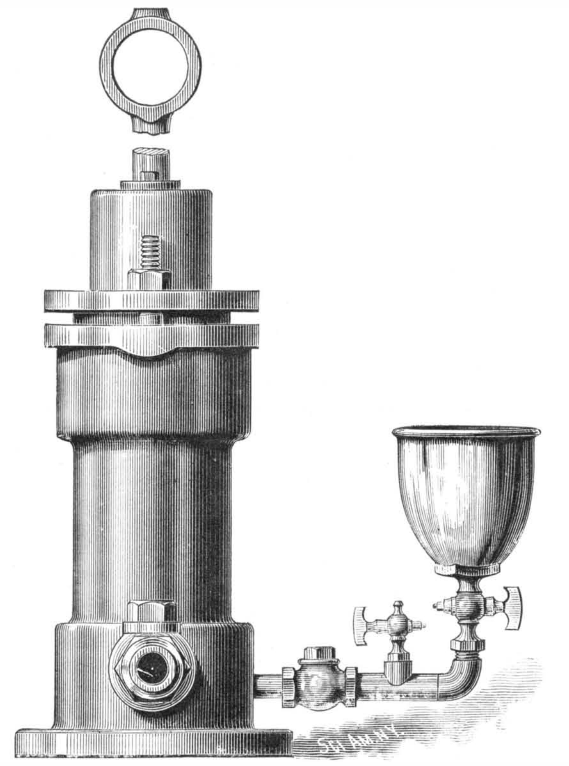
The ingenious valve used in this hammer seems as well adapted to one of its applications as another, performing its functions easily and with precision, whether used in the steering apparatus previously described or in the hammer shown in the engraving. Further particulars relating to this invention may be obtained by addressing Mr. Herbert Wadsworth, Merchants' Bank Building, 28 State street, Boston.



WADSWORTH'S STEAM HAMMER.

ATTACHMENT FOR BOILER FEED PUMPS.

The accompanying engraving shows an improved attachment for boiler feed pumps, for introducing into the boiler



CLEGG'S FEED PUMP ATTACHMENT.

along with the feed water any liquid for preventing or removing incrustation or scale, or to prevent foaming. It consists in a short pipe screwed into the lower end of the pump, having at its outer extremity a cup for containing the liquid to be introduced into the boiler. Between the cup and the pump there is a check valve in the pipe, also a stop cock for closing the communication between the cup and pump. Outside of the check valve there is a small air cock, which may be used to admit small quantities of air to the pump to act as an air cushion to the plunger to obviate pounding and the consequent wear and tear of the pump.

This invention was recently patented by Mr. Benjamin Clegg, of 526 Richmond street, Philadelphia, Pa., from whom further information may be obtained.

RECENT AMERICAN PATENTS.

An improved waste valve, which is applicable to either wooden or iron pumps, has been patented by Mr. Perry A. Peer, of Comstock, Mich. It consists of a pivoted cover arranged to slide over an aperture in a base plate that is secured to the pump.

Mr. Edwin A. Benson, of Detroit, Mich., has patented an improvement in hydrants, which provides for removing, replacing, repairing, renewing, or otherwise manipulating the ground faucet or valve of a hydrant without removing or digging around the box which contains it.

An improvement in car brakes has been patented by Mr. Nathan Webb, of Sacramento, Cal. The object of the invention is to provide a simple car-connecting brake clamp that can be used as a supplement to any other brake connecting clamp.

A hand car, adapted for running upon a track and dumping its load, and which may be used for loading wood or coal upon locomotive tenders, and for other similar purposes, has been patented by Mr. Stephen Johnson, of Huntsville, Texas.

An improved steam rock drill, in which the valve is shifted by the piston before it has completed its stroke, so that the piston will be cushioned, has been patented by Mr. Thomas J. Murphy, of New York city.

An improved weather strip, patented by Mr. Lawrence Scully, of Meridian, Miss., consists in a strip of rubber fitted to a groove in the bottom of the door, so that both of the edges of the strip project below the door and act as fenders against wind and rain.

Mr. William J. Orr, of Rock Hill, S. C., has patented an improved dust-excluding and car-ventilating window, which consists of a series of vertical parallel pivoted transparent slats between which the air passes freely, and which may be so adjusted that when the train is in motion a draught will remove the air from the car.

An improvement in the class of burners used for burning gasoline, naphtha, etc., has been patented by Mr. William H. Russell, of Sedalia, Mo. It consists in a burner tube having a cup near its upper end, a base piece at its lower end, and a hollow wire wound around the upper end of the burner and concealed in the cup with its ends extending to the base piece, one communicating with the supply pipe and the other with a chamber leading to the burner.

An improvement in passenger registers for cars, omnibuses, etc., has been patented by Mr. S. B. Crane, of Davenport, Iowa. The seat or foot rest is made movable so that when a passenger sits the device closes an electrical circuit which is connected with a recording device.

An improved spark arrester patented by Mr. Allan Talbott, of Richmond, Va., is intended for arresting sparks as they issue from the furnaces of steam boilers, and preventing them from passing into the open air. It consists in a number of inverted hollow truncated cones placed at the bottom and top of the smoke stack.

Mr. Martin Rabenau, of Baltimore, Md., has patented an improved apparatus for treating leaf tobacco for developing its flavor, increasing its burning qualities, and darkening its color.

Mr. Thomas H. Locher, of Alburtis, Pa., has patented a chair having a frame made entirely of band iron. The object of the invention is to produce a chair having the greatest strength and rigidity with the employment of a small amount of material.

An improved heat regulator for incubation has been patented by Mr. Frederick Meyer, of Doylestown, Pa. It consists in a lever carrying a tube with reservoirs at each end containing ether and mercury; when the heat expands the ether the mercury is forced to one end of the lever, causing it to tilt and operate the damper.

An improved pole attachment for vehicles has been patented by Mr. James L. Dykes, of Demopolis, Ala. The object of this invention is to furnish combined thills and tongue which may be readily adjusted as thills or tongue.

Mr. George W. Williams, of San Diego, Cal., has patented a simple and efficient trap for catching animals. It consists of a toothed ring secured to one end of a bent spring, the other end of the spring being provided with teeth and held down by a tripping device.

TERRESTRIAL GASTEROPODS.

Next to the insects no class of animals presents such a variety of families and species as the mollusks. While the majority of them inhabit the sea, a limited number abide in sweet water, and a few only live on dry land. These all belong to the order of Gasteropoda, and differ from the majority of other mollusks by being supplied with well developed pulmonary organs, enabling them to breathe atmospheric air. They may be divided into two groups—snails and slugs—the former of which are provided with a helical shell, while the latter are entirely naked shell, possessing instead of a shell only a calcareous deposit under the shield forming the fore part of the back. As the anatomical structure of both groups is identical we may describe them jointly. From the head protrude two pairs of tentacles, which have the form of the finger of a glove, and may be retracted and projected. The posterior pair carry the small black globular eyes. The tentacles are very sensitive to the touch and the eyesight is apparently very poor; the animal depends on its feelers, principally, for guidance. The mouth is located in the center of a thick muscular mass; in the upper lip lies embedded a crescent-shaped grooved plate, forming the upper jaw. Directly below and opposite to this is placed the tongue, which carries on its upper surface a disk lined with numerous transverse rows of teeth. In eating the snail grasps its food between the upper jaw and tongue, and rubs it to a smooth paste between the friction plates. By the peculiar motion of the tongue the paste is conducted into the œsophagus and stomach. On both sides of the tongue are situated the salivary glands, connected with the mouth by separate ducts. Behind the stomach is found a voluminous liver. This is traversed by the intestine, which turns, after leaving it, and leads to the anus located in the neighborhood of the branchial opening. Into the same opening are also emptied the secretions of the kidney, which is situated near the heart.

Two minute glands near the entrance of the œsophagus are the only organs that might be considered organs of hearing.

Respiration takes place through the branchial aperture, from which the air is conducted to the lung, a cavity nearly filled with a porous, spongy mass, from which numerous minute veins lead to the heart. The latter has two chambers, and by its pulsations sends forth the purified blood coming from the lung on its journey through the body, from which it returns again to the lung. The foot, or rather the ventricular plate bearing that name, is formed of powerful muscles, which propel the animal by alternate contractions and expansions.

Among the principal conditions necessary for gasteropodal life on dry land are moisture and warmth. If deprived of moisture by being, for instance, placed in a pasteboard box in a dry room, most snails will die soon. Instances are, however, on record in which snails have been kept, apparently dead, for months and even years, and revived again by the application of a little warm water. It is, therefore, natural that snails prefer moist spots, shady places under shrubs, trees, stones, etc. Many prefer to creep below the layer of leaves and moss covering the ground in forests, and some even live between the bark and wood of trees.

The most common family is that of Helix, of which alone nearly 5,000 species are known. They all have shells which have either the familiar form of the garden snail or are a little more elongated. The shells are generally wound from right to left, that is, when the mouth of the shell is placed to the right of the observer, the umbilicus turned toward the latter, the whorls will be seen to pass down from right to left toward the end. The whorls may either come into contact in the center and form a spindle, or may remain separated, forming a hollow shell. In some of these the umbilicus is closed, in some open.

The shell consists of about 5 per cent of animal matter, 90 per cent of carbonate of lime, and about 5 per cent of other mineral substances.

In our engraving are illustrated two of the commonest snails indigenous in Europe. The smaller ones are *Helix aspersa*, the common garden snail. It varies greatly in color and form, but is usually of a bright yellow color with brown bands, or numerous irregular stripes. About forty different varieties are known. The larger snail is *Helix pomatia*, or the edible snail, which is very common throughout this country and Europe.

Some snails hibernate regularly. *Helix pomatia* either works its way into the ground or seeks refuge in a natural cavity, and proceeds at once to close the entrance of its shell by a cover formed of material similar to that of the shell. The cover, although not firmly attached to the shell, fits almost air-tight into it. In this state the snail remains throughout the winter, until the warm air of spring and the increased moisture of the soil call it into life again.

In extremely dry weather, or on cool days, snails which do not hibernate retire into their shells; remaining for a while near the entrance, the salivary glands secrete a viscid mucus, which soon forms a partition, closing the shell entirely. As the exterior surface is exposed to the air, the viscid mass dries and forms a thin membrane, which is kept elastic by the moisture exhaled from the snail. As respiration does not entirely stop, there is necessarily going on a constant interchange of air and moisture, the former flowing in, the latter out. When the air becomes moist and warm, as on approach of rain, the air entering the shell carries back the moisture exhaled, the body of the animal, which was wrinkled up and retired to the innermost portion of the shell, swells gradually, until the diaphragm is torn, and the animal resumes its usual mode of life. The period through which this sleep extends varies greatly with exterior conditions.

As might be inferred from the low state of development of the eyes, light is only of secondary importance to the well being of snails; they seem to prefer shady, dark spots.

Snails are used as an article of food. Among the ancient Romans they were esteemed as a great delicacy. Special gardens were devoted to breeding them. Pliny relates of Fulvius Lippinus as one of the principal snail park owners, who is also said to be the discoverer of a delicious *pate* of grape juice, wheat flour, and other ingredients with which snails were served.

In Switzerland, Bavaria, Würtemberg, and Austria, snail culture at one time attained considerable importance. They were raised in numerous gardens; at Ulm alone over ten millions were annually raised, and shipped partially to Austria. Although this industry has now nearly disappeared, snails are still eaten in large quantities in Austria. They are collected in the fall and kept between layers of oats for use. The snails most esteemed in those countries are *H. pomatia, aspersa,* and *hortensis.*

Snails are of great importance as an article of food and commerce in Italy, where numerous kinds are consumed in large quantities. The principal seat of the snail trade is Palermo, but all larger cities have numerous establishments dealing in them, and in some places snail growing and snail hunting form distinct trades. Snails are extremely cheap, and this accounts for their enormous consumption. In the "flying" street kitchens a plate of snail soup can be had for one or two soldi, and this, together with a handful of maccaroni and a slice of watermelon, forms the daily repast of the average Italian lazzarone.

To the second group of terrestrial gasteropods, *Limacidæ*, belong our common slugs. They have no shell, but a calcareous deposit of more or less firmness in the shield covering the neck may be regarded as the rudiment of the shell. Anatomically the slug corresponds to the shelled snail, except that the entrails, which in snails are contained in a bag extending into the interior portion of the shell, are, in the slugs, contained in the main body, which is ordinarily covered by the mantle.

Slugs are divided into two subfamilies—Arion and Limax. *Arion rufus*, as a representative of the former, is very common throughout Europe, about five inches long and of variable color, generally black or reddish-brown. Similar in appearance and size is *Limax ater*, or road slug of Europe; it is generally black or dark-brown, and very common. This species is represented in the engraving.

TERRESTRIAL GASTEROPODS.

Angora Goats Turned to Profit.

The San Francisco correspondent of the Baltimore *Sun* reports a more hopeful prospect for those who have invested so largely in the raising of Angora goats on the Pacific coast. Hitherto these animals have not been profitable owing to the lack of a market for mohair. He says:

The owners of some thousands of these goats, before abandoning the enterprise, concluded to try some way to utilize them. They established experimental works in San José, the beautiful garden city, fifty miles south of San Francisco. After much experiment and vexatious discouragement they have now a flourishing factory, with fifty hands, over one half women. "The Angora Robe and Glove Company" have founded a new and very profitable industry. They have a large tannery, and they have created an unlimited demand for goat skins, till now of no paying value. Their goods, like the woolen fabrics of the coast, challenge comparison with like goods in any part of the world. We have a vast domain of mountain land, with evergreen shrubbery for goat pasture and a climate that is their paradise. What we sadly want is diversified agriculture and manufacturing industry. There is scarcely anything combining these qualities that we cannot raise on this coast, and the crowning success we record will doubtless encourage others in other directions.

Plain Talk to Southern Idlers.

Under this heading, the *Mercury*, of Meriden, Miss., gives some very pointed advice to Southern women, and winds up with a little advice to Southern boys. We quote the letter, premising that from the best of our information and belief, the women of the South have been more prompt to throw off the old prejudice against honest labor than the young men have. The *Mercury* says:

"Our Southern boys must be bred to trades instead of professions, be taught to prefer the plow handle to whittling on the streets and sunning themselves in front of grog shops. Work is the only, open sesame, to the cave where wealth is deposited. Industry and frugality is the great need of the South, but these will not be seen until false pride disappears and self-help takes its place."

DRAINAGE.

The State Board of Health of Massachusetts has lately made public the following useful information:

Local boards of health are reminded that, at this time of the year particularly, special attention is required to secure cleanliness about dwellings and throughout towns.

No decaying matter should be allowed in cellars. On the contrary, they should be kept sweet and clean, and as much exposed to fresh air and sunlight as possible. They should also be made dry, by draining if necessary. It should be remembered that the air of houses is supplied largely from cellars; so that the common practice of storing all sorts of rubbish there should be condemned. If the air of the cellar is impure, it often gives rise to various ailments in the persons breathing it in the rooms above; and not seldom becomes one predisposing cause of such diseases as typhoid fever, diarrhea, dysentery, cholera infantum, diphtheria, scarlet fever, sore throats, and numberless conditions of ill health which cannot be described under any particular name. If the air in the cellar is damp, neuralgia, rheumatism, and affections of the lungs and other respiratory organs are very apt to follow.

The air supplied to furnaces should never be from cellars, but from the outside atmosphere, and, if possible, on the sunny side of the building. This is a very important matter in schools, where there would generally be no difficulty in following the best methods. The air supply should never be drawn from shady back yards, or the vicinity of privies, sink-spouts, etc.

If kept clean ashes may be used to advantage in filling up low spots of land, making paths, etc.

Garbage should never be allowed to accumulate; all that is not fed to fowls or animals on the place should be kept in tight receptacles, and carried away frequently. Pig-pens should not be permitted in thickly settled places.

There should be no soakage into the ground near wells or houses permitted from stables and barns. It will often be found economical to save all the manure, liquid and solid, by receiving it in water tight vessels, etc., or mixing it with loam, under cover, and frequently carting it away.

Chamber slops, and slopwater generally, should never be thrown on the ground near houses. They may be placed directly on the soil of gardens, etc., or pumped up from water-tight cesspools, or be used by distribution under the surface of the soil, in the manner described on p. 334 of the "Seventh Annual Report of the State Board of Health," and now introduced in the town of Lenox, Mass. The chamber slops alone can be easily disposed of by mixing them with ashes or loam, as at the Pittsfield Hospital, by the method shown on p. 87 of the "Ninth Annual Report of the State Board of Health." If the kitchen slops are discharged directly into a cesspool care should be taken that the pipes do not get clogged with grease.

Earth closets serve a good purpose, particularly for sick people and invalids, if carefully attended to, and if well dried loam be used for them in sufficient quantity; they are more easily managed if liquid refuse be kept out of them.

The ordinary privy should be abolished. It is dangerous on two grounds: 1st. It must be so far from the dwelling as to seriously expose children, particularly during bad weather. 2d. It corrupts the air, the soil, and consequently too often the wells. Instead of the common privy-vault, which is not safe even if cemented, it is best to use under the seat some receptacle which can be frequently removed and emptied. Galvanized iron tubs, barrels sawn through the middle, etc., answer the purpose very well. If kept thoroughly disinfected with dry earth or ashes, they can be near houses, connected by passageways, and will not corrupt the wells.

If water closets are used, and there are no sewers, the best disposal of the sewage is by the flush-tank, and irrigation under the surface of the soil, as described on p. 135 of the "Eighth Annual Report of the State Board of Health." If cesspools must be used, they should be tight, and often emptied by the odorless process, or else have their contents pumped out on the surface of the ground for fertilizing purposes, where that can be done without causing a nuisance. If the sewage is placed on the soil in the morning of a dry, clear day, when the sun is shining, and in places where it may be readily absorbed by the earth, the odors from it are the least offensive. In very loose soil, and remote from dwellings, ordinary loose walled cesspools may be used without danger for a short time; but even then the custom cannot be approved.

The evils arising from want of attention to the suggestions briefly given above are many, and undoubtedly much ill-health can be thus explained. Good water, from deep wells, is much better than rain water, which is soft, and does not contain the lime, etc., so beneficial to health. If the wells and springs are kept free from contamination, as they may be with some care, until houses and streets become placed closely together, the water furnished by them is of the very best quality. A few illustrations of the baneful effects, when contaminated, are given.

A clergyman living in one of our towns reports as follows:

"About a year ago my son, thirteen years old, was taken sick with diphtheria. It was quite a severe case, and was very obstinate, resisting, day after day, all treatment; medicines did not have their usual effect. By and by we thought of the water (which was found upon chemical examination to be polluted with organic matter like that found in drains and cesspools). We immediately stopped using the water, concluding that the impure water was the probable cause of the boy's sickness, and the probable reason why the medicines would not work; for they had been mixed in this water, and he had used it for a gargle.

"With change of water, the sick boy at once began to mend, and was soon about the house again. This was the third case of diphtheria in our family within the space of some two years, and they were the only cases in the neighborhood, which led us to suspect something was wrong.

"I had myself been subject to a chronic irritation in my throat, often amounting to soreness and serious trouble, and also to frequent attacks of diarrhea, especially through the warm weather; but, for a year past, or since we ceased to use that water, I have had no trouble worth speaking of in either of these ways.

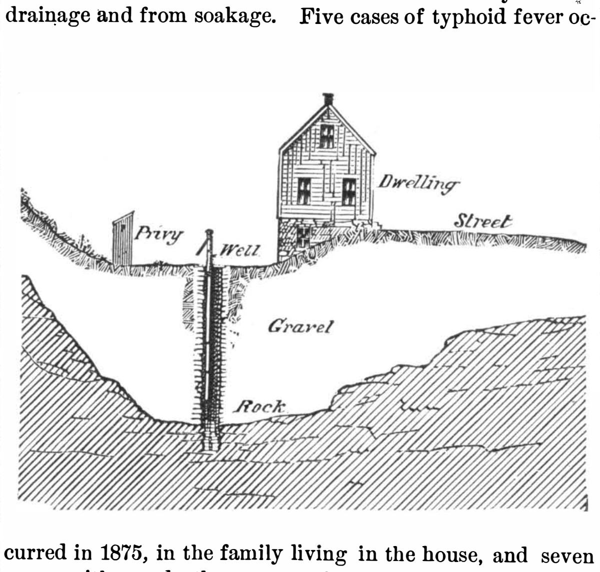
"The well is in the cellar, almost directly under the sink, 3 feet only to the right of it. The top of the well is 2½ feet from the cellar wall. The drain, originally of plank, was 16 feet long, so that the cesspool was within 17 or 18 feet of the well. But this was not the worst feature of the case. This plank drain, after a time, rotted away, so that the filthy water began to soak into the ground just outside the cellar wall, and within 6 or 8 feet of the well, and almost directly over it. The earth, when we removed it to lay a new tile drain, was good manure as deep down as we dug, and I know not how much deeper.

"The water looked clear, except just after heavy rains, and had no ill smell or ill taste about it. We now use cistern water and leave the well untouched."

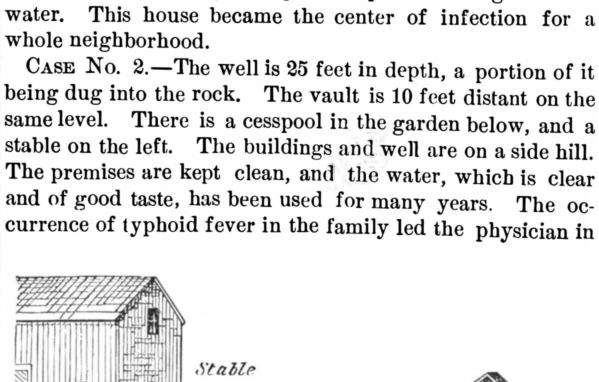
This case shows what great danger to health may exist unsuspected, when the rules suggested above are not followed out. It is impossible to say that a well is safe at any ordinary distance from a source of constant pollution of the neighboring soil, like a privy, cesspool, barnyard, etc. Often the filth goes a long distance, sometimes not very far. There is always a risk; and, even if well marked sickness does not occur as narrated above, more obscure affections are probably not uncommon.

Dr. J. G. Pinkham, in his "Report on the Sanitary Condition of Lynn," published in the "Eighth Annual Report of the State Board of Health," reports the following two cases, the illustrations in which are most clear and convincing:

CASE No. 1.—The diagram explains the position of the well, and shows the certainty of its pollution. The soil and subsoil are loose; contamination occurs both by surface drainage and from soakage. Five cases of typhoid fever occurred in 1875, in the family living in the house, and seven more, with one death, among other persons using the well water. This house became the center of infection for a whole neighborhood.



CASE No. 2.—The well is 25 feet in depth, a portion of it being dug into the rock. The vault is 10 feet distant on the same level. There is a cesspool in the garden below, and a stable on the left. The buildings and well are on a side hill. The premises are kept clean, and the water, which is clear and of good taste, has been used for many years. The occurrence of typhoid fever in the family led the physician in attendance to suspect the water, which, upon chemical examination, proved to be very much contaminated. There were five cases of typhoid fever in the family, and several others, with one death, among neighboring persons using the water.



Where wells are not in use the corruption of the air from foul privies, and by the emanation from the soil of the products of decomposition of filth, becomes a prominent factor in the spread of such diseases as typhoid fever, dysentery, diarrhea, diphtheria, etc. In towns, sources of filth on some premises may be more injurious to the health or more offensive to neighbors than to the occupants of the place itself. Different people are differently susceptible to disease, too, so that the filthiest places are not always necessarily those where there is most sickness.

A marked illustration of disease due to polluted air, when the drinking water was pure, occurred in a school in this State, in 1864, where 51 out of 77 young ladies in the institution were attacked with typhoid fever, of whom 13 died; 3 servants also died of the fever. The vaults of the privies were shallow, filled to overflowing, and emitted a very offensive odor, which at times pervaded the whole building. The kitchen drain discharged its contents on the surface of the ground, and a few rods from the school there was a foul barnyard.

Where filth has accumulated, and it is necessary to use a disinfectant, or if for other reasons it is desirable to do so, earth, lime, or chloride of lime will serve a good purpose. If it is wanted in liquid form, it may be made by adding to a pailful of water three pounds of copperas (sulphate of iron), with a pint of Calvert's carbolic acid, one pound of chloride of lime, or one half pound of lime.

For use inside of houses, a solution of nitrate* of lead or chloride of zinc† (Burnett's disinfecting fluid) is recommended. Whitewashing in cellars, sheds, etc., is a most excellent means of purifying the air. Prevention of the accumulation of filth, however, is better than the use of disinfectants. "To chemically disinfect (in the true sense of that word) the filth of any neglected district, to follow the body and branchings of the filth with really effective chemical treatment, to thoroughly destroy or counteract it in muck-heaps and cesspools, and ashpits and sewers and drains, and where soaking into wells, and where exhaling into houses, cannot be proposed as physically possible; and the utmost which disinfection can do in this sense is apparently not likely to be more than in a certain class of cases to contribute something collateral and supplementary to efforts which mainly must be of the other sort" (prevention of filth).

Directions for soil pipes, drains, etc., will be issued in a succeeding circular. At present it need only be said that sewers are of the first importance where the water carriage system is generally used for removal of sewage. Where for any reason they cannot be introduced, the greatest consideration should be used before it is decided to introduce water-closets, if the result must be to drench the soil with filth and water by means of cesspools.

It is in the highest degree important that each town should have an independent board of health to devote their attention to these matters. It is desirable that at least two thirds of such a board should be composed of persons not otherwise connected with the town government, and that there should be at least one physician on the board.

Chloride of Magnesia in Gas Meters.

Owing to the difficulty and expense of obtaining a good dry meter wet meters are still largely in use, and the question of what shall the liquid be is an important one. Water is, perhaps, the worse possible filling; it freezes in winter and evaporates in summer. Alcohol is free from the former disadvantage; but not from the latter. Glycerine, the use of which was first proposed by Prof. H. Wurtz, is better than either. A solution of chloride of magnesium has also been tried and found to be excellent, when the gas is free from ammonia, which is, unfortunately, seldom the case, as the white spots on our argand chimneys tell us. Goebel has tried chloride of magnesium, and found that when there is only 0·3 gramme of ammonia in 100 cubic meters of gas serious results follow in a few months. A part of the salt is decomposed, forming sal ammoniac, which combines with a second portion of the former to form a double salt, magnesia being precipitated as white powder on the clockwork and wheels. The double salt subsequently decomposes, liberating hydrochloric acid. Chloride of magnesia is most effective in purifying gas from ammonia.

Amyl Nitrite in Ague.

Dr. W. E. Saunders, of Indore, India, regards the nitrite of amyl as the most powerful diaphoretic, and uses it in all cases of fever to produce sweating. In a report of several cases of ague treated with this drug, printed in the *Indian Medical Gazette*, he claims that in no instance did the amyl fail to remove the attack in about one-third the usual time, and in most cases the fever did not return. The drug may be mixed with an equal part of oil of coriander, to make it less volatile and to cover its odor, and administered as follows:

Four drops of the mixture or two of amyl are poured on a small piece of lint, which is given into the hands of the patient, and he is told to inhale it freely. He soon becomes flushed, and both his pulse and respiration are much accelerated; and when he feels warm all over, the inhalation is discontinued, as the symptoms continue to increase for some time afterward. A profuse perspiration now sets in, which speedily ends the attack; in some cases, however, the cold stage merely passes off without any hot or sweating stage.

* One part in one hundred of water. Cloth soaked in such a solution, and hung up in a foul air, quickly destroys bad odors.

† One part in two hundred of water for foul liquids, etc. This is used by order in the German navy for bilge water. Labarraque's disinfecting fluid (chlorinated soda), one part to four of water, may be used with soap in washing floors, etc.

May Meetings.

During the first week in May the American Medical Association, the National Board of Health, and the Sanitary Council of the Mississippi Valley, were in session at Atlanta, Ga. Their meetings were largely attended. The epidemic of yellow fever last year, and its possible outbreak during the coming summer, naturally gave great prominence to questions relating to quarantine methods and general sanitation. The Medical Association chose New York as the place of its next meeting in June, 1880. Dr. Lewis A. Sayre, of this city, was elected president. The National Board of Health will meet again in Nashville, Tenn., next October.

The annual session of the American Institute of Mining Engineers was begun in Pittsburg, Pa., May 13. Over one hundred prominent metallurgists were present at the first session. The closing session was set down for Friday, May 16.

The sixth annual convention of the National Millers' Association began in Chicago, May 13, six hundred members present. In his annual address, the president, George Bain, proposed that the association be organized as a corporation on a legal basis for the purpose of carrying on suits regarding patents; that an attorney be appointed to look to the interests of the association as against the encroachments of patentees; that the success attending their efforts against the impositions of the Cochrane patent should encourage them to wage uncompromising warfare against the Denchfield patentees, and that a better system and practice of grading and inspection should be adopted.

The annual meeting of the Silk Association of America was held in this city May 13. The secretary reported that while there had been no great failures in the silk industry during the year, there had been, on the other hand, no instance of remarkable prosperity. The prices of silk have steadily declined during the year from 20 to 30 per cent, and in February fell lower than at any time during 30 years. More silk was consumed in this country last year than in preceding years, the imports being 38 per cent over those of 1877, and there has been a large increase in the receipt of raw silk from Japan and China. European raw silks have been cheaper than the Asiatic product. With the decline in the value of the raw material, manufactured goods have become cheaper. The lowering of prices and the absence of tariff excitements have also enabled manufacturers to make costly experiments and improvements during the year. The general tendency in woven goods has been toward work of the higher grade. The mills have been fully employed, but great expense has been incurred in the improvement and alteration of machinery. A decided advance has been attained in the production of dress silks, and more of them are made, and of a higher class, than ever before. If they are kept up to the standard there is every prospect of their displacing the loaded silks of Europe in our market by supplying a better and cheaper article. Nearly all the weaving mills are producing broad goods. The number of paying members of the association has been doubled during the year, and includes among its members nearly every silk manufacturer in the country. The following officers were chosen for the coming year: President, Frank W. Cheney, Hartford, Conn.; Vice-Presidents, A. B. Strange, New York, William Ryle, New York, Robert Hamil, Paterson, N. J.; Treasurer, S. W. Clapp, New York; Secretary, William C. Wyckoff, New York.

American Mutton.

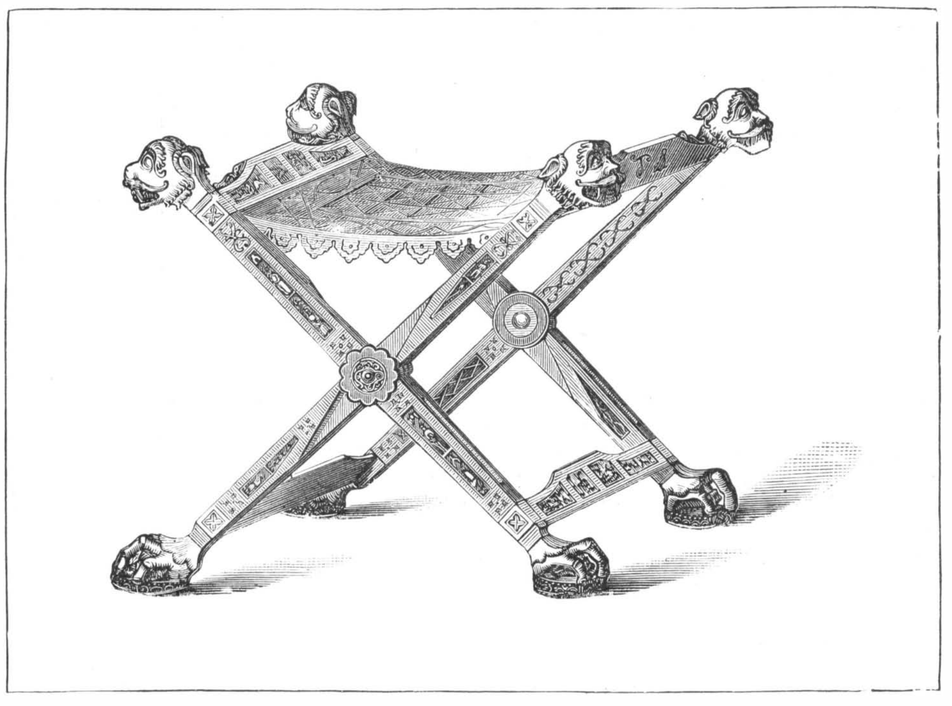
We must be prepared to hear shortly that American sheep are subject to no end of hideous diseases, and that the use of American mutton is hazardous in the extreme. The exportation of sheep to England increases rapidly, and the profits of English breeders are seriously threatened. Something will have to be done; and we shall not be surprised if an epidemic of tape-worms, or something equally distressing, is soon reported among eaters of American mutton. It is not possible that American sheep can be wholly exempt from the numerous maladies to which all flesh is heir—when exported!

Quick Work with Wool.

The exploit of the English baronet, Sir Roger Throckmorton, has been bettered by an Austrian clothier. Sir Roger wagered that between sunrise and sunset a coat could be made for him out of wool from the back of a sheep Accordingly the sheep was sheared at dawn, the wool was dressed and dyed, woven into cloth, cut and made to fit before nightfall. An Austrian clothier has done all this in eleven hours, so that he really has outstripped the Berkshire baronet, who allowed himself from 4 A.M. to 9 P.M.

STOOL OF INLAID WOOD AND EMBROIDERED CLOTH.

The design shown in the accompanying engraving is by J. Androuet du Cerceau, who lived from 1515 to 1558. It contains grotesque masks and other fanciful decorations. Many choice works of this artist are known, his refined taste having a large share in the art embellishments of the Renaissance period.



STOOL AFTER AN ELEVENTH CENTURY PATTERN.

BACON, in his instruction, tells us that the scientific student ought not to be as the ant, that gathers merely, nor as the spider, that spins from its own bowels; but rather as the bees, that both gathers and produces.

SPECIMENS OF TURKISH POTTERY.

The specimens of Turkish pottery shown in the engraving are of modern manufacture, but in strict resemblance to the oldest ware produced at Gallipoli, near Constantinople. It is green and gold, and is almost identical with forms of pottery in common use in Persia and India.

TURKISH POTTERY.

The Oldest Mine Map.

Dr. Gurlt, a German metallurgist, who has devoted much attention to the study of the history of mining and metallurgy, exhibited recently, before a German society, a copy of what appears to be the oldest map of a mine known. It is the plan of an Egyptian gold mine from the time of King Seti I., or about 1,400 B. C. The original, drawn on papyrus, is at the museum of Turin, Italy.

Some Aspects of Labor.

Reports coming in from all parts of the country indicate a greater demand for skilled labor than has existed for several years. And the redistribution of labor during the years of depression threatens in some instances to work no little temporary inconvenience to reviving industries. From New England, for example, there comes the curious report that several cotton mills find it impossible to go on for lack of hands. A large number of the more thrifty and forehanded cotton operatives left the East for the West when work failed in the mills, and now cannot be recalled, having taken up farming on their own lands, or engaged in some other occupation. This readiness of American workmen to leave one calling for another when occasion demands is one of the most encouraging features of our industrial classes, since it prevents any long continued distress among any class of operatives, when their special business fails, and equally prevents any protracted lack of labor in any field when a demand for it arises. The New England cotton mills will not have to wait long for hands if they can offer the average inducements in the way of wages, and if they cannot do that it is evident that there is no urgent demand for their products, in which case the world will not suffer from their suspension.

The demand for unskilled labor, even in this city where the glut of day laborers was supposed to be greatest not long since, is manifestly quite up to the supply. On this score a city daily remarks in a recent issue:

"It is commonly supposed that there are thousands of destitute and unemployed working men in New York who are anxious to get work at any wages which will support them. The steamship companies, it seems, would be glad to find some hundreds of this presumed multitude. They have failed, although they required only unskilled labor and have offered at least the means of daily subsistence in return for it. How much of the apparent and undeniable destitution in this city is a real consequence of a real lack of employment, therefore, and how much proceeds from the habit of promiscuous almsgiving without inquiry and from the growth of a positively vagrant pauper class in this country, are questions worth looking into."

Touching the same general topic a well-informed Philadelphia paper says: "The iron and steel trade was one of the very first to succumb to the pressure of the times, but even that is now exhibiting more activity that at any previous period since 1873; other trades are doing even better, and the number of mills and works which remain shut down for sheer want of remunerative business are exceedingly few. That any should stop, however, for want of hands, is most remarkable, in view of some of the speeches that are occasionally made in Congress and out of it by the self-styled labor reformers. According to the statements of these gentlemen, there are at the present time in the neighborhood of a million industrious skilled workingmen vainly seeking employment; but we are afraid that after deducting, say nine tenths of the number (as imaginary?) the other tenth is largely made up of the vicious tramps who vagabondize through the country to the terror of the agricultural population, and who would not work if they were ever so well paid for it. If work is wanted some of them can certainly find it among the mills of New England, which so greatly need operatives as to stop for want of them."

Existing and widely threatened strikes for higher wages still further testify to the increased demand for labor. How far these strikes will retard reviving industry and delay the better times coming for American labor remains to be seen. We are strongly inclined to believe that the good sense of the vast majority of our industrial classes will forbid their making haste thus to kill the industrial goose that is beginning to lay golden eggs, at the dictation of a misguided few who are determined to rule or ruin. Strikes are unprofitable at all times; at this stage of industrial revival they cannot be other than suicidal.

A SYSTEM of pneumatic tubes took the place of telegraph lines in Paris on May 1, for the transmission of messages from one part of the city to another. The charge is 50 centimes, or 10 cents, for open, and 75 centimes for sealed messages.

Girdling the Grape Vine.

The girdling of a grape vine has a very marked influence on the fruit: it causes it to grow much larger, to ripen sooner, and makes it of better flavor. Girdling consists in taking a rim of bark about one fourth or one sixth of an inch wide from the trunk or branches of the vine. Some recommend taking this rim of bark from the main stem, others from the side canes. As many may not understand the operation or the effect it has upon the vine, it may save the life of many a vine if we examine and see how it grows. A vine does not grow, as may appear at first sight, from the bottom upward, but from the top downward. The roots take from the soil what moisture the plant needs; also the mineral matter. This food cannot be used by the plant unless there is water in the soil to hold it in solution, as it must be in a liquid form to be taken up by the roots. This crude or undigested food or sap is carried to the leaves, not through the bark, but through the entire wood of the vine. When it reaches the leaves, it comes in contact with the carbon absorbed from the atmosphere by the leaves; here it is digested, and is now ready to be used by the vine in making new growth in what is called the cambium region, and is deposited in the form of cells just beneath the bark, so that all growth is made from the downward flowing sap, and not from the upward.

If a vine is girdled by taking away a rim of bark, a break is made, so that the sap as it descends cannot pass over this gap, and all growth must take place above where the bark has been removed. If the main trunk is girdled, that portion below the girdle must go without receiving any support from the rest of the vine until this wound can be healed over and complete circulation renewed. All this time the roots have furnished crude sap for the part of the vine above the girdle, and have received nothing in return. This cannot help weakening the roots, and if followed up it must entirely kill the vine. This gap may heal over (as it probably will if not done too late), when the circulation will be restored once more; but there has been a strain on the roots, and they must be somewhat exhausted. If only girdled once the vine may not be permanently injured; but if followed up it must be weakened, and the moment its vital forces begin to lag will disease of some form step in and hasten the work of destruction. If instead of girdling the main trunk a side shoot is taken (taking care to leave some untouched), the injury may not be enough to be felt by the roots, and the vine will not be injured to any extent. After a vine is girdled, the crude sap is taken up the same as before and is digested by the leaves. This prepared sap descends as far as the place where the rim of bark has been removed, and can go no farther. The result is, the branch is crowded with food that must be made use of, the fruit has more than the usual amount of nourishment supplied it, which causes it to develop faster, grow larger, and makes it of better flavor. If a single branch be tried, the effect of girdling can be distinctly seen; the cane girdled will show ripe fruit, while that on the remainder of the vine will hardly have begun coloring. I think the best results from girdling will be obtained if done in the following manner: As soon as the fruit is half grown, take a rim of bark from the side canes (leaving part ungirdled to supply nourishment to the roots, and to keep the vine in a healthy condition) near the main trunk. The rim of bark should not be over one fourth of an inch wide. This will make the fruit grow nearly as fast again as on canes that have not been girdled. The vine at this season is growing very vigorously, and will heal over the wound made by taking away this rim of bark in a short time. As soon as the natural circulation is restored, the fruit will seem to have stopped growing, and that on the rest of the vine will partly catch up with it; but if as soon as the circulation is restored another break is made by taking away another rim of bark, just above where the first one was taken, the fruit will ripen fully two or three weeks earlier than that on the rest of the vine. Last season I tried this method on a Concord vine. The first girdling caused the fruit to increase in size nearly as fast again as it did on the canes that had not been girdled. The wound healed over in a few weeks, and the berries seemed to come to a stand still. I removed another rim of bark just above where the first one was taken, and it was astonishing how quickly the berries began coloring. They were larger than those on canes not girdled, of better flavor, and ripened fully fifteen days sooner. If any one will take the pains to grow new canes each year to girdle the next, and cut away the canes girdled the year before as soon as they have produced one crop of fruit, I see no reason why girdling should not be practiced, and would even recommend it, as the fruit will ripen so much earlier that it will be in no danger of injury from early frosts, which in this latitude often destroy the crop. But do not girdle the main trunk, only the side branches, and grow new canes each year to girdle the next. If instead of this the main trunk is girdled, the vine will become weakened, and in a short time will be ruined.—*J. W. C., in Scientific Farmer.*

Cotton Mills for China.

The Berlin correspondent of the London *Morning Post* recently made the following statement in a communication to that journal: "The Chinese government has purchased machinery and engaged experienced engineers and spinners in Germany to go out to China and establish mills there. The government hopes by this means to make its country independent of Russian and English manufacturers, and to supply the home market with home produce. The mills are to be constructed and worked on the European principle." "Is this statement correct?" it has been asked. We know that it is, for the design of the government of the Celestial Empire has been heard of in Lancashire, and negotiations have been opened here having the above object in view. Here, then, we have the prospect of another competitor of a formidable character springing up to confront us. Doubtlessly, also, the new industry will be founded, cherished, and developed under a system of protection as rigid and uncompromising as the government may deem it safe to inaugurate. The result of this experiment, presuming that it will be made, can hardly be predicted. We shall have to wait patiently, and observe if the ingrained conservatism of Chinese nature will permit at home such a startling innovation upon the methods of spinning and manufacturing, immemorially old, that are in vogue in the country, as would be the planting of cotton spinning and weaving establishments upon the English system. Should this, however, take place, it will need no prevision to safely affirm that the industry of the West in another thirty or forty years will have to stand face to face to a competitor whose formidable character will dwarf all previous ones into insignificance. The personal qualities of John Chinaman, as shown abroad, where he has latterly begun to appear more frequently, reveal the fact that he is patient, docile, sober, industrious, and possesses great power of adapting himself to and mastering the details of any new occupation to which he may be put. Should he, therefore, in his own home take kindly to western methods of labor, the industrial and commercial states of the world would speedily be revolutionized. This is a possibility of the future.

Noumeite.

At the recent World's Fair in Paris, noumeite—a massive form of garnierite or hydrated silicate of nickel and magnesia —was exhibited in large quantities.

In a recent number of *Dingler's Journal* Prof. Rudolph van Wagner states that the largest nickel works in France make all their nickel, its alloys, and the salts used for nickel plating, from this New Caledonia ore alone. The ore, as it reaches the factories, has the following average composition:

Oxide of nickel	18
Oxide of iron	7
Magnesia	15
Silica	38
Water	22
	100

It occurs in serpentine, and possesses a beautiful green color, similar to, but not easily mistaken for, malachite. Its color, together with its variegated and clouded appearance has led to selecting the finest specimens and polishing them for use as setting in breastpins, earrings, and other ornaments. It is more especially to these selected and polished specimens that the name of noumeite is applied. Being massive and dense it cannot equal the fibrous malachite with its beautiful satin luster, but may yet find extensive use along with lapis lazuli in mosaics and the like.

The methods employed in extracting the nickel from the New Caledonian ores are quite different from those in use for other nickel ores, and much simpler. In the so-called mixed process the ore is treated with hydrochloric acid and the solution precipitated by oxalic acid. The nickel being now combined with an organic acid is readily reduced by simply heating it in a crucible with lime and charcoal to a high temperature. The metal thus obtained contains 99·5 per cent of nickel. In the other method, known as the wet process, the ores are likewise treated with hydrochloric acid, the iron and alumina precipitated with carbonate of lime, and every trace of sulphuric acid removed with chloride of barium. The nickel is afterward precipitated as oxide by means of chloride of lime and lime water. The metal obtained by reducing this oxide is of excellent quality, and can be beaten out under the hammer, which is not the case with either the English granular or the German cubical nickel. Riche's analysis gave the following results:

	Ni in the wet way.	Ni in the mixed way.
Nickel	97·75	98·00
Silicon	0·54	0·50
Carbon	1·25	0·13
Manganese	0·36	1·63
	100·00	100·00

Chloral a Poison Antidote.

According to the *Lancet*, Professor Huseman, of Göttingen, has been engaged in a long series of observations on the antagonistic and antidotal actions of drugs, and, among these, investigations relating especially to chloral.

Chloral hydrate is known to act as an antidote to strychnine, lessening the spasm, and even preventing death. It has a similar action in the case of the mixture of strychnine bases sold under the name of brucin, and also against the opium alkaloid, thebaia, which simultaneously tetanizes and lessens sensibility. The spasms produced by chloride of ammonium diminish under the employment of non-fatal doses of chloral hydrate, and can indeed be completely stopped. Nevertheless death occurs, probably from the paralyzing effect of both substances on the respiratory center. The antidotal effect of chloral on the action of the poisons which cause convulsions by their action on the brain, is not the same for all these substances. The quantity of the poison which can be counteracted by the antidote appears to be considerably greater in the case of picrotoxin than in the case of codeia. Of the latter, indeed, the fatal dose, and even a quantity half as much greater, can be rendered harmless, but twice the fatal dose cannot be counteracted, and is still fatal. Calabrin is counteracted by chloral hydrate in about the same degree as codeia. The symptoms produced in rabbits by poisoning with baryta are not materially altered by the action of chloral, which does not appear to prolong life. So, also, with carbolic acid; the spasms produced by it are not arrested by chloral, and the minimum dose fatal to rabbits still produces death. The combination of a fatal dose of carbolic acid with a non-fatal dose of chloral hydrate causes in rabbits a remarkable fall of temperature, which is not produced by the action of either of these alone. As a rule, when chloral antagonizes the action of these cerebral poisons, the respiration sinks in frequency much more than in the case of the analogous action of chloral on the tetanizing poison. The depression of temperature caused by the chloral is also independent of any peripheral loss of heat. The elevation of temperature due to division of the spinal cord is hindered by chloral hydrate.

ASA PACKER.

Judge Asa Packer, President of the Lehigh Valley Railroad Company and founder of the Lehigh University, died at Philadelphia Saturday, May 17. He was born in New London county, Conn., December 29, 1805, and at the age of seventeen, with no inheritance save a sound frame, an earnest purpose, and sterling character, set out to make his way in the world. He journeyed on foot to Susquehanna county, Pa., where he apprenticed himself to a carpenter. When master of his trade he married, and spent a number of years farming a piece of land owned by his wife's father. Tiring of that occupation, the young couple removed to Mauch Chunk, where Mr. Parker took command of a canal boat, and engaged in the business of transporting coal. In a couple of years he was able to build himself a boat and to enter into a profitable partnership with his brother. In 1840-43, he and his brother were building boats at Pottsville to carry coals to New York by the Schuylkill navigation system. Later, Mr. Parker took up the double enterprise of mining as well as transporting coal.

In 1852 he began the gigantic undertaking of building the Lehigh Valley Railroad, which was finished in 1855, and, with its branches, opened up the entire anthracite region of Pennsylvania. As Mr. Packer had foreseen, the railway at once gave an enormous impetus to the coal mining business, and developed other interests and industries proportionally, adding greatly to the prosperity and wealth of the State.

While carrying on these vast material undertakings Mr. Packer found time to carry on constantly the studies which he began in the evenings while learning his trade, and to render excellent service to his State and the nation in judicial and legislative capacity. His judicial title was acquired by service as county judge. In 1844 he was elected to the State Legislature, and in 1852 was sent to Congress, where he served two terms.

In his business career Mr. Packer acquired great wealth and used it most creditably. He gave munificently and steadily to charitable, religious, and educational objects, crowning his life-work by the establishment and liberal endowment of the Lehigh University, an institution designed with special reference to the needs of young men preparing to undertake the great mining, manufacturing, and other material interests of the country. In its course of studies the chief places are assigned to civil, mining, and mechanical engineering and other departments of practical and industrial science. To the endowment of this institution Mr. Packer gave in all upwards of $2,000,000.

Mr. Packer's personal life was marked by exceptional gentleness, kindliness, simplicity, and sincerity. He made many friends and retained them to the end. His entire career exemplified not only the highest type of success in personal and practical affairs, but paid the highest tribute to the institutions under which he lived, which made it possible for one, without wealth or family influence to begin with, to gain great wealth by honorable means, to benefit his age and country, and to leave behind him monuments that must make his life grandly productive through many generations.

Some years ago, at a meeting of eminent Pennsylvanians, Colonel J. W. Forney pronounced an eloquent tribute to Mr. Packer's life and character, worthy of recalling at this time. In it he said:

"Here is a character for youth and manhood to study. Here is a lesson to the one to move on in the path of improvement, and a stimulant to the other never to despair in the darkest hour of disaster and misfortune. We pick out Asa Packer as the miner picks out a piece of coal to show the value of the precious deposit from which it is taken; we pick him out to show what can be won by personal honesty, industry, and kindness to men; by courage in the midst of bad luck, by confidence in the midst of gloomy prophecy, by modesty in prosperity, and by princely generosity when fortune comes with both hands full to realize a just ambition. Mr. Packer's whole career exemplifies the truth that in the United States there is no distinction to which any young man may not aspire, and with energy, diligence, intelligence, and virtue attain. When he set out from Mystic, Conn., to make the journey to Pennsylvania on foot it is not probable that his entire worldly possessions amounted to $20. These possessions are estimated at $20,000,000, all of which has been accumulated, so far as known, without wronging a single individual."

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) J. A. B. asks: Can you tell us of a good hair wash to strengthen the hair and scalp, after such a dangerous disease as typhoid fever? A. See Professor Wilson's paper on treatment of the hair, SCIENTIFIC AMERICAN SUPPLEMENT, No. 102.

(2) W. H. C. asks: 1. Does it take more battery power to ring an electric bell than to work a telegraph machine, and why, magnets of same resistance? A. No. 2. Why will an electric bell not work through a telephone, and *vice versa*? A. Because the introduction of either into the circuit increases the resistance beyond that which the battery is capable of overcoming.

(3) E. S. writes: 1. I have a lot of printed postal cards, and would like to wash the print off. How can it be done? A. We know of no practicable method. 2. Which is the most powerful known explosive, and how does it compare with powder? A. Probably the socalled chloride of nitrogen (described in most works on chemistry). For practical purposes, trinitroglycerine or Nobel's explosive gelatine—six to seven times as effective as common blasting powder. 3. What is the chemical composition of the saliva of rabid animals? A. Not determined, we believe. 4. Who invented the Gatling gun? A. Dr. R. J. Gatling, of Hartford, Conn. 5. With what kind of an instrument did the British give each other signals at long distances in the late Zulu war? A. With the heliograph.

(4) L. P. S. writes: I have several very rusty steel bits (for horses) which I wish to silver plate. I have a battery and every necessary for silver plating, but rust troubles me. How can I remove cheaply and quickly? Dip in warm muriatic acid for a moment and then scour with clean sand and water. Pickel in dilute sulphuric acid, rinse, and suspend in the plating bath without touching. 2. Also a large mirror which looks as if it was dusty, but it is on the inside. Please tell how to brighten it up. A. Resilvering will be necessary. See p. 1670, No. 105, SCIENTIFIC AMERICAN SUPPLEMENT.

(5) C. L. asks (1) how stove cement is made? A. Moisten iron filings with strong aqueous solution of salammoniac (ammonium chloride). A little sulphur is sometimes added, to make the cement harden quicker, but it is better without. 2. Which is the best two horse engine in market? A. We cannot undertake to decide between rival manufacturers. 3. What material would you use for cleaning white shirts made dirty through wear, and which resist washing and bleaching? A. Soak in a 10 per cent solution of chloride of lime (calcium hypochlorite), then in water containing about three per cent of sulphuric acid, and finally rinse well in cold water.

(6) F. C. F. wishes to know (1) the horse power of an engine, cylinder 6x14, 60 lbs. of steam, and making 120 revolutions per minute. A. See p. 267 (4), current volume. 2. What is the rule to find the area of a piston? A. Square the diameter and multiply by 0·7854. 3. What kind of paint is best to put on a tin roof that has been painted once with common paint, and water is used from the roof? A. A good asphaltum varnish answers very well.

(7) F. G. asks: Is there any truth in the assertion that anthracite coal loses its heating qualities after being exposed to the air for a length of time? A. No.

(8) V. & B. ask what to impregnate wood with to render it incombustible. A. The following is one of the best: commercial tungstate of soda, 1 lb.; phosphate of soda, ¼ lb.; water, 2 gallons; dissolve. Apply boiling hot if possible.

(9) E. L. N. asks how to make a black printing ink, which shall be a heavy black, and of a bright color after printing. A. Small quantities of a superfine ink may be prepared as follows: Balsam of copaivi, 9 ounces; lampblack, 3 ounces; indigo and Prussian blue, 1¼ ounce; Indian red, ¾ ounce; yellow turpentine soap, dry, 3 ounces; grind upon a marble slab with a wooden muller until a pefectly smooth ink is obtained.

(10) J. E. L. asks (1) whether he can make a paper canoe by covering a light, strong wooden frame work with a single piece of common card board ⅛ inch thick and afterwards waterproofing the whole. A. Possibly; but we think it would not be serviceable. 2. What inexpensive substance can be used for the waterproofing? A. See answer to F. C. R. This page.

(11) F. C. R. writes: I am building a canvas boat, and would like to know what they use to waterproof canvas. A. The oiled waterproof is usually prepared by saturating the dry fabric with a varnish prepared about as follows: Boiled linseed oil, 100 parts; wax, 15 parts; litharge, 3; oil of turpentine, *q.s.* The oil is heated so as to readily melt the wax, which, together with the litharge, is then thoroughly incorporated with it and the mixture thinned down sufficiently with turpentine.

(12) B. A. asks for the process for making chloride calcium. A. Dissolve marble dust, chalk, or lime, in hydrochloric (muriatic) acid, filter, concentrate the solution by heating it in an open porcelain lined pan, and collect the salt which separates on cooling. This should be strongly heated (with constant stirring) to fusion in a clean iron pan to expel the remaining water.

(13) C. L. D. asks: 1. Is there any means of melting India rubber and have it retain its original elastic property? Is there any means of applying it to wood and have it retain said property? A. No. Native gum caoutchouc (unvulcanized rubber) is soluble in bisulphide of carbon containing about six per cent of absolute alcohol. This solution on evaporating leaves the rubber in its original condition. 2. Is the slipping of belts affected by the distance the power stands from machine, and if so how? A. An increase in the length of a belt increases its weight between the pulleys; this of course increases the pressure and friction on the pulleys.

(14) B. F. S. asks: Can a photograph be taken on any other substance than glass or tin? Can a picture be thrown upon some kind of material that can be lithographed from, without the process of drawing? A. Thereare several carbon and chromated gelatin processes—such as that Woodbury—that accomplish this. You will find several of them described in the SCIENTIFIC AMERICAN and SUPPLEMENT. Consult also Vogel's "Chemistry of Light and Photography."

(15) A. M. asks: 1. How can I make a good telephone, or where can I find descriptions? A. See the SCIENTIFIC AMERICAN SUPPLEMENT, No. 142. 2. How can I keep copper ores from tarnishing without spoiling their general character, and if any lacquer is to be used, what is the best receipt? A. A thin coating of an alcoholic solution of bleached shellac will sometimes suffice.

(16) W. V. R. writes: I have a large pile of cinders, taken from a cupola after melting which contains a large per cent of iron. Can I, after cleaning or scouring, melt them without mixing with other iron? I have been told I could do so by using a flux of lime stone or oyster shells. This I do not understand. Can you inform me how to use the flux and in what proportions, etc., to charge the cupola, which is 22 inches diameter, in order to melt 1,500 or 2,000 lbs. of the scrap at a melt? A. The slag can be fused as suggested; but in order to determine the proportion of flux necessary the per cent of iron in the slag must be known. Unless the per cent of iron in the slag is very large it is very doubtful if it can be economically extracted.

(17) C. H. B. asks: 1. Is phosphorus very dangerous to handle? A. It may be handled with impunity under water—in the air it is inflamed by very slight friction at ordinary temperatures when dry. 2. Will it show light in the dark, and how far can it be seen? A. Exposed to the air and moisture it exhibits (through slow oxidation) a faint, phosphorescent light. In utter darkness this light is faintly visible 100 yards distant; at much greater distances with difficulty or not at all. 3. What other substance that will show light without flame? A. You might substitute a small spiral of platinum wire heated to incandescence by the passage of an electric current.

(18) F. S. asks (1) if the year 1900 is a leap year. A. No, since it is not divided by 400. 2. Explain all about leap years. A. The earth makes the circuit of the sun in 365 days 5 hours and 48 minutes 49·062 seconds. This is called the solar year. The civil year is ordinarily 365 days, the excess (5h. 48m. 49·062s.) amounting in 4 years to very nearly a day. Accordingly each 4th year is given 366 days. But this counts a little too much, the excess amounting in a century to nearly a day. So, instead of calling the even hundred years leap years, they are made ordinary years of 365 days. This approximate correction involves an error of a little over one fourth of a day every century, which is nearly set right by counting each 400th year as a leap year. By these leap years and intercalated days (every 4th year except the hundreds not divisible by 400) the civil and solar years are closely reconciled, the object being to make the seasons permanently accord with the calendar. By making a further correction of one day every 4000th year, counting each 4000th year as not a leap year—the error is so small that 21,600 years must elapse before it will amount to a full day.

(19) E. S. W. asks: 1. How can I rid a house of cockroaches? A. A mixture, composed of 1 part of powdered borax and 2 parts of powdered sugar sprinkled upon the floor where they frequent, will soon eradicate them. 2. How can I find the side of the greatest square contained in a given circle? A. (*a*) If you mean the square exactly equal in area to the circle, it cannot be done. The square root of the area of the circle will give the side of a square approximately equal to the circle. Or multiply half the diameter of the circle by 3·14159. (*b*) If you mean the greatest square that can be drawn within the given circle, draw two diameters at right angles to each other and connect by a straight line any two adjacent extremities of such diameter. The last line will be the side of the required square. Or, take the square root of twice the square of half the diameter. 3. What is cyanide potassium? A. Cyanide of potassium is a compound of cyanogen and potassium (KCy). It forms colorless cubic or octahedral crystals, deliquescent in the air, and exceedingly soluble in water. Its solution always has an alkaline reaction, and when exposed to the air exhales the odor of hydrocyanic (prussic) acid. The salt is anhydrous, and is nearly as poisonous as hydrocyanic acid itself.

(20) W. H. C. asks: 1. What quantity of soft iron wire should be used in the center of an induction coil ½ the size of that described in SUPPLEMENT No. 160? A. Make the binder of wires about ¼ inch in diameter. 2. Why is wire better than one iron rod? A. A bundle of wires acquires and loses magnetism more rapidly than a solid rod of the same diameter.

(21) J. S. asks: How are carbon points that are used in electric lights made? A. By mixing finely pulverized gas carbon with a little coking coal, and baking the mixture under pressure for several hours or days.

(22) A. D. asks: Will you be kind enough to inform me if there is any cure for premature gray hair? I am a young lady of 25 years, and my hair is rapidly turning gray. My hair is thick, and far below my waist in length, but it is losing its dark color. Is there anything that could be taken internally to supply the coloring matter and restore the scalp to a healthy condition? A. Consult SCIENTIFIC AMERICAN, vol. 38, page 283 (12). The hair can be restored to a jet black, but probably only by artificial means, which are decidedly injurious to health. See lecture "Hygiene of the Hair," Professor Erasmus Wilson, SCIENTIFIC AMERICAN SUPPLEMENT No. 102.

(23) H. F. asks: Is there a book that contains all that is new relative to the telephone, microphone, phonograph, phonometer, etc.? A. Prescott's "Speaking Telephone, Electric Light, and other Novelties," contains much on these subjects. You will also find these instruments described in the SCIENTIFIC AMERICAN SUPPLEMENT.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

T. S. B.—It is spiegeleisen (mirror iron), produced by smelting, in a blast furnace with charcoal, a spathic iron ore containing a large percentage of manganese—used in the Bessemer process of making steel.—W. W. S.—The supposed animated horse hair is a species of the genus gordius, frequently found in still water. Linnæus calls it gordius aquaticus.—P. B.—It is magnetite inclosing granules of apatite or phosphate of lime.—G. L. R. A.—If the pots are to be used for melting fine glass, a clay containing less oxide of iron will be requisite.—B.—The sand contains enough iron to unfit it for fine glass.—J. M. H.—The gravel in large box consists chiefly of quartz mica, hornblende, and feldspar, derived from the disintegration of a synaitic granite. The sample in small box contains much graphite.—D. M.—A dolerite containing crystallized lime carbonate and iron sulphide—pyrite.—J. W. C.—Quartz containing illmenite—titaniferous iron, and a trace of copper. The quartz is not auriferous.—W. J. B.—No. 1. Haytorite—a quartz pseudomorph after datholite. No. 2. It is composed chiefly of silica and aluminum silicate, with traces of lime phosphate and sulphate.—H. T.—It is galena (lead sulphide), a valuable ore of lead.

COMMUNICATIONS RECEIVED.

On Crank Shafts. By R. G.
On Electric Light Telegraph. By F. P.
On Curious Application of Fluorescence. By P. P.
On Silver Powder. By J. C. W.
The Grand Discovery of the Ages. By D.
On the Metric System. By J. G.
On Brorsen's Comet. By T. J. L.
On Planets. By P. & J. S.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

April 29, 1879,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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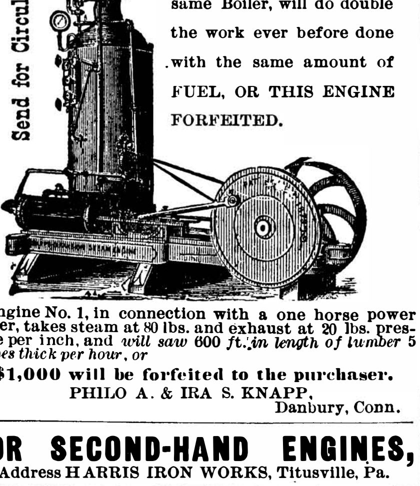

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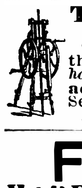

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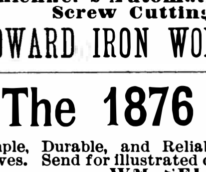

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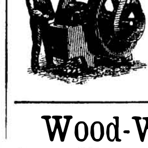

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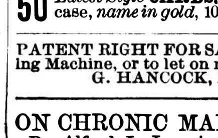

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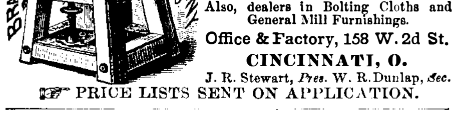

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