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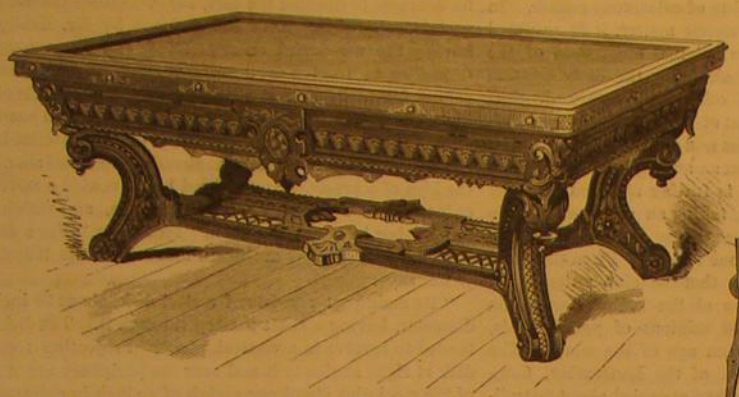

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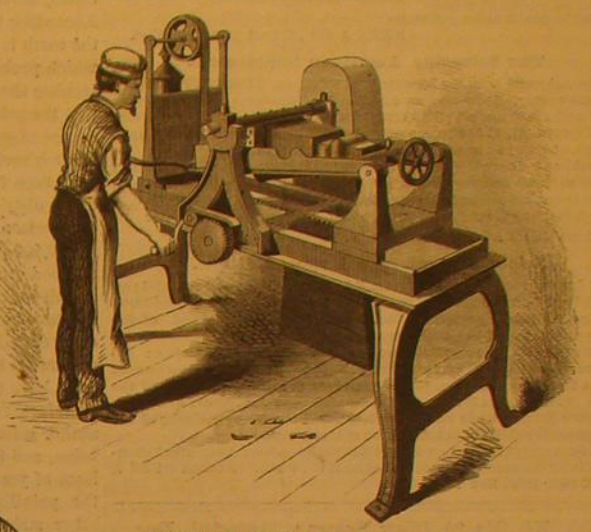

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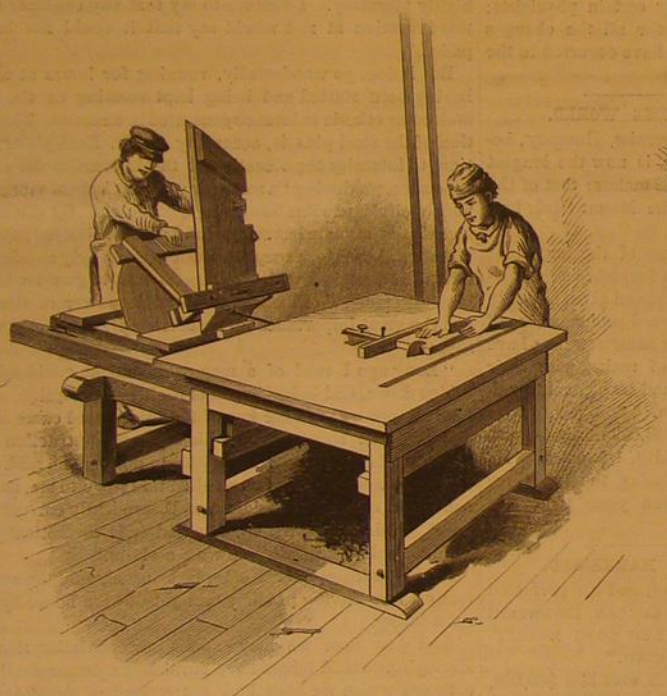

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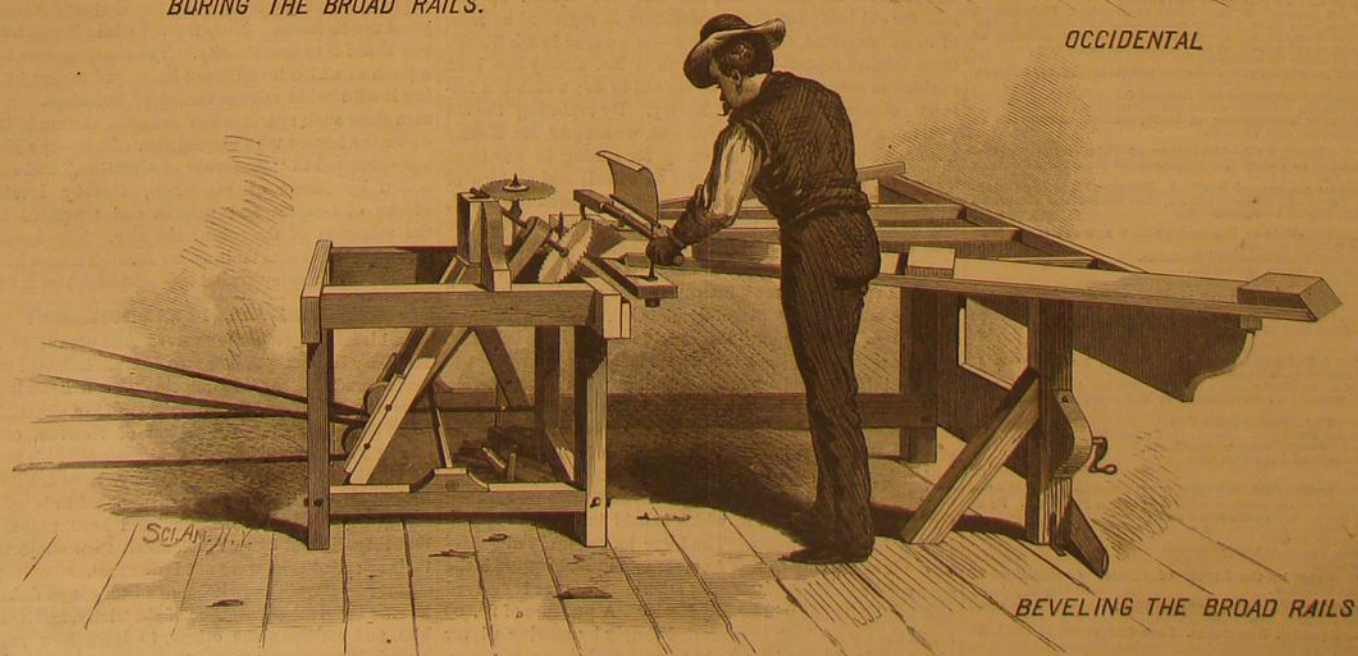

BEVELING THE BROAD RAILS

BILLIARD TABLES AND MACHINERY USED IN THEIR MANUFACTURE.—(See page 305.)

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A NEW ESTIMATE OF THE WORLD'S AGE.

Geologists, astronomers, and physicists alike have hitherto been baffled in their attempts to set up any satisfactory kind of chronometers which will approximately measure geological time, and thus afford us some clew to the antiquity of our globe. Mr. Millard Reade, of Liverpool, has recently contributed to the Royal Society a very suggestive paper, in which he endeavors to grapple with the question by employing the limestone rocks of the earth's crust as an index of geological time. Limestones have been in course of formation from the earliest known geological periods, but it would appear that the later formed strata are more calcareous than the earlier, and that there has, in fact, been a gradually progressive increase of calcareous matter. The very extensive deposition of carbonate of lime over wide areas of the ocean bottom at the present day is sufficiently attested by the recent soundings of the Challenger. According to Mr. Reade's estimate, the sedimentary crust of the earth is at least one mile in average actual thickness, of which probably one tenth consists of calcareous matter. In seeking the origin of this calcareous matter, it is assumed that the primitive rocks of the original crust were of the nature of granitic or basaltic rocks. By the disintegration of such rocks, calcareous and other sedimentary deposits have been formed. The amount of lime salts in water which drain districts made of granites and basalts is found, by a comparison of analyses, to be on an average about 3·73 parts in 100,000 parts of water. It is further assumed that the exposed areas of igneous rocks, taking an average throughout all geological time, will bear to the exposures of sedimentary rocks a ratio of about one to nine. From these and other data Mr. Reade concludes that the elimination of the calcareous matter now found in all the sedimentary strata must have occupied at least 600 millions of years. This, therefore, represents the minimum age of the world. The author infers that the formation of the Laurentian, Cambrian, and Silurian strata must have occupied about 200 millions of years; the old red sandstone, the carboniferous, and the poikilitic systems, another 200 millions; and all the other strata, the remaining 200 millions. Mr. Reade is, therefore, led to believe that geological time has been enormously in excess of the limits urged by certain physicists; and that it has been ample to allow for all the changes which, on the hypothesis of evolution, have occurred in the organic world.

THE LONGEST TUNNEL IN THE WORLD.

The Joseph II. mining adit, at Schemnitz, Hungary, begun in 1782 and finished last October, is now the longest tunnel in the world. Its length is 16,538 meters; that of the St. Gothard tunnel being 14,920, and the Mount Cenis tunnel 12,233 meters.

The object of the adit is the drainage of the important gold and silver mines at Schemnitz. It furnishes a geological section more than ten miles in length, and gives not only valuable information as to the downward prolongation of the lodes known in the upper levels, but some new ones have been traversed, and the entire series of rocks, with their mutual limits as well as modifications and occasional transitions, are disclosed without interruption.

The entire cost of the tunnel was 4,599,000 florins—about $2,300,000. Its height is 3 meters; width, 1·6 meter. By the methods of working employed during the last three years it would have taken twenty-seven years to do the entire work.

THE POWER OF VIBRATION HARNESSED.

Mr. Keeley has made another advance, and has perfected what the *World* describes in small caps as "AN INVENTION WHICH SENSIBLE MEN BELIEVE MUST ERE LONG REVOLUTIONIZE THE GREAT INDUSTRIES OF MANKIND."

Mr. Keeley's former generator, which cost him $60,000, was found to be inadequate, and has been broken up and sold for old iron; but this expenditure is regretted by none of those interested, for they know—so we read in the *World's* three column report—that through it Mr. Keeley has been enabled to accomplish what he set out to do; which is a fortunate circumstance for Mr. Keeley. By replacing the old generator with a new and perfect one, we are told, Mr. Keeley has done away with the necessity for storing in any large quantities the "vapor," formerly so called; and all idea of utilizing the power on a pressure engine has been discarded, and an engine has been made entirely new as to its principle. The engine is called a "vibratory engine;" and the whatever it is that runs the engine has been rechristened, receiving the expressive name "intermolecular etheric substance." This, as our readers will readily perceive, is quite a different thing from "cold vapor," and open to none of the scientific objections to which the latter was amenable.

This intermolecular etheric substance has never before been isolated either by chemical or mechanical means; and this achievement alone is sufficient to make Mr. Keeley the greatest discoverer of this age; indeed of all ages. And, curiously, the intermolecular etheric substance appears to be not more remarkable for its enormous expansive power than for the vast quantity of it, which is held in unresisting subjection by a little water. The force locked up in nitro-glycerine is as nothing to it. Another astounding feature is the ease with which intermolecular etheric substance is evolved and annihilated at will by Mr. Keeley. A pressure of 20,000 lb. to the square inch is generated simply by moving a lever about twelve inches long, so as to open and close a four-way valve placed within the "cross bar" of the generator, a small quantity of water having been previously ejected into the generator by means of a small rubber bulb. Another notable circumstance is recorded by Mr. Keeley's reporter, namely, that when the intermolecular etheric substance is evolved and discharged, "neither heat nor cold is generated, and the elastic force is to the touch, when allowed to escape in substantial form, perfectly dry." One does not need to be a man of scientific education to appreciate a marvel like this. Even the common every-day experience of uneducated people will tell them how unusual it is for elastic force in substantial form, escaping under a pressure of 20,000 lb. to the square inch, to feel perfectly dry and neither hot nor cold. We can account for it only by supposing the intermolecular etheric substance, this solid elastic force, to possess a texture so fine that it passes through the hand intermolecularly without impinging on the gross matter through which the senses operate.

It would not be fair, the *World* writer observes considerately, to tell all he knows about Mr. Keeley's discovery; but he ventures to disclose the fact, for which we cannot be too grateful, that "the force so produced by Mr. Keeley, and having the wonderful energy stated, can be at once condensed so as to give a resulting vacuum." This discovery cannot fail to be of vast advantage to Professor Crookes in his researches upon the trajectory of molecules *in vacuo*.

To utilize the enormous energy of the intermolecular etheric substance Mr. Keeley, as already stated, has abandoned the idea of a pressure engine, and has invented a novel machine, which he calls a vibratory engine, and which after much labor he has succeeded in "focalizing." For a description of this engine we are again indebted to the *World*. The writer says:

"Its main part consists of a steel disk, about 30 inches in diameter, having a shaft passing through it. The disk is intended to revolve in a vertical plane. Projecting from the disk at right angles to it and near its periphery are a series of 288 steel pins about one eighth of an inch in diameter and varying in length from about five inches to two and one half inches, these pins being highly vibratory. This disk is surrounded with a cast iron casing resting on a cast iron bedplate, underneath which are some steel disks that are also highly vibratory. I venture to say that any engineer seeing this invention at rest would say that it could not be propelled."

But it does go wonderfully, running for hours at a time, having been started and being kept running by the intermolecular etheric substance generated in a second. The function of the steel pins is, according to Mr. Keeley's explanation, to intensify the vibration of the intermolecular etheric substance, producing "a rotary or vertical circle of vibration," which circle of vibration runs the engine. By this device Mr. Keeley says he has succeeded in harnessing the power of vibration, hitherto, except in music, known only as a destructive power, against which engineers had to guard with the greatest care. To illustrate the terrible power of vibration and the great importance of harnessing it, the *World* writer says:

"Long ago I read of a man who said he could fiddle a bridge down, and being jeered at for his presumption, set his fiddle to accord with the key of the bridge, and came so dangerously near succeeding in his work of destruction as to convince the scoffers of his ability to do what he said. Mr. Keeley's motor and engine recalled this story to me, and also convinced me that the fiddler was theoretically correct in his boast. Indeed, Mr. Keeley says that it is theoretically possible to shake down a house with a violin."

In this statement Mr. Keeley is, as usual, only too modest, many a man having publicly brought down a house by skillful fiddling.

And just here we may express our conviction that Mr. Keeley's practical labors have furnished a demonstration of a theory which we have long entertained as furnishing an explanation of the conduct of the Emperor Nero during the great fire in Rome. Nero fiddled while Rome was burning, but he did it to save the city. The conflagration had reached a pitch at which it could not be stayed except by surrounding it with wide spaces vacant of buildings. Modern firemen clear such spaces when occasion demands by blowing down the houses with gunpowder. Nero—the Keeley of his age—resorted to "the power of vibration," and called it into action by means of his fiddle, thereby leveling whole blocks of temples and palaces and tenement houses, for the salvation of the rest of the city. The ignorant populace thought he was fiddling for fun. Those who do not understand Mr. Keeley are liable to misjudge him in likemanner.

WHEN ARE LAWS DISCOVERED?

In his letter to the SCIENTIFIC AMERICAN, of April 5th, Mr. Gary intimates that the world is not indebted to "learned professors" and to "laboratories" for a knowledge of the laws of gravitation, of magnetism, and of electricity, and he takes pains to specify the names of Newton, of Franklin, and of Faraday, as if they would exemplify his text. He evidently thinks that ignorant plow boys have not unfrequently broken into these fields that are supposed to be in the special charge of "learned professors," and have taught the latter that they did not know much about their subjects, and that their so-called laws were not laws at all.

But Mr. Gary's knowledge of history is as defective as his knowledge of magnetismand of electricity, and it may interest him, and perhaps some others, to learn how much of the knowledge we possess on the above subjects came from "learned professors" and their "laboratories."

1st. "Newton with his apple." It is a mistake to imagine that the law of gravitation was discovered in the garden when the apple was observed to fall; that happened in 1666. The law was discovered in 1683, at the time when the calculations began to assume such shape that Newton became unable to finish them and handed them over to an assistant. The discovery unnerved Newton, but it was not in the garden, but seventeen years after the observation. If Newton really thought that his discovery was made in the garden, his emotion was certainly very late in showing itself.

2d. "Franklin with his kite." Now what Franklin discovered was not a law, but the identity of electricity and lightning, an interesting fact that had many applications, all in accordance with what was known about electricity. But Franklin was a skillful experimenter, and also knew well what others had done, and so far was quite unlike Mr. Gary, who brags that he is ignorant of what others have done.

3d. Precisely the same may be said concerning "Faraday and his magnets and iron filings." He had then been twenty years in the laboratory of the Royal Institution, and he was professor of chemistry then, and a very learned professor he was, too, in both electricity and magnetism.

4th. "The power of steam." Now the names of those who gave attention to that subject and developed the power are:

(1) Hiero, of Alexandria, a mathematician and natural philosopher.

(2) Papin, a professor of mathematics in Marburg.

(3) Watt, an instrument maker to the Universityof Glasgow.

So far there is nothing to countenance the idea that conceited ignorance has added to the world's stock of knowledge in these directions; but let us see who has done the work and given us the laws in electricity and magnetism:

Gilbert, Fellow of the College of Physicians, London.

Galvani, Professor of Anatomy, University of Bologna.

Volta, Professor of Natural Philosophy, University of Pavia.

Oersted, Professor of Natural Philosophy, University of Copenhagen.

Ampère, Inspector General of the University of Paris.

Ohm, Professor of Mathematics, College of Cologne.

Weber, Professor of Natural Philosophy, Göttingen.

Faraday, Professor of Chemistry, Royal Institution, London.

Thomson, Professor of Natural Philosophy, University of Glasgow.

Maxwell, Professor of Natural Philosophy, University of Cambridge.

Henry, Professor of Natural Philosophy, Princeton College.

These are the men who have discovered about all we know about these matters; so it is evident that "learned professors" have done the work, and it was done in "laboratories." When Mr. Gary took his supposed discovery to the late Professor Henry, the latter, after listening patiently to his statement, told him to buy $50 worth of books and study up on magnetism before he wasted more time in experiment, and to this advice may now be made the recommendation that before he writes any more history of science he be at the pains of studying it more carefully. E.

MOLECULAR CHEMISTRY.—No. 1.

The question whether matter is or is not infinitely divisible is of no direct consequence to theoretical chemistry, as we are not in possession of any facts that could enable us to decide it. We do, however, possess evidence that matter exists in the form of exceedingly minute particles. The porosity of bodies, their compressibility, and their contraction and expansion when they are cooled or heated, would alone warrant the conclusion that the matter they contain exists in a state of division, because it does not fill the space it occupies. The familiar experiment of mixing half a pint of absolute alcohol with half a pint of water and obtaining less than one pint of mixture admits of no other interpretation than that these substances consist of particles separated by spaces, and that some of the particles of one have found their way into the interstices of the other.

Let us now see how this purely physical conception of matter will aid us in the explanation of chemical facts.

On analyzing the chloride, the bromide, and the iodide of hydrogen, we find them to contain for every gramme of hydrogen: 35·368 grammes of chlorine, 79·750 of bromine, and 126·533 of iodine. Again, these identical quantities are found in combination with 39·040 grammes of potassium in each case, and also with 22·980 grammes of sodium in each case. It appears, then, that 39·040 grammes of potassium are proportional or equivalent to 22·980 grammes of sodium and to 1 gramme of hydrogen; also, that 35·368 grammes of chlorine are equivalent to 79·750 of bromine and to 126·533 of iodine. The analysis of vast numbers of chemical compounds has shown these figures to be invariable, and it has been ascertained not only that the substances mentioned, but that every element has a weight peculiar to itself, which it retains throughout all its numerous compounds. In other words, the constituents of a chemical compound are combined in fixed unalterable proportions. Thus, pure chloride of sodium, no matter how it may be prepared or from what part of the world it may be obtained, always contains its chlorine and its sodium in the proportion of 35·368 to 22·980. Hence chemical formulæ are made to tell us not only what elements a substance contains, but also in what proportions they are combined. Chemists have their table of combining numbers, and when they write down the initial letters of elements, as for instance HI, they mean one part by weight of hydrogen combined with 126·533 parts of iodine.

To Wenzel and Richter belongs the credit of having first recognized the equivalent relations between the quantities of different bases required to neutralize the same acid, and also between the quantities of different acids necessary to neutralize the same base.

Dalton discovered that carbonic acid contains the same quantity of carbon as carbonic oxide, but twice as much oxygen; also that marsh gas contains as much carbon as olefiant gas, but twice as much hydrogen. From these and many other facts he formulated the following law, which has been firmly established by extensive investigations. When a substance combines with a greater weight of another than the ascertained equivalent or proportional weight of the latter, it will do so with twice, three times, four times, etc., that equivalent, and not with any intermediate or fractional number. Thus 14·009 parts by weight of nitrogen will combine with 15·960, or $2 \times 15{\cdot}960$, or $3 \times 15{\cdot}960$, or $4 \times 15{\cdot}960$, or $5 \times 15{\cdot}960$ parts of oxygen, but not with $1\frac{1}{2}$, $1\frac{1}{4}$, $1\frac{1}{8}$, etc., times 15·960.

The explanation of this wonderful fundamental fact of chemical science is as profound as it is simple. We have seen that matter is composed of particles separated by spaces; we now learn that these particles have different weights. The weight of a particle of hydrogen being taken as unity, the weight of a particle of oxygen will be 15·960, of nitrogen 14·009, of chlorine 35·368, of sodium 22·980. These ultimate particles have received the name of atoms, and we retain this name, not because they cannot be further subdivided—an assertion that would lead us to pure speculation—but because they constitute the smallest undivided portions of matter whose actual existence we have a right to affirm. Without complicating the present discussion with the details of the dynamical or kinetic theory, it will be stated, and no doubt readily conceded, that these atoms must be regarded as the centers or vehicles of forces, and as subject to the laws that govern larger bodies of matter. Now, what happens when two substances combine? The atoms of one simply enter in the sphere of attraction of the atoms of the other, and arrange themselves in groups or *nuclei*, each of which acts as a whole, and the result is a compound body having new properties. Now, it is evident that we may have a nucleus composed of one atom of nitrogen + one atom of oxygen (NO), or of one atom of nitrogen + two of oxygen (NO_2), etc.; but as these atoms are never divided, we cannot have $1\,N + 1\frac{1}{2}\,O$. We may therefore reasonably conclude that the atoms of different substances possess different weights, and that the combining or equivalent numbers, determined with the utmost care from innumerable analyses, especially by Berzelius and Stas, represent the relative weights of these atoms. What their absolute weight may be we cannot tell; all we know is that an atom of oxygen weighs 15·960 times as much as an atom of hydrogen, and so for the other elements. It follows, furthermore, that the combining weights of a compound body must be equal to the sum of the atomic weight of its constituents, which clearly explains the discovery of Wenzel and Richter alluded to above.

Let us now examine the method by which the combining, or, as we may now call them, the atomic weights of the elements have been ascertained. Suppose we had analyzed 100 grammes of water and found them to contain 11·11 grammes of hydrogen and 88·89 grammes of oxygen. The proportion is evidently very nearly as 1:8; but the question arises, How many atoms of oxygen and how many of hydrogen are necessary to form the smallest possible quantity of water? If water contains one atom of each, the combining weight of oxygen is 8; it if contains two of hydrogen to one of oxygen (H_2O) the combining weight of oxygen is 16; if it contain two of oxygen to one of hydrogen (HO_2) the combining weight of oxygen is 4, etc. Our analysis does not tell us. If we analyzed all possible combinations of oxygen, and so ascertained that it never combines in a quantity less than 16 (more accurately 15·960); or if, in a similar way, we found that water never combines in a lower proportion than 17·960, we might then safely set down the composition of water as H_2O, or $2 \times 1 + 1 \times 15{\cdot}960 = 17{\cdot}960$, two atoms of hydrogen for every atom of oxygen. Such a course would, however, involve an amount of labor and an accumulation of difficulties that would render it impossible in practice. It will be the subject of the next paper to show how these difficulties were overcome, and how the way was paved for further discovery. C. F. K.

EDISON'S ELECTRIC ILLUMINATOR AND DR. DRAPER'S EXPERIMENTS THIRTY YEARS AGO.

Now that the publication of Mr. Edison's patents for electric illumination has made the public acquainted with the details of his process, it is well to recall what had been done on this subject many years ago.

Dr. John W. Draper, in a memoir published in the *American Journal of Arts and Sciences*, 1847, and also in the *London, Edinburgh, and Dublin Philosophical Magazine* of the same year, gave an exhaustive examination of this subject. He used a strip of platinum, brought to incandescence by the passage of a voltaic current through it, and showed that the light emitted increases in brilliancy far more rapidly than the increments of temperature. The strip of platinum, brought to a proper temperature by the passage of the electric current, was connected with an index lever, which measured its expansion. The results thus obtained proved that the increase in the intensity of the light of the ignited platinum became very rapid as the temperature rose. At 2,590° Fah. the brilliancy of the light was more than thirty-six times as great as it was at 1,900°. This paper is reprinted as Memoir I. in his recently published "Scientific Memoirs" (Harper & Bros.).

The facts he had thus obtained he applied practically in the construction of a lamp. At p. 45, in the volume referred to, he says:

"Among writers on optics it has been a desideratum to obtain an artificial light of standard brilliancy. The preceding experiments furnish an easy means of supplying that want, and give us what might be termed a 'unit lamp.' A surface of platinum of standard dimensions, raised to a standard temperature by a voltaic current, will always emit a constant light. A strip of that metal, one inch long and one twentieth of an inch wide, connected with a lever by which its expansion might be measured, would yield at 2,000° Fah. a light suitable for most purposes. An ingenious artist would have very little difficulty, by taking advantage of the movements of the lever, in making a self-acting apparatus, in which the platinum should be maintained at a uniform temperature, notwithstanding any change taking place in the voltaic current."

This memoir treats of the whole subject of the incandescence of platinum very exhaustively, measuring the heat emitted, the light emitted, and its spectrum analysis. Gas companies and others, interested in the rivalry between electric and gas illumination, will do well to examine it closely. Though printed in 1867 the experiments it relates were made two or three years previously. Subsequently Dr. Draper used iridio-platinum, and found that he could obtain a much brighter light because of its greater infusibility. At that time the method could not be recommended for public use, because it required a nitric acid battery. The dynamo-electric machine has of late years removed that difficulty.

AMERICAN INDUSTRIES.—No. 12.

THE MANUFACTURE OF BILLIARD TABLES.

To business men and men of sedentary habits the question of exercise and recreation is a vital one. Of course there are endless varieties of amusement that may be indulged in, some being beneficial and desirable, while others are pernicious and to be deprecated. Among forms of innocent diversion, a game of billiards may be commended as being a mild form of exercise which sufficiently occupies the mind to dispel thoughts of business, while it brings into action almost every muscle in the body.

Billiards, like every other game or amusement, may be perverted; but the legitimate use of the ball and cue is undoubtedly beneficial. The game is a social one, and may be properly played by both sexes. That it is growing in popularity is shown by the constantly increasing demand for billiard tables and their appurtenances.

There are now several manufactories of billiard tables in the United States, but perhaps the oldest and the largest is that of Mr. H.W. Collender. These works are situated in the beautiful village of Stamford, Conn. The five story building, with its two towers and French roof, appears more like a modern university building than a manufactory.

The basement contains the engine driven by steam from a boiler in the adjoining boiler house. It also contains the machinery for cutting and planing lumber, and for sawing the slate which forms the bed of the table. The offices and packing room occupy the first floor. Upon the second floor the broad rails and cushions are made. Upon the third floor there is a variety of machinery invented by Mr. Collender especially for the manufacture of these tables. Upon the fourth floor the various parts that have been made by machinery and by hand are assembled and fitted; and upon the fifth floor the varnishing and polishing are done.

In making the wooden frame of the table only the choicest materials can be used, and the wood requires three years' seasoning to insure its staying in place. The corners of the broad rails are carefully mitered and bored by accurate machinery, shown in the lower portion of the engraving, on the first page, and they are fitted to iron corner pieces having a socket for receiving the leg. All of the cross-pieces are secured by iron sockets, so that when the parts of the table are fastened together they are not liable to be thrown out of adjustment by atmospheric changes.

The legs are shaped by the machine shown in the upper right hand corner of the engraving, and are sand-papered by the machine shown in the central figure. The varnishing and polishing are of necessity done by hand. A large number of men are constantly employed in this department, giving the final touches which render the exterior of the table attractive. After having spent more than twenty years in perfecting the wooden frame of the billiard table so that it would always support the slate bed in a true plane, Mr. Collender has devised two forms of iron frame of elegant design, which support the bed at every point and are entirely exempt from any objection that might be brought against wooden frames. These tables, the "Imperial" and the "Occidental," are shown in our engraving.

In many points the manufacture of billiard tables is like that of a piano or first class article of furniture, but greater accuracy is required than in either of the branches referred to. As an evidence of the superiority of these tables we may mention that at the Centennial and the Paris Exhibitions they took the highest premium. The warerooms of Mr. H. W. Collender are at 788 Broadway, New York; 84 and 86 State street, Chicago, Ill.; and 17 South Fifth street, St. Louis, Mo.

A JAPANESE EXHIBITION.—The second General Industrial Exhibition in Tokio is announced for 1881. The latest census gives Tokio a population of 1,042,000.

TESTING LUBRICANTS.

We give, from *Engineering*, engravings of a machine employed by the Eastern Railway Company of France for ascertaining the value of various lubricants, the particular machine illustrated being one which was exhibited by the company, at Paris, last year. Referring to Fig. 1, it will be seen that the testing apparatus consists of a horizontal iron disk, A, driven at a uniform speed, and having bearing upon its upper surface three gun metal blocks, *t t t*, fitted to a second disk, B; this second disk being pressed down on that first mentioned by means of a lever, R, fitted with an adjustable weight. A small hand worked lifting arrangement, D, enables the weighted lever, R, to be raised so that the upper disk, B, can be removed, and the lubricating material to be tested spread over the surface of the disk, A.

When the arrangement just described is in operation it is evident that the disk, A, as it revolves, will tend to drag the disk, B, round with it, the rotative force thus exerted depending upon the pressure exercised upon the disk, B, and upon the nature of the lubricating material between the two rubbing surfaces By connecting the spring of a dynamometer to the periphery of the disk, B, the amount of work absorbed in friction during the time that a sample of lubricant is being used up can be ascertained, while, the duration of the experiment being duly noted and the elevation of temperature registered, the data are obtained for forming a practical estimate of the value of the lubricant under trial. The dynamometrical apparatus consists of a weight, X, slung by a band passing over a cam fixed on a horizontal spindle mounted on the frame, F, the periphery of the disk, B, being also connected to the cam just mentioned, so that as the disk, B, is dragged round by disk, A, the weight, X, is raised. Owing to the form of the cam, the weight, X, offers a constantly increasing resistance as it is lifted, and the amount by which the weight is raised is thus a measure of the force with which the disk, B, is dragged round; or, in other words, it is a measure of the friction between the disk, A, and the rubbing pieces, *t t t*. The amount by which the weight, X, is raised is registered as follows: The spindle on which the cam is fixed carries also a small pinion, S, which engages with a rack actuating the style, K, and thus gives to the latter a movement proportional to the force with which the disk, B, is dragged round. The style, K, shown to a larger scale in Fig 3, is fitted with a spindle, *a*, provided with a fork carrying the small cutting roller, *b*, and this roller, being pressed down on to a continuous band of paper, H, by the counterweights, L, marks on the paper a curve, which forms a measure of the frictional grip between the disks, A and B.

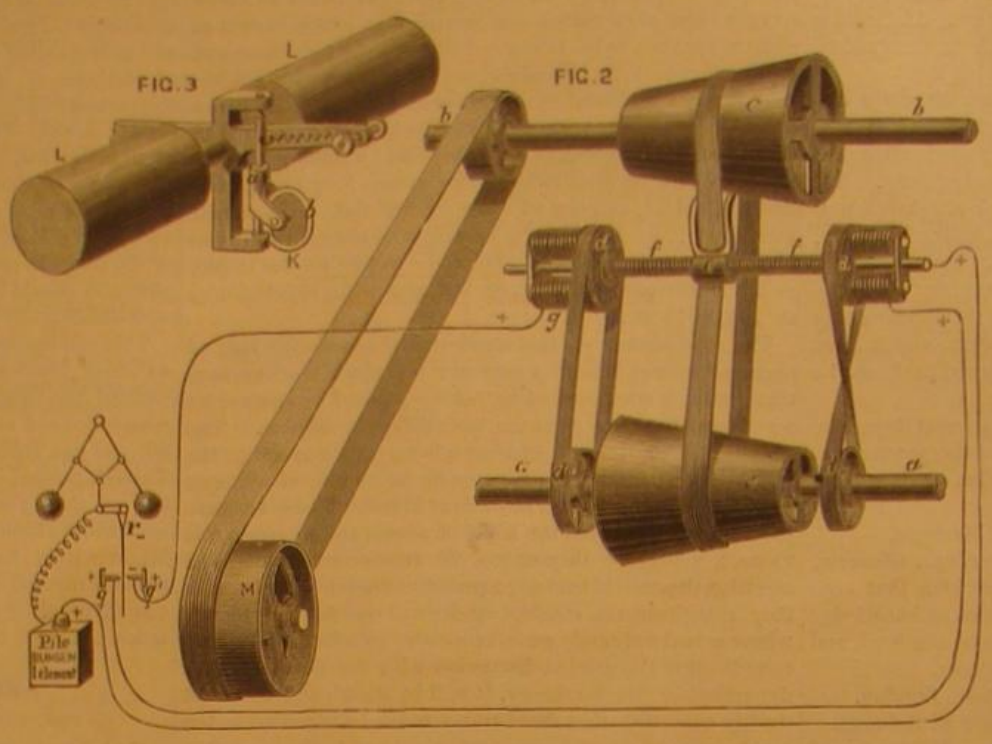
The uniform movement of the paper, H, is obtained by means of a worm mounted on the driving shaft, U, of the machine, this worm gearing into a worm wheel, V, fixed on a spindle carrying a cylinder which forces the band of paper against a second divided cylinder. This latter cylinder receives a rotative movement by gear so proportioned that the strip of paper is advanced one millimeter at each turn of the disk, A, while an inking apparatus, G, also driven by gearing, enables the millimeter divisions to be printed on the band of paper as it passes. The time of an experiment is recorded by an electric clock, I, which makes a mark upon the band of paper every half minute.

The uniform rotation of the disk, A, is secured by the use of a centrifugal governor acting through the ingenious electric arrangement explained by the diagram, Fig. 2. This arrangement acts as follows: The centrifugal governor, J (which derives its motion from the driving shaft of the apparatus), acts by means of a lever upon the spring, *r* (see Fig. 2), which oscillates between two contact points, *q q*¹, placed a very small distance apart. According as the speed of the apparatus varies above or below that corresponding to the mean position of the governor, the latter establishes a contact between the plate, *r*, and the one at the other of the contact points, *q q*¹, and by so doing causes a current to traverse the coils of the one or the other of the electro-magnets, *g g*. The arrangement of the connections will be readily understood from Fig. 2, from which it will be seen that the positive pole of a single cell Bunsen battery is connected to a shaft, *f*, on which the two electro-magnets are mounted, one end of the coils of each magnet being also connected to this shaft. The other, or negative, pole of the battery is connected to the spring, *r*, and according as the governor rises or falls it is thus brought into connection with the contact points, *q* and *q*¹, respectively. These points are, in their turn, connected by wires, one to each electro-magnet, the contact point, *q*¹, being connected to the left hand and *q* to the right hand electro-magnet in Fig. 2. Thus, if the governor rises, a current is made to traverse the coils of the right hand electro-magnet; or *vice versa*, if the governor falls, the left hand magnet is brought into operation The shaft, *f*, on which are mounted two electro-magnets, also carries two loose pulleys, *d*¹ *d*¹, which are driven by belts from the pulleys, *d d*, on the main driving shaft of the apparatus, one of the belts being crossed and the other open, so that the loose pulleys, *d*¹ *d*¹, are driven in opposite directions. On the central part of the shaft, *f*, a screw is cut, and a nut, *e*, fitted to this screw carries a fork acting on the belt connecting the two pulleys, *c c*. The upper of these conical pulleys is fixed on a shaft, which carries also a pulley from which a belt is led off to the fast and loose pulleys, M. This speed governor is very sensitive, and is found to control the speed well.

Toward the end of the experiment, as the lubricant becomes used up, the friction between the two disks, A, B, increases, and as soon as it reaches an amount greater than the resistance offered by the weight, X, the disk, B, is carried round, and a stop on it comes into contact with the abutment, R, the detent, Q, being at the same time operated upon and the weighted lever, P, liberated, this lever, as it falls, moving the driving belt from the fast to the loose pulley, and so stopping the apparatus.

The curve drawn on the traveling paper indicates, by its greater or less regularity, the general behavior of the lubricant during the experiment, while it also affords a measure of the coefficient of friction. The diagram also indicates the duration of the experiment.

The residue left on the surface of the disk, A, assists, by its appearance, the deductions regarding the value of the lubricant.



Figs. 2 and 3.—TESTING LUBRICANTS.

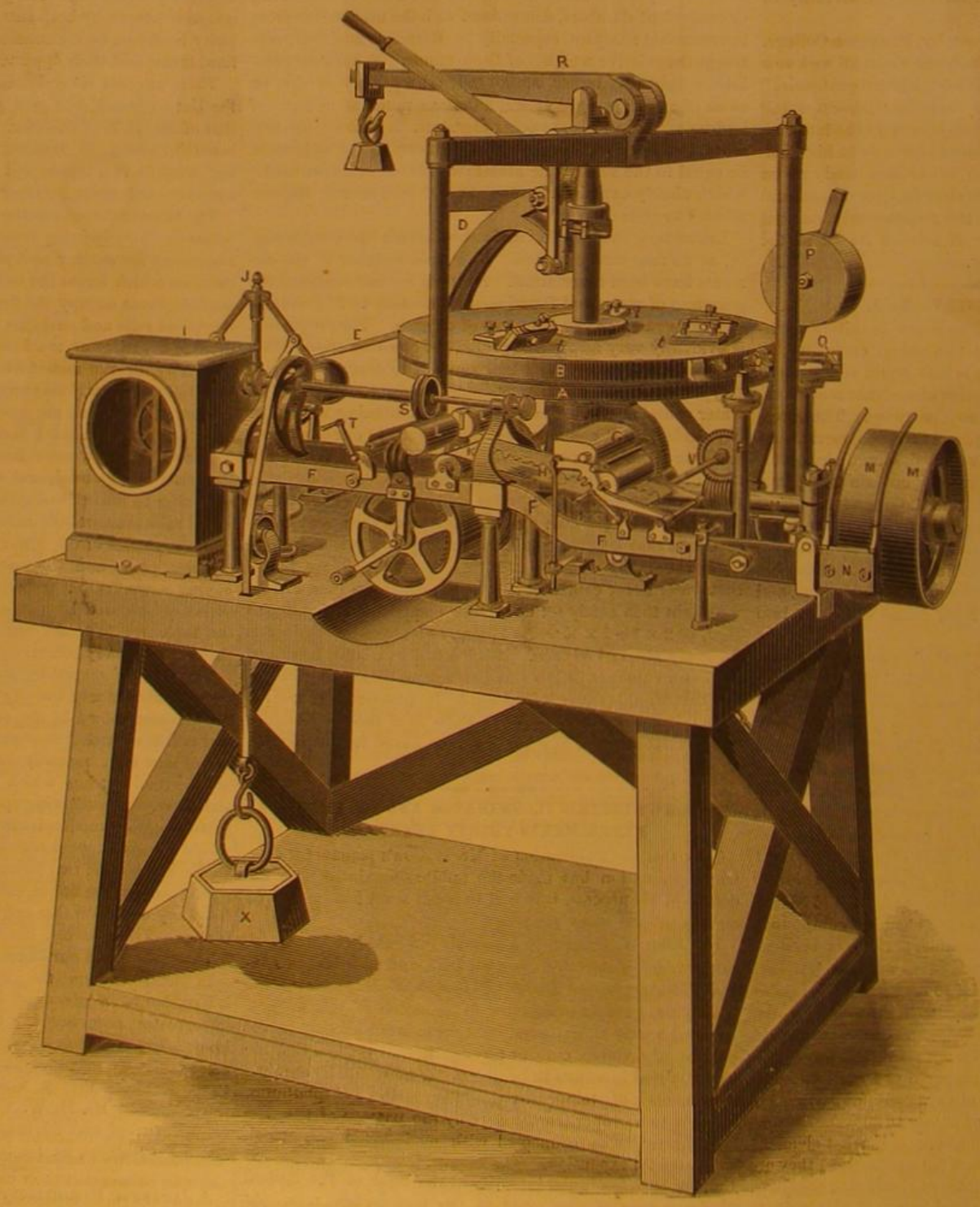


Fig. 1.—MACHINE FOR TESTING LUBRICANTS.

Ether with Cod Liver Oil.

The fact that cod liver oil cannot be tolerated in a very large number of cases where the use of the remedy is indicated, led the New York Therapeutical Society to refer to a committee, for investigation, the claims of Dr. Foster, who first suggested the combination of the oil with ether as a means of overcoming the difficulty. The committee, after an examination of 94 cases, report that the evidence before them warrants the conclusions: (1) That the addition of ether to cod liver oil, in about the proportion of fifteen minims to each half ounce (or an equivalent amount of Hoffman's anodyne instead of ether), will succeed in the vast

majority of cases in enabling the patient to take the oil, even though it previously disagreed; (2) that in some cases in which the oil still disagrees after the addition of the ether, the difficulty may be overcome by giving the ether separately from fifteen minutes to half an hour after the oil is taken. No facts were laid before the committee from which they could judge as to whether the etherized oil is superior to the plain oil in its ultimate effect upon nutrition, supposing them to be equally well tolerated by the stomach.

A FEW NOVELTIES.

The accompanying engraving represents several simple inventions recently patented in the United States. Most of them are of the class that sell for a few cents—a class of inventions that are, as a rule, more profitable than any other.

Fig. 1 shows an improved candlestick invented by Mr. John Frick, of New York city. It is composed of three parts, two of which cross each other and form the base and support for the candle; the third, the disk, is slotted radially to receive the crosspieces, and has a turned-up edge for retaining any tallow that may drip from the candle.

A can opener is shown in Fig. 2; the knife used in it in Fig. 3. This instrument consists of a frame which receives the top of the can, having attached to it a handle and carrying the small knife, which cuts the cover as the opener is turned on the top of the can. Mr. T. F. Wilson, of Washington, D. C., is the inventor of this device.

A fountain mucilage brush, the invention of Mr. J. B. Davids, of New York city, is shown in Fig. 4. It consists of a brush adapted to a bottle, and provided with a tubular handle, having on its upper end an elastic bulb for containing mucilage or any other liquid to be applied with the brush. By compressing the elastic bulb and dipping the brush in the liquid and then allowing it to expand, the liquid is drawn into the bulb through the hollow brush handle, a small hole being provided near the lower end of the handle to admit the liquid.

The improved weighing scoop shown in Figs. 5 and 6 was recently patented by Mr. John Berks, of Ogdensburg, N. Y. It has a spring balance in the handle, and is graduated so that it may be used for measuring as well as weighing.

An improved nozzle for holding dies in the process of hardening is shown in Fig. 7. It is the invention of Mr. Joseph B. Harmstead, of San Francisco, Cal. It is especially designed for use in mints. The face of the die is hardened first, the back being protected by the inwardly projecting rim.

Mr. L. C. Mumford, of San Francisco, Cal., has devised a cork extractor, shown in Fig. 8. It is made wholly of spring sheet metal. Its construction, as well as the manner of using, will be readily understood by reference to the engraving.

Mr. Ezra A. Quinby, of Memory, Iowa, the inventor of the tree compress shown in Fig. 9, claims that by applying the compress so as to prevent the return of the sap to the roots the limbs will mature much earlier than they otherwise would, and will bear fruit earlier and in greater quantities.

Fig. 10 shows a hand corn sheller invented by Mr. George W. Grimes, of Bluffton, Ind. It consists in a ring, provided with two or more rows of inwardly projecting teeth, and having a handle by which it is manipulated. The sheller is held by one hand, and the ear of corn is thrust into it and turned with the other hand.

A simple and effective wrench for holding fruit jars while the cover is applied or removed, is shown in Fig. 11. It is the invention of Messrs. D. Sherman and G. D. Dudley, of Lowell, Mass., and it consists of two handles connected by a band which passes around the jar. The inventors prefer to use wood in its manufacture and to make it entirely of one piece.

The bottle stopper shown in Figs. 12 and 13 is the invention of Mr. C. G. Hutchinson, of Chicago, Ill. It consists of a wire loop of peculiar form, having attached to it a rubber disk which acts as the stopper. Fig. 12 shows the bottle stopped; Fig. 13 shows it open.

RECENTLY PATENTED NOVELTIES.

The Discipline of Education.

A great deal that is said about the importance of classical education as a discipline of the mind largely disregards the operation of ordinary duties in this direction. We can imagine that a young nobleman, so situated as to be above or beyond those compulsory circumstances that force the average man to exertion, would without the discipline of a college education fall into very loose and idle mental habits. College training is with him the only thing that will teach him to govern his desires, to concentrate his attention, and to bring his mind under the control of his will. Without the obligations and stimulus of college life he would be likely to develop into a very slothful and self-indulgent maturity, with little command over his faculties and little inclination to exercise them. It is this fact, we apprehend, that lies at the root of nearly all the utterances that we hear upon the subject—utterances that are for the most part traditional, that are borrowed from the higher ranks of English life, and which are derived from observations purely special and local in their character. They apply with equal force to a small proportion of our own people, it being evident that young men of wealth would sink into marked inferiority if educational discipline did not extend well into their manhood. But we are convinced that the requirements of the schools, the mental training which comes of a study of the ancient languages and the higher mathematics, are far from being so completely disciplinary as the ordinary experiences of the professions and the trades. The lawyer in his practice soon gains the power of concentration, and is fairly compelled to bring his mind under the control of his will, his discipline being more thorough, more exacting, more sustained, than any that can be invented by college systems. The daily experience of the physician is likewise efficient in bringing all the functions of the mind into subordination and under control. It is only by sustained effort and severe concentration that the man of letters can succeed; the painter and the poet are helpless if their intellectual powers are not fully at their command. It will be said here that the exact purpose of college discipline is to prepare men for these exacting duties. But in our observation training at college bears so small a proportion to that which comes with the competitions of life that it is scarcely traceable We have always found that men whose necessities force them to bend their energies to work are the men who hold themselves well in hand, and that other men usually have little power of application; that is, the classification does not distinguish between educated and uneducated men, but between working and non-working men. In the list of men who have attained success or contributed notably to the world's advance, it will not be found that those who have exhibited remarkable mental power and intellectual self-command are specially on the side of the university class. Three of the most conspicuous men in English philosophy and science—Herbert Spencer, Huxley, and Tyndall—have developed their remarkable powers from the impulses of their natural gifts and not by the aid of college discipline or classical guiding. Perhaps their labors would have been easier under a thorough preparatory course—this is not easy to gainsay—but the fact remains that in the pursuit of their several ends they have brought their mental forces under complete and perfect control. Necessity is the great master, and it operates on all classes of society—it gives the power of concentration to the lawyer, teaches the physician to be self-contained and studious, gives efficiency to the pen of the writer, drills the bookkeeper and the clerk, and trains the hand of the artisan. It is an ever-present and most exacting schoolmaster; and, as with an immense majority of people this schoolmaster begins his lessons in youth by means of the struggles and burdens of life, and continues them without relaxation to the end, the discipline within certain limits is complete—the self-control being general, but the proficiency lying, in each case, solely along the line of experience. —*Appletons' Journal.*

The Formation of Character.

There is a practical as well as a scientific basis for the position taken by the Rev. Phillips Brooks in a recent discourse in this city, namely, that the law of evolution rules in the moral as well as in the physical world. Nature does not create, but is always developing. In last summer's roots nature finds the germ for next summer's verdure.

"If somebody should give me a diamond to carry to Europe, I can know exactly how much would be lost to the world were I to drop it into the sea; but if a seed should be given me, I can only regard it with awe as containing concealed within it the food of untold generations. That is the difference between looking at truth as a diamond or as a seed —as final or germinal.

"In all training of character, continuity and economy must be supreme. The notion that character is spontaneous is held by most people in the earlier portion of their lives, and is wrong. When they discover this, nine tenths change to the other extreme. This is wrong too. Hosts of young men think that their character will form of itself and that they will necessarily become better as they grow older. Hosts of old men believe that their character is fixed and that it is impossible for them to become better. Such beliefs are foolish. People are also wrong in thinking that they can put off their bad traits and put on good traits. The old failures cannot

be thus transformed, but out of the old habits new can be formed. This is what many a poor creature needs to know. We must make what we are to be out of what we are already."

Machinery in America.

In our leading remarks last month we endeavored to show the important part which machinery may be made to perform in enabling us to oust all competitors from our own markets, and in enabling us to make a profit and still undersell in countries where protective duties have been increased on the importation of English manufactured goods.

Our remarks have met with some attention from some of our most deservedly distinguished men, and the question at issue has chiefly turned on the patent laws. Are cheap patents good for the trade of the country? Lord Selborne says "No." We say "Yes."

The United States of America already possesses cheap patent laws, the cost of obtaining a complete patent there only amounting to £13 and upward, against £190 in this country at the present time, and it is therefore a fair argument to consider what advantages these laws give to the manufacturers in the States. Taking this standpoint, we assert at once that their power to compete where they now do with English makers is traceable to the perfection of their machinery, and that they owe their perfect machinery to the stimulus given to ingenuity by their cheap patent system.

We must remember that the manufacturers in the States have to pay dearer for their coal, their iron, and their labor than their English competitors; they are further handicapped by heavy protective duties; and we ask, therefore, what is the explanation of their advantage over us? How is it possible for them to undersell us in any one item if we have such essential advantages to start with? Let us hear what Mr. Thomas Brassey, M.P., has to say about it. Lecturing in January, 1878, on the comparative efficiency of English and foreign labor, he urged that we have much more to fear from the highly paid labor of America, *which brought labor-saving machinery and mechanical skill to such a high degree of perfection* [the italics are ours] than from the lower wages of the Continent of Europe. Referring to the success with which the Americans have competed with us in the making of small arms and locomotives, he says:

"It would at first sight seem incredible that our engine builders should have been beaten in a neutral market with no hostile tariff. Anyhow, it would have been expected that, if we were beaten, it would have been by the Belgian or German makers, who command an ample supply of labor at comparatively low rates. The contrary, however, has happened, and it is a country where labor is paid at rates unknown in the Old World which has supplanted us. We have been conquered by the mechanical skill of the employer in devising labor-saving machinery, and by the industry and energy of the workmen, who, if they have earned high wages, have worked longer and more industriously than many among our own mechanics have been disposed to do."

The above remarks were quoted in a paper by Mr. A. J. Mundella, M.P., read before the Statistical Society, February 19, 1878. The paper dealt with the question, "What are the Conditions on which the Commercial and Manufacturing Supremacy of Great Britain depends?" Mr. Mundella used Mr. Brassey's remarks to show that American skilled labor is equal to English. We think, however, that it has a great significance in connection with the cheap patent system, as that alone accounts to us for the stimulus to Americans to be always inventing and producing the perfected labor-saving machinery which Mr. Brassey speaks of.

In further considering the comparative efficiency of English and American labor, Mr. Mundella himself incidentally touches on the importance of the machinery. He says:

"The American under equal conditions will produce nearly, though not quite, as much as the Englishman. Wherever I have found him producing more it was due to his having been furnished with better machinery and appliances to work with."

In the discussion on Mr. Mundella's paper, Mr. J. B. Brown, who stated that he had given a great deal of attention to the question of the comparative efficiency of American and English labor, said:

"Everywhere he went in America he found the manufacturers were in favor of protective duties. A large number of the most intelligent of them said they would willingly yield a great portion of the tariff at once, because the American workmen and the improved American machinery could hold themselves against the world. . . . From his own experience, he found that the American machinery on the whole was superior to the English, quite as well made, generally more ingenious, and more successful in saving manual labor."

Another speaker (Mr. H. D. Pochin), said:

"There was a time when our workmen were equal to any workmen in the world; but any one acquainted with the facts would know that in certain classes of machinery we were outdone by the Americans, not because they had greater skill than our own workmen, but because of the spirit that was abroad among them, and the doctrines that were being instilled into them."

The foregoing testimony to the efficiency of American machinery is all the more valuable for our purpose because of its incidental character. We find our point further supported in an article which appeared in the *Fortnightly Review* for March, entitled "An American View of American Competition." In it, the writer, after referring to the small army required by the United States of America, and the room for immigration, says:

"If there is any force in this reasoning, our competition with other manufacturing countries in supplying neutral markets with manufactured goods will not be compassed by low rates of wages paid to our factory operatives, or to the working people engaged in our metal works and other occupations, but first, by obtaining and keeping such an advanced position in the application and use of improved tools and machinery as shall make high wages consistent with a low cost of production."

We think the evidence we have quoted clearly establishes this one fact that, although paying higher wages, and paying more for materials, the manufacturers of the States are able to compete in neutral markets with certain classes of goods, simply and entirely owing to having better, *i. e.*, more productive or more economical labor-saving machinery than we have in this country.

Now we come back to inquire how it is that the Americans have better devised machinery than we have. The answer we have to this serious question is contained in a simple remark made to us once by an intelligent workman, who had been in the United States: "You see, in America you can get a patent for £10 or so, and every one thinks how he can invent something."

The future manufacturing and commercial supremacy of this country depends to a greater extent than will ever be imagined by a superficial observer, on our keeping ahead in the excellence of our machinery and appliances. We have seen how the superiority of the American machinery enables the masters to pay high wages for skilled labor. Why should not England and English workmen have the same benefit? The remedy lies in our own hands. Let us, for the sake of trade, meet America on its own ground, and practically free ingenuity from taxation. Let there be no greater cost for protecting inventions than is readily payable by any saving workman. Let the people agitate for cheap patents, so that the humblest inventor may be able to protect his invention and recoup himself for serving his country, and we venture to predict that our machinery and appliances will be so perfected that no country will be able to compete with us in a single article worth mentioning, and so the trade of the world will flow unreservedly into our hands. —*The Machinery Market.*

American Meats in England.—A New Process for Preservation.

The Farm, published in Dublin, Ireland, in discussing the subject of importing live cattle into the British Islands, says: The carrying of live cattle over great distances by sea is surrounded with difficulties, which may, no doubt, be overcome, but which cannot be done away with entirely, and, so far as our present experience has gone, it seems certain that the necessities of these islands will, more and more, require to be supplied by improvements in the processes for the collecting abroad and for the carrying of dead meat.

Alluding to the present traffic the writer says: For some time past American beef and mutton have been largely imported into this country. In Liverpool alone, frequently there arrive in one week consignments amounting to over 5,000 quarters of beef, 1,500 carcasses of mutton, and 1,000 pigs. When the carrying of dead meat first commenced endeavors were made to preserve it by freezing it while quite fresh and keeping it frozen until the time when it was to be used. This, however, turned out very unsatisfactorily. First, it was very difficult to freeze the meat and to keep it uniformly frozen for a great length of time—ten days or more; and in the next place, it was very soon found that meat which has been frozen undergoes decompositon with extraordinary rapidity as soon as it is thawed. No doubt, the cellular texture is broken up by the freezing process in such a way as to favor decomposition if once commenced.

A great improvement on the "freezing process" was introduced two or three years ago. The animals are slaughtered under the best conditions as to health and cleanliness. The carcasses, having been quickly cleaned, cut up, and covered with a loose pack sheet, are hung in a chamber which is kept cooled with dry air, at a temperature not so low as that of freezing, but at about 35° Fah., which is three degrees above the freezing point. Until now this has been effected by supplying the meat chambers with air that has been passed backward and forward through tubes which are cooled in a chamber packed with ice. A steam engine forces or draws air through these tubes, and throws it into the meat chambers. In passing through the tubes the air is thoroughly cooled, and the moisture which it possesses is at the same time removed, condensing in the tubes and being allowed to run away. When it enters the slightly warmer meat chambers it is both sufficiently cold to keep down their temperature, and sufficiently deprived of moisture to be comparatively dry.

The carrying of meat by this process has been most successful. Not a cargo has been lost, we believe. It is necessary to carry a spare supply of ice to provide against accidental delays. The extra ice can, however, be sold at a fair price, though ice machines in this country have made foreign ice much less valuable.

Very recently a machine has been constructed in Glasgow, at the Finnieston Engineering Works, and has been tested with the most satisfactory results. A large chamber in which dead meat was suspended was kept at a temperature of about 35° for several weeks at a time in the autumn of 1878. At the end of the time the meat proved to be perfectly sound and good; and it remained so after being taken out of the cooling chamber and kept for several days. Subsequently an experiment was commenced in which the chamber was maintained for a long period, about three months, at a temperature close to the freezing point, with the hope of being able to import dead meat from Australia and New Zealand. These experiments are still being carried on, with results which, up to the present time, are quite satisfactory. It is the invention of a Mr. Coleman.

The principles of the machine may be briefly explained. When air is compressed it becomes heated. This is very commonly shown, as an experiment, by means of an air syringe, in which the ordinary exit is closed with a stop cock. When the piston is suddenly forced into the barrel by a blow, the air contained within the barrel becomes compressed, and is heated to so high a temperature that a bit of German tinder placed within the barrel can easily be set on fire. Conversely, if a quantity of highly compressed air is allowed to expand, doing work against pressure in expanding, it becomes cooled. Mr. Coleman's machine depends for its action on these principles. Its object is to obtain a large quantity of highly compressed dry air at a low temperature; to allow the air to expand, not merely rushing off through a stop cock, but to expand doing work such as is done by steam in a steam engine—under which circumstances the air becomes cooled in proportion to the work it does; and, finally, to throw this cooled air into the meat chambers.

For this purpose, air, at ordinary pressure and temperature, is drawn into a set of cylinders, and then compressed suddenly. During the compression a great amount of heat is developed, and this has now to be got rid of. Accordingly, water is injected in spray into the compressing cylinders, and the compressed air is cooled down to the temperature of the coldest water.

The next process is to remove the water, and at the same time to cool down the compressed air still further before the expansion is proceeded with; and a part of this process is most ingenious, and most interesting from a scientific point of view. First, the air is thrown against a set of disks perforated with very fine holes, and in passing through this fine grating, a large proportion of the water which is held up by the air in very minute globules is then taken from it, and is allowed to run away through cleverly devised valves; but, further, the air, still at high pressure it will be remembered, is conducted up by slanting zigzag pipes through the meat chamber and brought back. Now, the meat chamber is at a very cold temperature, and the air in being carried through it is being reduced down to the temperature of the chamber, and it is then brought back to the engine to be still further cooled in expanding from its compressed state. In this lies one of the great theoretical interests of the process; for it will be noticed that there is no limit, except the practical one of construction, to the cooling effect to be obtained. Let one cooling machine be connected with another, and a third with the first mentioned, and so on, each one working from the cooled chamber of the one that precedes it in order, and the cooling can be carried on indefinitely. We should, of course, be met by difficulties as to conduction of heat by the materials used, and as to loss of chilled air by leakage, but the conception is highly interesting.

The passage of the compressed air through the chilled zigzag pipes has another important use. Any moisture still contained by the compressed air is condensed, and trickles back through the tubes which are slanting upwards. It is collected at the bottom, and passes away through proper valves.

The very cold dry air, at high pressure, is now brought back to the engine which drives the whole machine. This engine is an ingenious compound engine. It is worked partly by steam and partly by the highly compressed air. The steam piston and the air piston are both connected to the movable parts of the engine, and each does a portion of the whole work. The cylinders for steam and air are, of course, quite distinct. The part of the engine driven by steam we need not refer to; it is with the expansion of the air that we are concerned here. It is allowed to enter the cylinder at high pressure; doing so, it forces the piston before it, expanding and doing work. When, by expanding, it has come down to atmospheric pressure, it is intensely cold, and it is then allowed to escape from the cylinder through proper valves during the back stroke of the engine. It is passed forward by tubes, which are covered with felt, or some non-conducting material, to prevent loss of cold, and allowed to enter the meat chamber.

There are a great many beautiful and ingenious details in the construction of the machine to which it is impossible to refer in this notice. Among the practical difficulties that arose in the working of it was the lubrication of the air part of the engine. All the oils tried became frozen and clogged the moving parts. The lubrication is now effected with glycerine, which does not freeze.

DISCUSSING the causes of the depression in English trade, the *Pall Mall Gazette* remarks that the substitution of steel for iron by the Bessemer process, and still more by the elimination of phosphorus from the Cleveland ores (now positively accomplished) is a revolution as great as followed upon the inventions of Crompton and Arkwright. It means, most probably, the total decay of the iron trade of North and South Wales, of Scotland, and of a large part of Staffordshire. In the end it will largely benefit England, but the transition is full of suffering.

NEW AGRICULTURAL INVENTIONS.

Mr. George L. Gifford, of San Antonio, Texas, has invented an improvement in gang plows, in which a number of plows are connected with a single beam, and placed so that parallel furrows are thrown up. The plows may be adjusted to any desired angle.

An improved grain drill, for drilling wheat and other grain, has been patented by Mr. Perry E. Browning, of Browningsville, Ky. It may be used upon inclined or uneven ground, distributing the seed uniformly under all circumstances.

Mr. Albert H. Mason, of Niles, O., has devised an improved hay elevator, which may be suspended from the top of the barn, and is so arranged that it will lift the hay from the wagon and deposit it in the mow for distribution.

A wagon body, which may be readily converted into a rack, has been patented by Mr. Levi Talcott, of Minetto, N. Y. The matter of arranging the parts so as to form either a wagon body or wagon rack is very simple.

An improved device for removing and collecting bugs from vines has been patented by Messrs. George W. Wood and Charles H. Smith, of Faribault, Minn. It consists in an apparatus mounted on wheels, and having wings for gathering the tops of the plants and shaking the bugs into a receptacle from which they cannot escape.

THE DETROIT RIVER TUNNEL AND BRIDGE.

The beginning of the railway tunnel under the Detroit River, below Detroit, was formally celebrated April 23. It was originally intended to prosecute the work by the cofferdam process, but the plan was disapproved by the Canada authorities because of the threatened obstruction to navigation. It is now proposed to construct the tunnel by boring, though the results of the initial operations were not encouraging. The rock, a soft limestone, was found to be so broken by fissures and so full of water as to raise a doubt as to the possibility of completing the work by boring. A fair trial will be made, however, and the hope is that the plan first proposed will be consented to in case of failure by boring. When completed the tunnel will greatly facilitate the business of the Canada and Southern Railroad, and will control the southwest traffic.

The bridge project is designed to connect the Great Western and Grand Trunk Railways of Canada with the Northern Michigan and Michigan Central Railways at Detroit by crossing the river a short distance above Windsor, where Belle Isle divides the stream into two channels.

The bridge will extend from Hamptramck, on the Michigan shore, to Belle Isle, and will have a draw of 300 feet; and from the island it will extend to Walkerville, on the Canadian shore, a distance of 2,500 feet. In the latter distance there will be three drawbridges, of 300 feet each, leaving, excepting a pier in the center, 600 feet for navigation. It is claimed by the promoters of the bridge that two sets of boats can pass at one time within each of the 300 feet draws. The bridge will be 14 feet above water level. The draws can be swung within four minutes. The bridge will command a view two miles distant on either side, and the current will not be remarkably rapid. It is said that the bridge will be an open one.

THE PATENTEES' PROTECTIVE ASSOCIATION.

During the congressional contest over the proposed alteration of the patent laws last winter, the SCIENTIFIC AMERICAN received from inventors throughout the country not a few communications suggesting and urging a union of inventors and patentees for the better protection and advancement of their rights and interests. The opinion of the paper was freely expressed that a quicker and surer method of protecting patent interests would be through immediate individual action, by which the sentiment of the people could be brought to bear on their representatives in Congress. Fortunately the threatened subversion of the patent system was defeated in the House, mainly, we believe, in consequence of just such personal efforts for the enlightenment of Congress as we had urged.

The desire for union among patentees, however, seems not to have been fruitless. At a meeting in Louisville, Ky., in February, an organization of patentees was begun, and the following preamble was adopted:

"*Whereas*, The unparalleled progress which, in a single century, has raised the American people from a dependent colony to the foremost rank among nations, is largely due to the genius of her inventors, stimulated by liberal patent laws:

"*Therefore*, We do hereby organize under the title of the 'Patentees' Protective Association,' to protect the interests of inventors, and all others interested, under the patent laws of the United States, and to guard the public against imposition, that no discredit may rest upon our national patent system."

The Hon. Eugene Undwood was elected president; and the secretary, Mr. H. Burkhardt, writes us that the design is to form, eventually, a national association of inventors and patentees. The office of the association is at No. 30 Third St., Louisville, Ky.

THE School of Art Needlework, which was opened in Boston last October, has been remarkably successful. It has had one hundred and eighty-four paying pupils and forty-five free pupils, and their work, for originality and artistic feeling, is said to be wonderful.

Patent Office Report for 1878.

Summary of the business transactions of the United States Patent Office for the calendar year ending December 31, 1878, as shown by the annual report of the Commissioner of Patents to Congress:

APPLICATIONS RECEIVED, PATENTS ALLOWED, ETC.

Applications for patents, including designs	20,260
Applications for reissues of patents	638
Patents issued, including designs	12,935
Patents reissued	509
Caveats filed	2,755
Patents expired during the year, exclusive of designs	2,617
Patents withheld for non-payment of final fee	832
Applications for registration of trade marks	1,577
Trade marks registered	1,455
Applications for registration of labels	700
Labels registered	492

Number of patents issued to the several States and Territories, with the ratio of population to each patent granted; also the number of patents issued to subjects or citizens of foreign governments:

STATES AND TERRITORIES.	Patents and Designs.	One to every
Alabama	39	25,563
Arizona Territory	2	4,829
Arkansas	45	10,776
California	320	1,750
Colorado	35	1,138
Connecticut	529	1,015
Dakota Territory	5	2,836
Delaware	39	3,209
District of Columbia	146	908
Florida	3	65,582
Georgia	105	1,127
Idaho Territory	2	7,499
Illinois	998	2,547
Indiana	345	4,842
Iowa	325	3,676
Kansas	63	5,784
Kentucky	145	9,110
Louisiana	76	9,564
Maine	140	4,477
Maryland	183	4,267
Massachusetts	1,199	1,216
Michigan	390	3,036
Minnesota	129	3,408
Mississippi	38	21,787
Missouri	315	5,499
Montana Territory	3	3,865
Nebraska	50	2,459
Nevada	36	1,180
New Hampshire	92	3,459
New Jersey	490	1,870
New Mexico Territory	3	30,624
New York	2,599	1,685
North Carolina	53	20,214
Ohio	1,070	2,490
Oregon	35	2,568
Pennsylvania	1,296	2,718
Rhode Island	190	1,143
South Carolina	28	25,300
Tennessee	98	12,842
Texas	130	6,219
Utah Territory	7	12,398
Vermont	109	3,032
Virginia	113	10,842
Washington Territory	13	1,842
West Virginia	58	7,620
Wisconsin	251	4,218
Wyoming Territory	8	1,138
United States Army	4	....
United States Navy	1	.....
Total	12,354	.....

Of the patents, including designs, there were granted to the—

Citizens of the United States	12,354
Subjects of Great Britain, including Canada	336
" of France	60
" of Germany	98
" of other foreign governments	87
Total	12,985

Germany's Subterranean Telegraph System.

The system of subterranean telegraph wires designed by the Postmaster General of the German Empire will be completed, according to present arrangements, in a year and a half. Two lines will then traverse the empire diagonally; the one running from northeast to southwest, from Königsberg to Strasbourg, the other from northwest to southeast, from Hamburg to Ratibor, a town in the extreme south of Silesia. These two main lines will cross one another in Berlin. In the west of the empire a subterranean telegraph will run in a curve from Strasbourg through Cologne to Hamburg; in the east another line will connect Königsberg with Ratibor; and finally, a cable will traverse southern Germany, running generally east and west, though apparently the exact route for this last telegraph has not yet been definitely decided upon. When the proposed system is completed, therefore, all the fortresses and commercial towns of any importance in Germany will be connected with one another by subterranean wires. The cable first laid down, that from Berlin to Halle, has been subjected to the severest scientific tests, and the results have been most satisfactory. A great advantage of the subterranean system is that it avoids all interruptions by storms.

The Telelectroscope.

We have recently on one or two occasions alluded to the telelectroscope invented by M. Senlecq, of Ardres. We now have before us some very ingenious and curious applications of selenium, in which its peculiar property of changing its electrical conductivity when exposed to light varying in intensity is utilized. The several devices are the invention of Mr. George R. Carey, of Boston, Mass. Perhaps the most curious of these instruments is the selenium camera obscura, which is capable of transmitting telegraphically an image of any object and making a permanent impression of it at a distant point. In this case a person may sit before the camera in New York while his photograph is made in Boston. Mr. Carey employs two methods of accomplishing the object, one being something like M Senlecq's, and the other totally different. We hope to present to our readers before long the details of these interesting instruments.

DISINFECTION.

The State Board of Health of Massachusetts have lately given to the public the following useful information on the above subject:

Recent experiments made under the direction of the International Cholera Commission have shown that the ordinary methods of disinfection are inefficient, and in practice they have often failed to arrest the spread of infectious diseases.

As it is impossible to experiment directly upon the unknown low organisms, which are thought to be the means of transporting the various infectious diseases, the effects of chlorine and sulphurous acid were studied upon known living organisms; the probabilities being thought to be in favor of the theory that complete disinfection should destroy at least all known forms of life, although it may be true that the tenacity of life of the infective matter of various diseases differs, just as the degree of cold necessary to put a stop to yellow fever is much less than that required to arrest the spread of cholera.

Chlorine and sulphur fumes, in sufficient quantity, were found to be efficient in killing insects, fungi, bacteria, and infusoria: the objections to chlorine in houses being that it is more costly, that its use is more difficult, and that it destroys metals, textile fabrics, and colors.

The burning of ten grammes of sulphur for each cubic meter of air space, tightly closed, was found not to kill bacteria, infusoria, or all insects; twenty grammes, however, were proved to be sufficient for that purpose. One volume of water, when saturated at 59° Fah., absorbs thirty-seven volumes of sulphurous acid—enough to kill all the low organisms found in putrid urine.

The following articles were found uninjured after several hours' exposure to an atmosphere in which twenty grammes of sulphur had been burned to every cubic meter of air space: A clock of steel and brass, rusty and clean nails, gold and silver money, a military epaulet, various colored silk articles, a colored rug, calico, down pillows, a gilt framed looking-glass, books, water in an uncorked bottle, flour, meat, salt, bread, apples, cinnamon, vanilla, cigars, wall paper, oil paintings, varnished articles, gas fixtures, water fixtures; a highly polished razor had a slightly cloudy appearance on its upper side, but that was easily rubbed off. The flour and meat were cooked and eaten, and the cigars were smoked, without any abnormal taste or smell being observed; in the bread not all of the observers noticed a slightly acid taste; the inside portion of the apples was unchanged, the skin was slightly sour; the water, after standing, had an acid reaction, but no decided taste or smell. Litmus paper placed between the leaves of books and under the carpet was turned bright red. Many of the articles exposed had a decided smell of sulphur at first, but that soon disappeared.

The experiments seemed to show that clothing, bedding, and other articles may be disinfected without being changed chemically or injured; and it should be added that practically this method has apparently accomplished perfect disinfection, as tested in Berlin.

If we may judge from these results, effective disinfection, by burning sulphur, requires eighteen ounces to each space of one thousand cubic feet. The sulphur should be broken in small pieces, burned over a vessel of water or sand, so as to avoid danger from fire, and, if the room is large, it should be put in separate vessels in different places. The room should be tightly closed for six hours and then aired; it is better that the room should be warm than cold. Of course, efficiently disinfected air is, during the process of disinfection, irrespirable. Most articles may be disinfected in this way, if hung up loosely in the fumigated chamber, although it would be an additional safeguard to expose anything thick, like a bed mattress, to prolonged heat at a temperature of about 240° Fah., and, indeed, heat must, with our present knowledge, be considered the best disinfectant. With this end in view, local boards of health are advised to procure furnaces and laundries, as is commonly done in other countries, to be used for the sole purpose of disinfecting articles which have been exposed to the infectious diseases, as recommended in the Ninth Annual Report of the State Board of Health, and described by Dr. A. H. Johnson, in an exhaustive paper on scarlet fever (pp. 255 *et seq.*), in that report. Of course, a much simpler disinfecting furnace than that described will answer every purpose. For ordinary use, in disinfecting houses, the sulphur process is the best.

A solution of chloride of zinc (one part of Burnett's disinfecting fluid to two hundred of water) very quickly kills bacteria which have been placed in it, and arrests putrefaction. Caustic lime serves equally as well (1 to 100), but leaves a sediment not always easy to remove. Carbolic acid in sufficient strength to be effective (1 to 100) is more expensive and of disagreeable odor.

It is needless to add that "disinfectants" used in sufficient quantities to destroy bad smells do not necessarily kill microscopic living organisms; and it is not supposed that they directly influence the so-called "germs" of the infectious diseases, unless concentrated to the extent which has been mentioned.

Finally, fresh, pure air acts as one of the best "disinfectants" by enormously diluting the infectious matter, and, under certain conditions, including time, must render it inert to all effect, even if not quickly destroying it, as many think is the case.

A COMPLIMENT to the Hancock Inspirator has just been awarded to it by the English Government ordering a number of the machines.

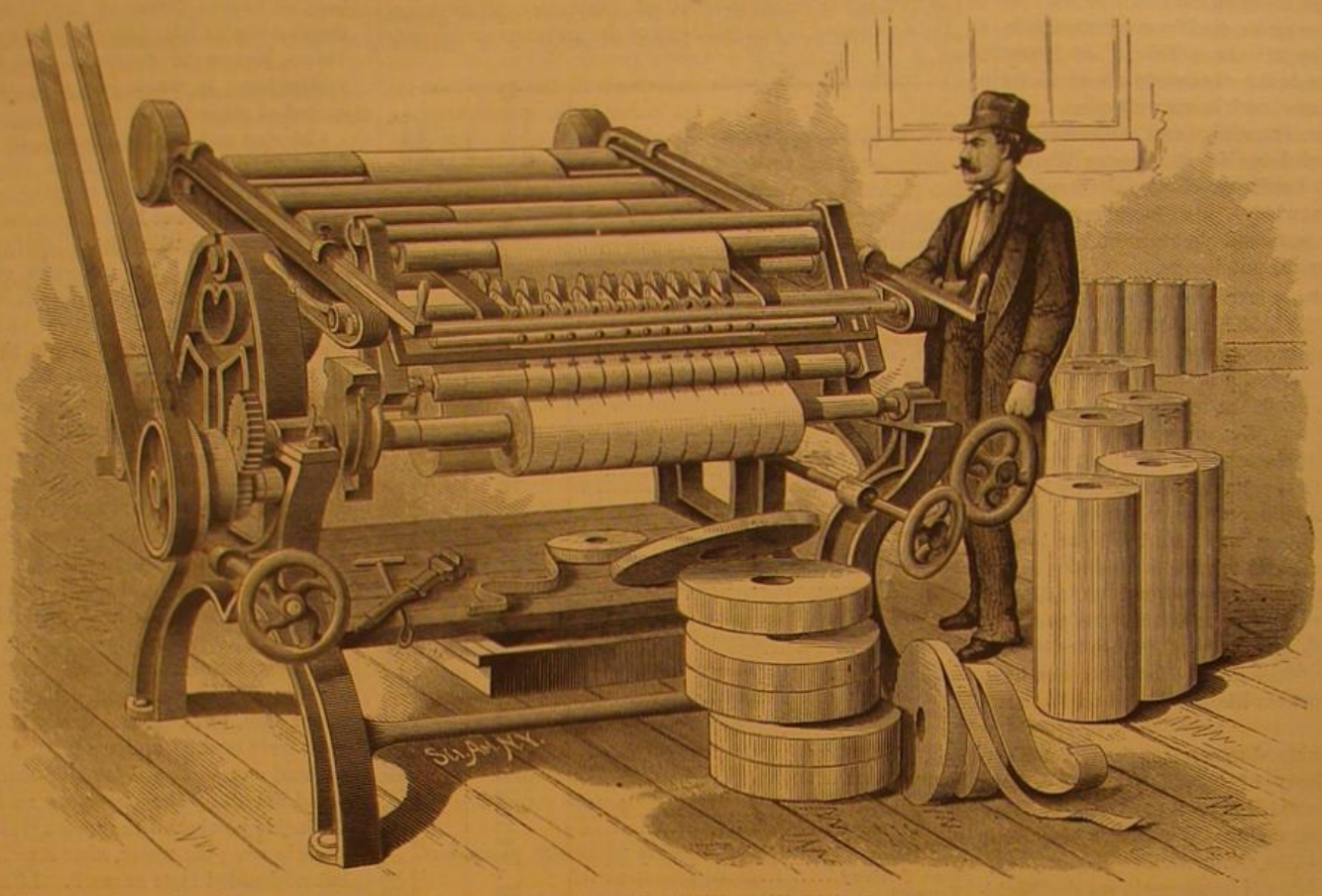
IMPROVED PAPER CUTTING AND WINDING MACHINE.

Our engraving illustrates an improved machine for cutting roll paper, such as is used in telegraphy, for rolling ribbons for hat bindings, etc.

The machine, although quite simple in its construction, is capable of performing a large amount of work. The roll of paper to be cut into strips is placed on a shaft at the rear of the machine, and is passed alternately over and under the rolls in the pivoted frame at the top of the machine, thence between circular shears to the shaft that receives the strips. This shaft is rotated by power received through the belt, and the circular shears are turned by the paper itself, which passes between elastic rollers on the shear shaft. Tension is given the paper by a friction brake on the shaft which holds the paper supply. The rollers in the pivoted frame smooth and stretch the paper, and the shears make a clean cut without danger of tearing the paper. The machine will cut paper strips of any desired width and wind them in solid coils, and it may be adapted to paper of any thickness from the finest tissue to cardboard.

The manufacturers inform us that only one attendant is required, and that the expenditure of less than one horse power will cut into strips of any desired width at least 4,000 lbs. of paper in ten hours and wind it perfectly. The machine might be easily combined with a paper machine so as to cut and wind the paper as it comes from the calender without the necessity of rewinding, in fact it seems a very important adjunct to paper machines designed to manufacture paper in rolls.

This machine was recently patented by Mr. Ignatz Frank, and is manufactured by the Cutting and Winding Machine Company, No. 124 Baxter street, New York city, Mr. George W. Gilbert, Secretary.



FRANK'S PAPER CUTTING AND WINDING MACHINE.

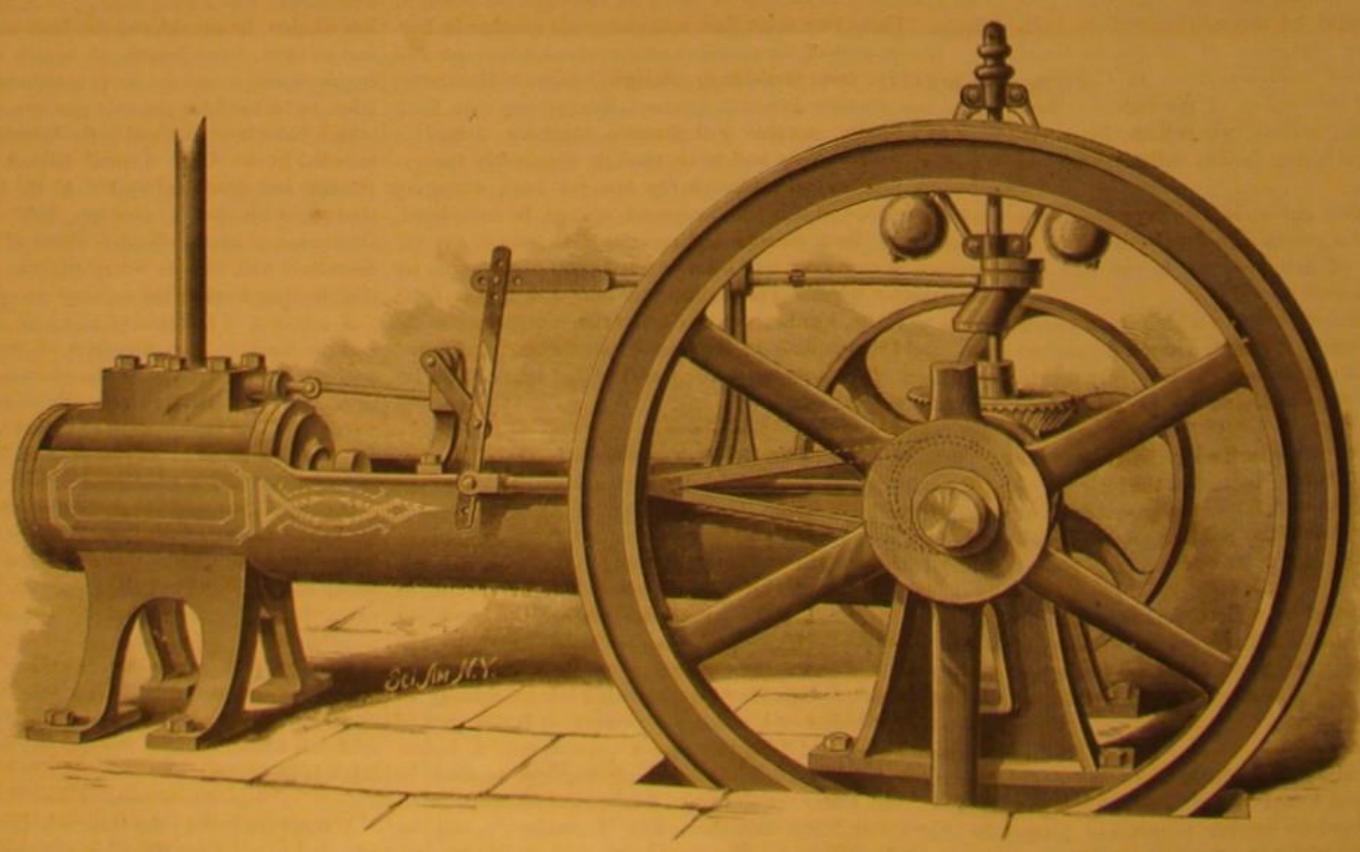
NEW CUT-OFF FOR STEAM ENGINES.

We give herewith an engraving of an engine provided with an improved cut-off recently patented by Mr. George H. Cobb, of Palmer, Mass. In this engine a single slide valve is operated by the joint action of two eccentrics, one of which is secured to the main shaft, while the other moves freely in a longitudinal direction upon the governor shaft, but is prevented from turning thereon by a slot in the eccentric and a feather in the shaft.

The cam or eccentric on the governor shaft is graduated, so that its center varies in position at every point in its width, the eccentricity passing around from one side of the shaft to the other. The governor acts upon the movable eccentric and varies its position according to the speed of the engine.

The straps of the two eccentrics are connected with a link or lever, which is fulcrumed on the lever that operates the slide valve of the engine, and the governor takes its motion from the main shaft through miter gearing.

It is a very simple matter to adjust the cut-off to the speed of the engine, the adjustment depending on the relation of the governor arms with the movable eccentric. This device appears practical; it certainly is very simple, and possesses the advantage of being applicable to engines already in use.



COBB'S IMPROVED CUT-OFF.

The Nobility of Science.

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

OYSTERS in China are frequently dried for use instead of being eaten fresh. They are taken from the shells, plunged for an instant into boiling water, and then exposed to the rays of the sun until every particle of moisture has evaporated, when it is said they will keep for a length of time, while preserving the full delicacy of their flavor. The finest and fattest bivalves, bred on the leaves and cuttings of the bamboo, are chosen for this process, those taken from the natural beds being inferior in quality, and not sufficiently plump for the operation.

Wooden Pendulums.

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

A Curious Property of Heat.

Mr. C. J. Henderson has been conducting some experiments lately in Edinburgh with a view to finding out what is the most economical way of heating a public hall, and has decided that the best results are to be obtained by using an accumulator or stove-room, where the heat, generated by any means whatsoever, is collected, and from which it is discharged through one opening about three or four feet square and seven or eight feet from the floor. The experiments unexpectedly exhibited with what instantaneousness and equality heat is transmitted through space independent of the direction in which the entering heated air is moving; for thermometers were placed at the same height on each of the four

walls of the hall which was to be heated, and it was found that just as the heated air entered from the stove room so the mercury in the several thermometers rose, whether they were hung on the same wall in which was the opening to the stove room, or on the north wall, fifty feet away.

THE KANCHIL, OR PYGMY MUSK.

BY DANIEL C. BEARD.

Last winter while we New Yorkers were bringing into requisition all modern appliances within our reach to ward off the cold waves that came rolling over us from the mountains and plains of solid ice of the northern frozen regions, while our ears and nose, our fingers and toes, were tingling in the frosty air of midwinter, the crew of the good ship Janet Furguson were sweltering under the burning rays of a tropical sun. The ship was on her return trip from Singapore to New York with a cargo of pepper and spices. When passing through the Straits of Sunda she was met and surrounded by the usual fleet of native bum boats laden with fruits and curiosities. Among the miscellaneous cargo of these sea peddlers' boats one had aboard some of the most graceful, beautiful little creatures one could well imagine—five full grown live deer, not larger than small rabbits. The captain of our Janet Furguson after some parley succeeded in purchasing them, giving in exchange an old silver watch. The ship's carpenter soon built for them a convenient little house, about the dimensions of a small dog house, with "Deer Lodge" neatly painted over the door, and in these comfortable quarters the little midgets made in safety a voyage of 136 days, becoming great favorites with the crew. One fawn was born during the trip, but when discovered by the mate of the vessel the buck had eaten off its legs and it was dead.

Arriving off Sandy Hook the Janet Furguson encountered a cold wintry gale, all hands were kept busy, and during the confusion three of the little creatures that had managed to escape from their snug little house perished with the cold. Immediately after arriving at port the fourth, a fine buck, fell a victim to our (to them) inhospitable climate. The only survivor, a beautiful doe, represented in the above drawing, came into my possession; but she only lived about a week. In spite of all my care she too expired, killed by the cold breath of our New York winter.

She was a timid little creature, and although perfectly tame objected to being handled, but she would take food from my hand and allow me to stroke her back. She had the pose and action of our ordinary deer. When watching her as she leaped over a footstool, or stood, head erect, with one fore foot gracefully poised, in an eager, listening attitude, or crept timidly and stealthily close to the wall and behind the articles of furniture, it was as difficult to realize that it was a real live deer as it is to believe that the midget General Mite is actually a living specimen of the genus *homo*.

The pygmy musk is common in the peninsula of Malacca and the neighboring islands, frequenting the thickets. They are nocturnal in their habits, and are often surprised by the natives in the act of making a raid upon the sweet potato patches, and captured by throwing sticks at their legs or caught in nooses; in the latter case they frequently escape by feigning death.

The Malays prize them both as articles of food and as domestic pets. It is of this species that a rather doubtful story is told to the effect that when closely pursued by the hounds they will leap into the overhanging branches of some friendly tree, and hang suspended by their large canine teeth until the too eager foe rushes by, then dropping to the ground they will calmly retrace their steps. It is said that the creatures can make most extraordinary leaps, and that they display great cunning. They have no musk bag, and like the rest of the family are destitute of horns. The antlers we see upon stuffed specimens in the windows of the taxidermist are artificial.

The doe in my possession measured 15 inches in length; the head rather large, being 4½ inches from point behind the ears to tip of its nose; nose movable, always wet and cold like a pointer dog, and like that dog she possessed a keen scent. The round, short ears gave the animal the appearance of a mouse. The canine teeth were short, slender, and sharp, and, unlike the buck's, did not extend below the lips. The ten inch mark upon the rule came above the highest part of her back. The legs were extremely delicate: a Faber lead pencil looked thick and clumsy beside them. The tiny hoofs only measured two-eighths of an inch at the broadest part, where the cloven parts united. The color is a general reddish brown, darker upon the back, where the hairs are tipped with black; an indistinct dark band runs from a point between the ears to nose; rather stiff gray hairs upon the sides and back of neck; fawn colored sides; three white streaks under part of neck; soft white hair upon belly and the anterior upper part of hind legs and the posterior upper part of fore limbs; the lower jaw is also white.

These animals could in all probability be acclimated in our Southern States, especially in Florida, abounding as that State does in swamps and thickets, where the animals could secure coverts and breed.

THE KANCHIL, OR PYGMY MUSK.—(*Tragulus Pygmæus.*)

Progress of Petroleum.

The result of the operations in the producing regions of Pennsylvania for the month of March is, says *Stowell's Petroleum Reporter*, certainly surprising, to use a very mild expression. They reveal a state of affairs that have never before existed in the oil regions, and we think gives very little hope for the immediate future. The following facts appear:

1st. That there were more wells drilling at the close of the month than in any corresponding month since 1870.

2d. More wells were completed during the month than in any month since November, 1878.

3d. The daily average production of the new wells was larger than in any previous month of which we have record.

4th. The number of rigs erected and being erected at the close of the month exceeds that of any previous month.

5th. The amount of crude produced in the month was lager than in any previous month since the commencement of the business.

6th. The amount of stock in the producnig region exceeds the amount ever before held.

7th. The shipments out of the region were larger rhan in any corresponding month in the past.

8th. The price of crude at the wells ruled lower than in any corresponding month since 1862.

The annual report of the Chief of the Bureau of Statistics on commerce and navigation for the fiscal year ended June 30, 1878, is at hand, from which we make the following extracts:

A larger percentage of the mineral oil product of the country is exported than of any other product, except cotton.

Petroleum ranks fifth in value among the exports of the United States, as shown by the following statement of the five principal commodities exported during the fiscal year ended June 30, 1878:

Cotton	$180,031,484
Wheat	96,872,016
Pork, bacon, hams, and lard	86,679,979
Indian corn	48,030,358
Petroleum and products of	46,574,974

It has been ascertained as the result of careful computations that the quantity of petroleum and its distilled products exported during the year ended June 30, 1878, was equivalent to 407,482,175 gallons of crude oil, or in other words, that the exports of petroleum constituted about 66 per cent of the entire amount produced.

25·58 per cent was shipped to	Germany.
13·97 " " " " "	the United Kingdom.
11·34 " " " " "	Belgium.
5·09 " " " " "	Italy.
5·08 " " " " "	France.
4·70 " " " " "	the Netherlands.
34·24 " " " " "	all other countries.

Of the total exports 82·24 per cent was exported to Europe, 11·75 per cent to Asia, Africa, and Australia, 0·52 per cent to the British North American Provinces, 5·28 per cent to Mexico, the West Indies, Central America, and South America.

Total exports of petroleum and its products from the United States from January 1, 1879, to April 4, 59,756,732 gallons; same time in 1878, 50,630,744 gallons; increase in 1879, 9,125,988 gallons.

The daily average production for the month of March, 1879, was 47,615 barrels, against 38,980 barrels for March, 1878, which is an increase of 8,635 barrels, or about 22 per cent, to which add 9·4 per cent produced in 1878 more than was needed for the export and home trades, and we have an increase of about 31·4 per cent in production to be provided for.

The exports from the United States from January 1, 1879, to April 4, 1879, were about 18 per cent more than were exported in the same time in 1878.

Should the present rate of 22 per cent increase in production be kept through the year, which it now bids fair to do, and the present rate of 18 per cent increase in exports maintained, we will have at the close of 1879 an overwhelming amount of stock on hand, except new markets shall be found, which will increase the export demands; or new uses, which will increase the home trade.

The number of producing wells at the close of March, 1879, was 10,692. The number of drilling wells completed in March was 338. Total production in March, 1,476,065 barrels; the average daily production of the new wells in March was 211-10 barrels; the average daily production of all the wells for the month was 4 1-10 barrels.

The stock in the producing regions has been increased during the month, 502,186 barrels, making the total stock at the close of the month 6,294,849 barrels, and is held by pipe companies, tankers, and operators.

RECENT MECHANICAL INVENTIONS.

An improved washing machine, which does its work principally by pressure upon the clothes, has been patented by Mr. Charles P. Rood, of La Fargeville, N. Y. The machine consists of a tub having a number of deep transverse ribs in the bottom, and a fluted roller carried back and forth over the bottom by a carriage worked by a rack and pinion.

An improved clothes pounder, which acts by forcing air through the clothes, has been patented by Mr. C. F. K. Wilson, of Seymour, Iowa. It is designed to clean the clothes without rubbing.

An improved animal trap, which is designed to be set over a barrel set in the ground and partly filled with water, has been patented by Messrs. N. H. Williams and L. Chapman, of Murrayville, Ill. The trap readjusts itself after having caught an animal.

Mr. Peter H. Baker, of San Francisco, Cal., has patented an improved door latch, which may be used simply as a latch or it may be locked with a key, which will prevent the withdrawing of the latch.

An improved hand truck, in which the bearer bars, to which the axle is bolted, and the back guard are made in one piece and bolted to the inner flanges of angle iron side bars, has been patented by Mr. Thomas Hill, of Jersey City, N. J.

Mr. Frederick Hollick, of New York city, has patented an improved vehicle wheel, having a flanged tire and fellies provided with radial spokes, which are secured in the divided hub in a novel and substantial manner.

An improved guide for harness makers' sewing machines, which enables the machine to be used in sewing up seams in round lines, has been patented by Mr. James W. Hollingsworth, of Paoli, Ind.

An improved press, for baling cotton and other similar materials, has been patented by Mr. E. F. McGowen, of Houston, Texas. This invention consists in a novel arrangement of gearing for operating the press without changing the motion of the driving shaft.

Messrs. D. W. and H. Johns and Henry Embs, of New Albany, Ind., have patented an improved machine for making ox-polls. In this machine the ox-polls are made by the rolling process, the iron bar being first bent into a V-shape and the eye formed; the ends or flanges are then closed by stationary dies as the poll comes from the roll.

Messrs. C. H. Lane, W. A. Hutchins, and John McGrew, of Garnettsville, Ky., have devised an improved washing machine, which consists of two hollow cylinders provided with longitudinal ribs and arranged to rotate in contact with each other.

An improved machine for operating a clothes pounder or churn dasher has been patented by Mr. P. C. McCune, of Mount Etna. A revolving platform supports the tub or churn, and a reciprocating lever carries the pounder or churn dasher, as may be required.

An improved carriage wrench, which consists essentially of a socket wrench divided longitudinally, the two parts being jointed together and provided with adjusting screws, has been patented by Mr. E. A. Robbins, of Fairfield, Me.

Mr. Abner Hart, of Ogden, Ill., has devised an improved washing machine, which is provided with recessed pounders having air pumps attached, and with foot levers in connection with hand levers for operating the pounders.

An improved machine for operating a churn, turning a grindstone, sawing wood, and for other applications where a small power is required, has been patented by Mr. E. H. Drake, of Horseheads, N. Y. The invention consists in a novel arrangement of a weight and gearing.

Mr. Charles B. Hill, of Nashville, Tenn., has patented an improvement in middlings purifiers. This machine, which seems simple and effective, cannot be described without diagrams.

Mr. John B. Overmeyer, of New Lexington, O., has devised an improvement in time locks, which is so arranged that in case the watch movements which control the main bolt should stop the lock may still be opened from the outside at a certain fixed time.

An improvement in vehicle axles, patented by Messrs Thomas Reichelderfer and Peter W. Wertz, of Longswamp (Mertztown P. O.), Pa., consists in a novel splice connection for securing the axle spindle to the axle.

An improved heat regulator, patented by Mr. E. S. Gary, of Baltimore, Md., is operated by the expansion and contraction of a fluid acting on a piston connected with the damper of a stove or furnace.

Mr. Henry Reese, of Baltimore, Md., has patented an improved wrought iron railway tie, having upturned lugs for holding the rail and provided with an ingenious looking device for preventing the displacement of the rail.

A novel mechanical movement for converting motion either for an increase of power or speed has been patented by Mr. Theodore Scholze, of Angola, Ind.

Cast Steel Armor for Ships.

The material of which thick armor should be made, says Mr. Barnaby, is now the subject of anxious experiment in Germany and France, as well as in Italy and England. Steel and other alloys of iron are so little known or understood, that there is a large field for experiment open for the armor plate maker and for the artillerist. Steel has been tried many times alone, and in combination with iron, but it never gave enough satisfaction to secure its adoption until experiments were made at Spezzia with plates 55 centimeters thick, manufactured by Schneider & Co., at Creuzot. With these the Italian Government were so well pleased that they are plating the Dandolo and Duilio with such plates. Those of us who visited the French Exhibition last year may have seen a steel armor plate produced by this firm, bent to the form of a turret, 32 inches thick, and weighing 65 tons. Those who went to the works at Creuzot, by favor of Mons. Schneider, may also have seen an ingot of cast steel, suitable for making an armor plate, and weighing 120 tons. The rival firm of Terre Noire exhibited armor plates of steel which had not been hammered, or rolled, or otherwise forged. They were simply cast plates, tempered in oil, and annealed. Judging from the admirable series of specimens and tests and analyses, the manufacture has already attained a large degree of precision, and is full of promise. I believe that the Italian Government will shortly test some of it with the big Elswick gun, and it may be that blocks of cast steel will revolutionize the manufacture of armor by making the rolling operations unnecessary, and bringing down the cost to that of ordinary large castings. The French Government have also made many experiments with steel armor at Havre, but have not yet satisfied themselves that they should give up wrought iron. Experiments with steel in England have shown that steel can be made of great hardness, so hard that it will break up all projectiles which strike it, and that will not suffer seriously in doing so. Sir Joseph Whitworth has obtained some most remarkable results in this direction, and he is still pursuing the inquiry.

NATURAL HISTORY NOTES.

Winter Habits of the Eel.—It is well known that the eel will, of its own accord, leave a pond or stream and wander overland to another locality. This occurs, says Dr. C. C. Abbott, in the *Science News*, usually when the hot summer's sun has evaporated the water of the pond in which the fish happens to be, or so lessened its bulk that the eel finds the locality no longer suited to its wants. In such a case the animals leave the stagnating waters of a land-locked pond, and, with a serpent-like motion, pass through grass well wetted with dews or showers. They seem to exhibit a sense of direction in their movements, and always head for the nearest stream. These land migrations are more frequent during evenings, when a heavy dew is deposited, than at other times. In watching the progress of the work in clearing a piece of meadow land on March 8th, Dr. Abbott was surprised to find, in a mossy mass of earth and roots, through which water from a neighboring spring circulated (though not in sufficient quantity to enable any fish to swim in it), a group of eels, seventeen in number. They were not in a tangled mass, so intermingled as to suggest that they sought contact for mutual warmth, but each was coiled in a snake-like manner by itself. On taking them up they seemed sluggish, and made no effort to escape until revived by the warmth of the writer's hand, when they struggled to get free. When given their liberty they wriggled in a very direct line for the nearest point at which they could reach the ditch hard by. Two of the fishes were dissected, and the amount of matter in their stomach was so small that Dr. Abbott believes that they had been fasting during their semi-aquatic sojourn in the place where they were detected. Subsequent close examination of the spot showed that the spring water did not, and had not, run as a stream through it. There was every indication that these eels had voluntarily left the ditch, fifty feet distant, and sought out this spring hole, which from its southern exposure and constant supply from the spring was a comfortable spot. The question arises: is this a common occurrence, and do eels hibernate habitually, choosing the soft, muddy bottoms of our deeper ponds and the tidal portions of our rivers?

A Green Spored Toadstool.—As well known to botanists the *Agaricini*, or toadstool, tribe is primarily divided into five series, according to the color of the spores. These series are: the white spored (*Leucospori*), pink spored (*Hyporhodii*), brown spored (*Dermini*), purple spored (*Pratella*), and black spored (*Coprinarii*). Hitherto no species of toadstool belonging to the several genera into which the order is divided has been known to occur with mature spores of any other color than some shade of those above noted Recently Mr. C. H. Peck has detected a species of *Agaric* with green spores. Until some other species shall occur with spores of this color he is disposed to assign this anomalous specimen to a place among the white spored species, to which in structure it appears to be related.

Self-Fertilization of Plants.—The Rev. Geo. Henslow, after a thorough study of the subject, claims that Mr. Darwin's works have gone too far to strengthen the belief that intercrossing is absolutely necessary for plants, and that if self-fertilization be continued for lengthened periods the plants tend to degenerate and thence to ultimate extinction. This he believes to be absolutely false. In an article in the *Popular Science Review* he gives the following conclusions: 1. The majority of plants can, and possibly do, fertilize themselves. 2. Very few plants are known to be physiologically self-sterile when the pollen of a flower is placed on the stigma of the same flower. 3. Several plants are known to be morphologically self-sterile, in that the pollen cannot, without aid, reach the stigma, but is effective on that of the same flower. 4. Self-sterile plants from both the above causes can become self-fertile. 5. Highly self-fertile forms may arise under cultivation. 6. Special adaptations occur for self-fertilization.

The "Digger" Mollusk and its Parasite.—The pretty little shellfish, the "digger" (*Donax fossor*), not uncommon on our New York coast, represents a countless mass of life off Cape May, New Jersey, large areas looking like barley grains lying on a malting floor when the tide retires. The mollusk gets uncovered by the breaking surf and immediately reburies itself with its powerful foot when the waves retire. The siphons are long and active, looking like so many wriggling worms. Although the prey of shore birds and fishes, and beset with parasites, they lie so thickly as even to interfere with one another in burying themselves. The liver of these bivalves is always found beset by flukes, from half a dozen to several dozen, and a bell-shaped trichodina crowds the branchial cavity.

The May-bug in Europe.—The grub of the May-bug or May beetle (common to Europe and America) is perhaps, with the exception of the phylloxera, the most destructive pest the French husbandman has to contend against. At a recent sitting of the Central Horticultural Society, of Paris, it was stated by the head gardener at Chantilly that they were destroying the roses. One hundred and eighty-seven days' labor were expended upon about an acre of ground, each man disabling 5,000 of these insidious grubs daily, the total amounting to close upon a million. Another member stated that he had had upward of half a million collected on every hectare of his estate.

These beetles, according to old accounts, were at one time as great a plague in England as the locust is in America. A writer in the *Philosophical Transactions* states that on February 24, 1574, there fell such a multitude of these insects into the river Severn that they clogged and stopped the water wheels. Further, we are told in the Transactions of the Dublin Society, that the country people in one part of the kingdom suffered so greatly by the devastations made by these insects that they set fire to a wood some miles in length, which parted two adjacent counties, to prevent them dispersing themselves any further that way.

The Age of Seeds and the Sex of Flowers.—At a meeting of the Botanical Society of France, M. Duchartre called attention to a statement of M. F. Cazzuola in the Bulletin of the Tusculan Horticultural Society, in 1877, to the effect that melons raised from fresh seed bear a large proportion of male flowers and very few female flowers; while, on the other hand, seedlings raised from old seed bear many more female flowers than male. The statement was confirmed by M. Millet, a French grower; and, it may be added, by the experience and practice of gardeners in England (on the authority of the *Gardeners' Chronicle*).

Should the English Sparrow be Protected?—These birds, which have now proved such a nuisance in America, seem to have no friends at present except those few persons who were instrumental in introducing them. The English themselves warned us against the pest. Not long ago a great outcry was raised against them by the farmers in Algeria, and now we have the same evil report of them from the kingdom of Saxony. A recent English paper says that "the Council of Agriculture of the latter country has decided to petition the government to repeal the law which makes it an offence to destroy them. Indeed the feeling against sparrows has become so strong in some parts that the inhabitants have decided to destroy them in defiance of the law. It is asserted that a microscopical examination of their crops proves that sparrows live upon grain during eight or nine months of the year, and are only insectivorous when reduced to it by necessity. It is the same cry from far and near, from America and Australia, where the 'dissolute, unmusical rover' has been introduced and protected by stringent enactments, in return for which he was expected to eat a great many insects and very little else."

The Effect of a Sea Voyage on Animals.—Most of the wild animals procured for the menageries and zoological gardens of Europe and America are brought from Africa *via* North Germany by Mr. Reiche, the proprietor of the New York Aquarium. They are brought from Africa (mainly as cubs) to Trieste and thence to North Germany, and from there they are distributed to countries where they are wanted. These animals are usually brought to the United States by the North German steamers, and it is interesting to learn about their habits on shipboard. Charles Reade, the novelist, always inaccurate when he goes out of his way as a writer of fiction to dip into science, has stated that the sagacious elephant in storms at sea saves himself from being washed off the deck by throwing himself flat upon his belly, with extended legs and trunk outspread with suction power upon the planks. Captain Nevnaber, however, says that no shipmaster would undertake to carry a loose elephant on deck, because tumbling about in a gale he would be a more dangerous object than the loose gun told of by Victor Hugo.

The elephant, of all other wild animals transported by steamer, are confined in the strongest kind of boxes, and the boxes themselves are secured in the firmest manner. In a storm the lions, tigers, and hyenas prove the greatest cowards. They also suffer a great deal from seasickness, and whine about it. The elephant utters few sounds when he is seasick, but he sways his great head from side to side, and looks "unutterable things." The horse is the most nervous and sensitive animal that goes to sea, and a hen shows the most utter disgust with life when seasick, by vomiting and eccentric movements.

THE CALAMAR.

Besides the different varieties of sepia the calamar, *Loligo vulgaris*, is the most remarkable member of the family of Decapoda. The fleshy, naked cylindrical body is somewhat elongated and conically pointed toward the back. The two fins are united on the back and impart to the animal the form of the point of an arrow. In the back is contained a flexible horny shield. The first pair of arms is shortest, next follows the fourth, then the second and third pairs. The additional two grasping arms, peculiar to all decapoda, are nearly twice as long as the body; and their thickened ends are lined with four rows of sucking disks. The predominating color of the calamar is a brilliant carmine red.

The calamar is very common throughout the Mediterranean and on the coasts of the Atlantic, and especially during the fall numerous swarms are met with, counting many thousand individuals. Sometimes large numbers are caught in the nets prepared for catching large fish.

The wanderings of the calamar depend upon those of swarms of numerous small fish which form its nourishment.

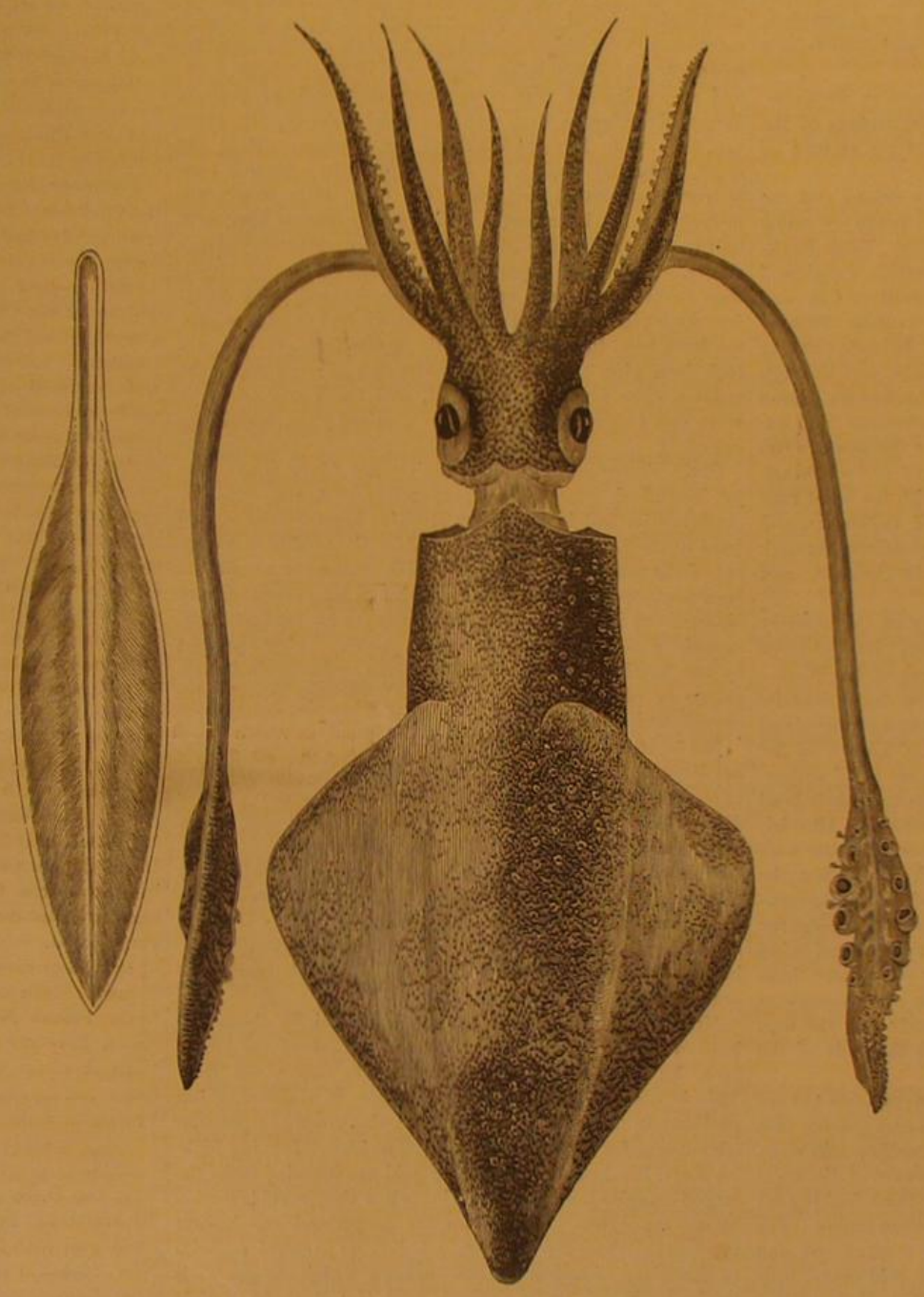
The weight of the calamar frequently reaches twenty pounds; individuals weighing more are occasionally found, sometimes reaching a length of two feet and a half. The mean length is about eight inches.

During his sojourn at Naples Brehm had ample opportunity to study the habits of the calamar in the aquarium as well as in the sea, and states that the animal's habits are quite unlike those of the sepia.

On several occasions from ten to sixteen individuals were placed in the tanks of the aquarium, but they invariably died in a short time, having spent their few days of imprisonment in continuous monotonous motion.

While the octopus and sepia are easily acclimatized in the aquarium and propagate themselves, the calamar seldom lives over two days in imprisonment.

Like the octopus and sepia, the calamar forms one of the principal articles of diet of the inhabitants of Italian seaports. In Naples, and in fact all the cities and villages situated on the coast, they are offered for sale in the public markets. The animals of medium size are preferred, as their meat generally has the most agreeable taste. When injured or excited, the calamar changes its beautiful red color and turns successively violet, green, and yellow, which gradually changes again into crimson. This behavior the Naples fishermen make use of to demonstrate the freshness of their fish to their customers. The calamar is not killed, but left to die gradually while being exposed for sale. When a customer calls, a small incision is made in one of the arms; the animal changes its color immediately, and the customer is satisfied.



THE CALAMAR.

Notes on the Apple Worm.

Mr. J. Savage, of Lawrence, Kansas, in a recent number of Colman's "Rural World," remarks upon the freedom of Michigan apples from the work of the apple worm (*Carpocapsa pomonella*). This same freedom was generally noticed in 1878, not only in Michigan, but in many parts of New York, and it doubtless obtained elsewhere. It will be well for us to endeavor to arrive at the reasons. To my mind the following, first stated by me in the New York *Tribune*, may very properly be urged: 1. The very general failure of the apple crop in 1877, as exemplified in the report for that year which we find both in the Proceedings of the Michigan Pomological Society and in those of the American Pomological Society. This failure was in many localities so nearly total that scarcely any apples were grown, and it follows, as a consequence, that very few codling moths were produced to perpetuate the species the following year. A second reason, so far as Michigan is concerned, may be found in the fact that in no State in the Union have more intelligent and persevering efforts been made to prevent its ravages. Through the columns of the agricultural and horticultural journals, as well as in the pages of their Pomological Transactions, the simple methods of fighting this pest, that have been reported and recommended in the Missouri Reports, have been persistently kept before the people, while Professor Beal, of the Agricultural College, has, perhaps, done more good than any one else by showing that it cost him no more than 4 cents per tree to keep the bands around the trunks, changing them every nine days in the warm months, from the first appearance of the worm until the end of August, in an orchard of 250 trees. I agree with him when he asserts that "if a man will not take the trouble to keep his fruit from the worms he deserves to eat wormy apples."

Missouri apple growers should take courage from these facts. Since my connection with the Department of Agriculture there have been sent to me four different kinds of patent bandages to be used as traps for this apple worm, but I can find no advantage in any of them over the simple paper bandages, first recommended by me in 1872 and since very generally employed.—*Professor C. V. Riley, before the late annual meeting of the Missouri State Hort. Soc.*

Powder Barrel Boring Insects.

Captain McGinnis, U. S. A., has recently communicated to the editors of the *American Naturalist* specimens of an insect (probably *Callidium variabile*) which have been found to injure the hickory hoops of the powder barrels in the St. Louis Powder Depot. So injurious has this gnat proved that no inconsiderable sum is now annually spent by the Government in re-coopering barrels in order to make good the damage thus done. Means have been taken to prevent the further ravages of the insect.

Tucker and Avery's Anti-friction Journal Bearing.

This invention was erroneously described in our issue of May 3 as Avery's anti-friction journal bearing, whereas it should have received the above title.

Mr. Avery states that it was the suggestion in the SCIENTIFIC AMERICAN of the necessity of such an invention that led him to invest in it, and that it was not invented at the suggestion of the SCIENTIFIC AMERICAN, as stated in the article referred to.

The Cotton Worm.

One of the most valuable papers read before the recent session of the National Academy of Sciences was that by Prof. C. V. Riley on the hibernations and migrations of *Aletia argillacea*, the parent of the cotton worm which has for years devastated the cotton fields of our Southern States. Professor Riley says that this foe to agriculture has received but little intelligent study, and that this is somewhat surprising considering the great losses suffered from its ravages. A careful examination of these losses, which he has lately been making from the most reliable published statements and from the returns of numerous correspondents, shows that this one insect alone, during a year when it is generally prevalent, may injure the crop to the amount of $30,000,000, and that the average actual annual loss during the fourteen years since the war has been about $15,000,000. There is good evidence, also, to show that its injuries were equally severe before the war.

The use of Paris green, recommended by Professor Riley in 1873, has, he says, partially protected the crop, but the use of arsenical preparations is too expensive and unsafe to afford general protection.

Among the other difficulties in the way of efficient protection is the lack of sufficient knowledge of the habits of the foe to be encountered. Regarding the hibernation of the species three theories are worthy of consideration. (1) That it hibernates in the chrysalis state; (2) that it hibernates as a moth; (3) that it hibernates only exceptionally in any of our cotton growing States, but comes into them on the wing from warmer climates where the cotton plant is perennial. . . .

At first blush it would seem easy enough to dispel whichever of these theories is erroneous, and settle the question under consideration by a few simple facts of observation. The trouble, however, is to get at the facts.

After detailing the observations relied on to support the various theories enumerated, Professor Riley rejects the first, and is unable to choose between the last two. He says:

"Regarding the migrating powers of the moth there is abundant and satisfactory evidence. The last brood of moths, appearing late in autumn, are especially apt to migrate beyond the cotton belt, and consequently far beyond the region where they can perpetuate their species, if, as all the facts indicate, it can live upon no other plant than *gossypium*. I have received the moths taken as far north as Racine, Wis., where they occurred in such numbers as to ruin acres of cantelopes by puncturing them with the proboscis and sucking the juices. Similarly the moth has been found on the Atlantic coast, hundreds of miles away from the nearest cotton plant. This power of extended migration being therefore proved and admitted, it is but natural to conclude that the insect comes each year from some country where the cotton plant is perennial, as, for instance, the Bahamas; and there are other facts which lead to this view. . . .

"To sum up our present knowledge bearing upon the subject, it is safe to conclude that the insect does not hibernate in the chrysalis state. The evidence would also seem to militate against the possibility of hibernation even in the moth state. Yet there are so many well attested cases of the moth being seen flying during mild winter weather that the question cannot by any means be considered as settled."

English Saddle Horses.

The requisite qualifications of an English lady's saddle horse, according to the *Agricultural Gazette*, London, are as follows: Here all the caprice of fashion and the weight of the breeder's intelligence are concentrated. The great aim being to secure an animal light in the hand, springy in his paces, with that due proportion of bone and sinew which will bear wear and tear, because ladies, once up, unless thorough horsewomen, think, "Oh, he is a horse, and he must go!" I can almost challenge the seller on the point whether the horse has carried a lady by observing the unequal wear of the forelegs. The near leg in cantering bearing all the concussion, is often very looped, if not archy, in comparison. In this class of horse length of limb and pastern joint is desirable—long pasterns, good knees, deep shoulders, deep, blood like quarters, the feet sound, hoof dark colored.

Hydraulic Gold Mining in California.

During a recent visit to this city, one of the largest hydraulic miners of California, Mr. John H. Thomas, explained quite fully the methods and prospects of the hydraulic and drift mining enterprises of that State. The business he pronounced in its infancy, though it had already yielded something like $300,000,000. "There are yet square miles of unexplored gravel, and of the gravel beds actually explored, tunneled, drifted, and opened, not one-twentieth have been worked. The Union, a drift mine, averaged over $40,000 per acre. The Down East, also drift, got over $300,000 from six acres." "This," continued Mr. Thomas, to a *Tribune* reporter, "has been about the average of our drift mines, which, working only three or four feet of the gravel nearest the bed rock, got from $2 to $13 per cubic yard, at an average expense, including improvements, of about 25 per cent of the product, when paying $3 to $4 a day for miners. Our hydraulic mines show averages of 12 cents to 60 cents a cubic yard, and there are from 10,000 to 200,000 cubic yards per acre; an average in the main channel of 80,000 to 100,000 cubic yards an acre. An inch of water, about 2,000 cubic feet, with head of 100 to 200 feet, will wash from 3 to 4 cubic yards a day, and costs from 2 cents to 10 cents an inch."

In an interview with a writer for the *American Exchange*, Mr. Thomas described at greater length the geology of the gravel beds, and the manner in which they are gleaned of their stores of precious metal.

Feather, Nelson, Slate, and Onion Valley creeks and the Yubas, all head in a group in a ridge whose peaks are called Washington Hill, Pilot Peak, Mount Fillmore, Table Rock, Grizzly Mount, and others. All these are within a region of twenty miles square in Plumas and Sierra counties, Cal., and are from 6,000 to 7,000 feet high, on the western slope of the Sierra Nevada range. The parallel of latitude running through Virginia City and Gold Hill, Nevada, and through the greatest upheaval of gold and silver veins known, passes through this group of peaks about fifty miles west, and extends to the gold bluffs on the coast, where the western rim of the continent turns back to the northeast and southeast. From this group of peaks a line parallel with the coast runs southeast through the main gold leads of California, and fifty miles further east a second parallel would run through the main gold and silver leads of Nevada, Arizona, and Mexico.

The geological formation and topography of the country seem to point to this ridge between Virginia City and these groups of peaks as the mineral shed or peak of the West—or the point of main upheaval of the precious metal deposits of the Pacific mountain ranges. The main hydraulic and drift mines of California are upon what are known as the Blue, White, and Gray leads. These leads are to all appearances the channels of rivers that in past ages took their head at this group of peaks, and ran southeastward. Alluvial, glacial, and volcanic action filled these channels, first with sand and gravel, then covered them with lava, when the channels seem to have been lifted up, and even mountains tumbled upon them, while the region to the east became the higher part of the Sierras. These had their peaks, and being lower and sloping to the west, the rivers of modern times run westward nearly at right angles, cutting new channels or cañons, and leaving parts of the old channels near the tops of mountains from 200 to 3,000 feet above the beds of the rivers of to-day.

These washings from the old channels, swept down toward the Pacific, formed the deposits in the bars and gulches that enriched the "Forty-niners" and their immediate followers, who, washing up the streams to find the source of the enormous deposits of gold, ran into the mountains looking for quartz veins until at last the old channels were found. The modern deposits in bars and gulches were worked out, and the impression is prevalent abroad that the gold gravel beds of California are exhausted, when the truth is that the real gravel deposits of the State were only lately found, and, large as has been the aggregate yields of gold gravel in California, enough is now known of these old channels to show that only a very small portion of their wealth has been removed.

These three main channels—the Blue, White, and Gray—so named from the prevailing shade of the gravel, starting from the points named, extend southward to the lowlands some seventy-five miles, then on to the ocean, lying in a belt about thirty miles wide. The White and Blue, often running together, are the main channels, and are from 300 to 3,000 feet wide and from 5 to 200 feet deep, averaging from 60 to 80 feet where best defined. These channels or beds meander, are shallow and deep, narrow and wide, like the beds of running rivers, and have banks, shores, or rims of country rock, slate, and granite. These "rims" must generally be pierced with tunnels that strike the bottom of the channels and afford an outlet out of which the gravel can be carried or washed.

The bed or channel itself can only be ascertained—being covered over by mountains, lava, loam, and forests—by tunnels from rim to rim, and shafts from surface to bed rock. When the body of gravel is thus accurately determined, and its average value found by testing all parts exposed, the next thing is to decide on the manner of mining. If the gravel is covered with only a few feet of loam or lava, it can be done by hydraulic power, that is, by a stream of water with a force of 100 to 300 feet fall directed against the bank. If the bed should be covered with too much rock or lava to do this, then it is "drifted"—mined like coal, the gravel carried out and emptied into a sluice or flume, through which water washes it. The third step is to get the necessary water. Very little water is required for drift mining, but for hydraulic a vast quantity and a fall of 100 to 300 feet are necessary. The unit of water measure is a "miner's inch," or the amount of water that will flow in twenty-four hours through a hole one inch square with six inches pressure—about 2,000 cubic feet. For effective work there should be at least 1,500 inches. Each inch of water will move from 3 to 5 cubic yards of gravel per day, and as a mine uses from 1,000 to 5,000 inches, it washes down from 3,000 to 25,000 cubic yards per day. Such a bulk of detritus would soon choke up any ordinary river channel, and equally important to successful hydraulic mining is a free escape of the gravel washed, or a "dump." This provision nature has furnished in some cases, notably near the head of the great leads, in the deep ravines made by the modern rivers, which here fall for long distances at an angle of 45°, and from 500 to 2,500 feet below the beds of gravel washed.

Although these gravel deposits are almost unlimited, it requires large, organized facilities to realize. While a miner with a pick, shovel, and pan or rocker was force and equipment enough for old-fashioned gulch mining, really effective hydraulic or drift mining requires a large working force and an equipment that costs many thousands of dollars. When Mr. Thomas first went to California, twenty years ago, they were just washing out the gulches next to the great leads, and some were drifting into the channels near bedrock, but found the gravel too high; then water was brought in by sluice boxes, and six-inch canvas hose with half inch nozzle, under 75 feet pressure, were thought large affairs. Soon iron pipes were introduced, first six inch, then twelve, and more recently thirty-six, and even forty-four inch pipe, and from a few hundred feet of canvas pipe we have now in one mine nearly 90,000 feet of thirty-six inch iron pipe. With the introduction of iron pipe, the nozzles were gradually enlarged, and the Little Giant, a large cast iron nozzle working on a swivel joint, was introduced.

Craig discovered that by rifling the Little Giant, the jet, instead of whirling and expanding, shot out straight, retaining its full force. Then Hoskins invented the second joint to the Little Giant, which enables the raising or lowering of the nozzle, and under several inventions a nozzle has been perfected, the largest of which can be moved in any direction by a child; one of eight inches, with 200 feet head, capable of moving 3,000 cubic yards per day, being operated by one hand with ease. Thus one man, with perfect ease, moves as much gravel in a day as 1,000 men could with shovels and cars.

But to attain this effectiveness frequently requires vast expenditures. Ditches must be run from ten to sixty-five miles, carrying from 500 to 5,000 inches of water. These ditches cost from $20,000 to over $500,000, and one is now being built by the Pioneer Company that will cost, when completed, $1,250,000. The plans of several companies have cost from $1,000,000 to $2,000,000. The most of these have been completed within the last five or eight years. Hydraulic mining has been carried on in California for twenty years, but the first ten years was mainly used in experimenting and organizing.

Mr. Thomas' operations having been chiefly about the head of the Blue lead, the largest and richest of the gravel beds, he was naturally most inclined to talk about that. This is not only the richest gold region in California, but probably in the world. This district also possesses peculiar advantages for hydraulic mining. The channels being highest there, the heavier particles of gold are found, just as the largest nuggets are the first to sink when the gravel is floated by moving water. The ravines are deeper and the descent more rapid than lower down, enabling us to build a series of grizzlies and undercurrents, through which the gravel is strained and repeatedly washed, until almost every particle of gold is freed and is caught. Undercurrents are merely sluices placed in steps, so that the gravel falls from one to the other. Grizzlies are heavy iron grates which catch the bowlders and through which the gravel is sifted; they are placed at the point where the washings fall into the sluice. The gravel miners were some years in perfecting this system, and now can save fully 30 per cent more gold than in earlier years.

A New Metallic Paint.

Mons. C. M. Jacob, of Paris, obtained a prize medal at the French Exhibition for a metallic paint which, according to our foreign contemporaries, possesses valuable qualities for a variety of purposes. There is no substance, it is claimed, requiring coloring matter to which it is not applicable.

One of the most important features of this invention is its adaptability for capsuling any kind of bottles or jars containing liquids or viands. The colors employed for the various purposes are not confined to any particular shade, and when on, the articles painted with them have all the appearance of different colored bronzes. The liquid paint having been poured into an ordinary utensil, the neck of the bottle, when properly corked, is dipped into it, and removed almost as quickly as in the waxing process; the paint appears to set instantly, is dry in three minutes from the time it is applied, and becomes quite hard in about one hour. It can be branded in the usual manner, the marks being indelible, and the most important effect claimed is that the bottle becomes hermetically sealed, which is not the case with an ordinary capsule. If the properties of this new production are not overrated, it will, no doubt, play a most important part in many other articles.

The National Academy.

The proceedings of the first two days of the annual meeting of the National Academy of Sciences were reported two weeks ago. On the morning of the third day four new members were elected, namely, Professor Cleveland Abbe, of Washington, well known by his meteorological researches and as a mathematician; Dr. Horatio C. Wood, of Philadelphia, an eminent physiologist and botanist; Professor J. W. Gibbs, of Yale College, a distinguished physicist and professor; and W. G. Farlow, of Harvard University, eminent for his scientific researches.

In the afternoon the following papers were read: "On the Stability and Instability of Drainage Lines," by G. K. Gilbert; "On a New Polariscope Method for the Detection and Estimation of Dextro-glucose in Cane Sugar and Inverted Sugar," by Professor C. F. Chandler; "On the Ignition of High-tension Fuses," by General H. L. Abbot; on "Hibernations and Migrations of Aletia Argillacea, the Parent of the Cotton Worm," by Professor C. V. Riley; on "Two New Forms of Micrometer," by Professor E. C. Pickering; "Report on Dredgings in the Caribbean Sea, on the Coast Survey Steamer Blake," by Professor Alexander Agassiz; and on "Physical Hydrography of the Gulf of Maine," by Professor Henry Mitchell.

Professor Agassiz's report of his dredging operations in the Caribbean Sea during the past year was extremely interesting. He had, he said, verified a theory held by him for some time regarding the necessity and utility of deep sea dredging—that almost all the fauna found at the greatest depths by the Challenger expedition are also to be found in a depth of not more than 2,500 fathoms. The work of the Challenger had been confined to dredging at great depths, and occupied about two and a half years, while he, on a small steamer of 350 tons, had been able, in a few months, to make a collection of deep sea fauna second only to that of the Challenger expedition, and approaching near to it in respect to completeness and variety. Professor Agassiz, therefore, concludes that it is not necessary, in order to procure most of the deep sea fauna that frequent great depths, to extend the operations of dredging much beyond 2,500 fathoms, while a great majority of the forms are found much within that limit. Professor Agassiz then discussed the question of a sunken continent once occupying a great share of the area of the present Caribbean Sea, and connecting the West India islands with the coast of Central and South America. He offered some interesting theories respecting the flow of the Gulf Stream and its causes, which differ materially from the explanations usually given.

On the fourth day (April 18) the following papers were read: "The Winds on Mount Washington Compared with the Winds near the Level of the Sea," by Professor Elias Loomis; "On a Mineral Locality in Fairfield County, Conn.," by Professor J. G. Brush; "On the Great Silver Deposits recently Discovered in Colorado, Utah, and Nevada," by Professor J. S. Newberry; "On the Influence of Jupiter upon Bodies Passing near the Planet," by Professor H. A. Newton; "On the Recurrence of Solar Eclipses," by Professor Simon Newcomb; "On Projections of the Sphere which Preserve the Angles," by Professor C. S. Peirce, and "An Account of the Geodetic Arcs Determined by the Coast Survey, in Relation to the Figure of the Earth," by Professsor J. E. Hilgard.

The Velocity of Light.

At the U. S. Naval Academy, Annapolis, Ensign A. A. Michelson has begun (under orders from the Naval Department, and with funds supplied by Mr. A. G. Heminway, of New York) the erection of apparatus for the more accurate determination of the velocity of light. The method to be employed by Ensign Michelson is described as essentially that of Foucault, with the exception that a lens of great focal length and a plane mirror are used instead of a concave mirror. This arrangement permits the use of a considerable distance, giving a longer interval of time, and insuring greater accuracy. The displacement of the image of a slit is the quantity to be measured, and this in Foucault's experiments was a fraction of a millimeter—and the velocity of light could not be determined with any greater accuracy than could this displacement—which would be a fraction of one per cent. In the experiments made at Annapolis by Ensign Michelson the displacement has been increased to over one hundred millimeters. Hence, the error introduced by this measurement would be less than one thousandth of the whole, or less than twenty miles.

Another, though not an essential feature, is the use of a tuning fork, bearing a mirror on one prong and kept in motion by a current of electricity, by means of which the speed of the revolving mirror can be ascertained with the same degree of precision. The mirror is put in motion by a blast of air furnished by a small rotary blower, which is turned by a steam engine. By this means a very steady speed is maintained. The entire apparatus is now nearly complete, and in two or three weeks the observations will be begun.

THE President of the British Iron and Steel Institute, Dr. C. W. Siemens, announces that the Council of the Institute have conferred upon Peter Cooper the Bessemer gold medal of 1869, in recognition of his eminent services in the promotion of metallurgical science.

TO INVENTORS.

An experience of more than thirty years, and the preparation of not less than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. In addition to our facilities for preparing drawings and specifications quickly, the applicant can rest assured that his case will be filed in the Patent Office without delay. Every application, in which the fees have been paid, is sent complete—including the model—to the Patent Office the same day the papers are signed at our office, or received by mail, so there is no delay in filing the case, a complaint we often hear from other sources. Another advantage to the inventor in securing his patent through the Scientific American Patent Agency, it insures a special notice of the invention in the SCIENTIFIC AMERICAN, which publication often opens negotiations for the sale of the patent or manufacture of the article. A synopsis of the patent laws in foreign countries may be found on another page, and persons contemplating the securing of patents abroad are invited to write to this office for prices, which have been reduced in accordance with the times, and our perfected facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN.

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.

The best results are obtained by the Imp. Eureka Turbine Wheel and Barber's Pat. Pulverizing Mills. Send for descriptive pamphlets to Barber & Son, Allentown, Pa.

Valves and Hydrants, warranted to give perfect satisfaction. Chapman Valve Manuf. Co., Boston, Mass.

Steam Tug Machinery, Engines, Boilers, Sugar Machinery. Atlantic Steam Engine Works, Brooklyn, N.Y.

Kimball's Catarrh Cigarettes, an instantaneous relief and a pleasant smoke. They contain no tobacco.

"We get 10 lb. more steam since using 'Downer's Boiler Liquid,'" writes a party who appreciates the merits of the above article. Clean boilers, with more steam and less fuel, is the verdict. A. H. Downer, 17 Peck Slip, New York.

The Globe (Miner) Street Lamp; most durable, none better. Address J. G. Miner, Morrisania, N. Y. City.

For Sale.—Two Horizontal Engines, 50 and 25 H. P.; Price $675 and $450; are first-class, new, and complete. Address H. Nadig & Bro., Allentown, Pa.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Drop Hammers, Die Sinking Machines, Punching and Shearing Presses. Pratt & Whitney Co., Hartford, Cts

Air Guns.—H. M. Quackenbush, Manufacturer, Herkimer, N. Y.

Boilers ready for shipment. For a good Boiler send to Hilles & Jones, Wilmington, Del.

Wanted—Estimates for Manufacturing Coleman's Mill Pick, advertised in another column.

The only Portable Engines attached to a boiler having cold bearings. The Peerless and Domestic. Francis Hershey, successor to F.F. & A.B. Landis, Lancaster, Pa

For one dollar, with your chest measure, we will send, post paid, a pair each of our O. K. Shoulder Braces and Bonanza Armlets. J. W. Smith & Co., 178 Devonshire St., Boston, Mass.

H. W. Johns' Asbestos Roof Paint forms the most durable and economical protective coating in the world for tin roofs, exposed brick walls, iron work, barns, fences, etc., for which it is in every respect equal to the best white lead, while it costs only half as much. It is made in a variety of beautiful colors, samples of which will be sent on application to 87 Maiden Lane, New York.

Lightning Chisel Pruner. Centennial award. For sale or royalty. Address Flournoy, Knowles, Md.

Magnets, Insulated Wire, etc., for experiments. Catalogue free. Goodnow & Wightman, 176 Washington St., Boston, Mass.

Shaw's Mercury Gauges, 5 to 50,000 lbs.; accurate, reliable, and durable. T. Shaw, 915 Ridge Ave., Phila., Pa.

New Pamphlet of "Burnham's Standard Turbine Wheel" sent free by N. F. Burnham, York, Pa.

17 and 20 in. Gibed Rest Screw Lathes. Geo. S. Lincoln & Co., Hartford, Conn.

Sheet Metal Presses, Ferracute Co., Bridgeton, N. J.

Vertical Burr Mill. C. K. Bullock, Phila., Pa.

Excelsior Steel Tube Cleaner, Schuylkill Falls, Phila., Pa.

Diamond Drills, J. Dickinson, 64 Nassau St., N. Y.

A Cupola works best with forced blast from a Baker Blower. Wilbraham Bros., 2,318 Frankford Ave., Phila.

For Solid Wrought Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

The Ornamental Penman's, Engraver's, Sign Writer's, and Stonecutter's Pocketbook of Alphabets; 32 plates; 20 cts; mail free. E. & F. N. Spon, 446 Broome St., N. Y.

Linen Hose.—Sizes: 1½ in., 20c.; 2 in., 25c; 2½ in., 29c. per foot, subject to large discount. For price lists of all sizes, also rubber lined linen hose, address Eureka Fire Hose Company, No. 13 Barclay St., New York.

Dead Stroke Power Hammers; cheapest and best for general forging and die work; 500 in use. P. S. Justice, of Philadelphia,

Forsaith & Co., Manchester, N. H., and 213 Centre St., New York. Specialties.—Bolt Forging Machines, Power Hammers, Combined Hand Fire Engines and Hose Carriages, new and 2d hand machinery. Send stamp for illustrated catalogues, stating just what you want.

Partner Wanted.—A party with limited capital.—Address Des Moines Linseed Oil Works, Des Moines, Iowa.

Presses, Dies, and Tools for working Sheet Metal, etc. Fruit & other can tools. Bliss & Williams, B'klyn, N. Y.

Nickel Plating.—A white deposit guaranteed by using our material. Condit, Hanson & Van Winkle, Newark, N.J.

Needle Pointed Iron, Brass, and Steel Wire for all purposes. W. Crabb, Newark, N. J.

The Lathes, Planers, Drills, and other Tools, new and second-hand, of the Wood & Light Machine Company, Worcester, are being sold out very low by the George Place Machinery Agency, 121 Chambers St., New York.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon & Co., 479 Grand St., N. Y.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, N. Y.

Portland Cement—Roman & Keene's, for walks, cisterns, foundations, stables, cellars, bridges, reservoirs, breweries, etc. Remit 25 cents postage stamps for Practical Treatise on Cements. S. L. Merchant & Co., 53 Broadway, New York.

For Sale.—7 foot bed Putnam Planer, $350. A. A. Pool & Co., Newark, N. J.

Pulverizing Mills for all hard substances and grinding purposes. Walker Bros. & Co., 23d & Wood St., Phila., Pa.

Steel Castings true to pattern, of superior strength and durability. Gearing of all kinds. Hydraulic cylinders, crank shafts, cross heads, connecting rods, and machinery castings of every description. For price list and circular, address Chester Steel Castings Company, 407 Library St., Philadelphia, Pa.

Walrus Leather for Polishing Agricultural Implements nd all kinds of metal. Greene, Tweed & Co., N. Y.

Elevators, Freight and Passenger, Shafting, Pulleys, and Hangers. L. S. Graves & Son, Rochester, N. Y.

Machine Cut Brass Gear Wheels for Models, etc. (new list). Models, experimental work, and machine work generally. D. Gilbert & Son, 212 Chester St., Phila., Pa.

Holly System of Water Supply and Fire Protection for Cities and Villages. See advertisement in SCIENTIFIC AMERICAN of this week.

Diamond Self-clamp Paper Cutter and Bookbinders' Machinery. Howard Iron Works, Buffalo, N. Y.

Best Power Punching Presses in the world. Highest Centennial Award. A. H. Merriman, W. Meriden, Conn.

Electro-Bronzing on Iron. Philadelphia Smelting Company, Philadelphia, Pa.

Improved Steel Castings; stiff and durable; as soft and easily worked as wrought iron; tensile strength not less than 65,000 lbs. to sq. in. Circulars free. Pittsburg Steel Casting Company, Pittsburg, Pa.

For Shafts, Pulleys, or Hangers, call and see stock kept at 79 Liberty St., N.Y. Wm. Sellers & Co.

Wm. Sellers & Co., Phila., have introduced a new Injector, worked by a single motion of a lever.

Rubber Hose, Suction Hose, Steam Hose, and Linen Hose; all sizes. Greene, Tweed & Co., 18 Park Pl., N.Y.

The SCIENTIFIC AMERICAN Export Edition is published monthly, about the 15th of each month. Every number comprises most of the plates of the four preceding weekly numbers of the SCIENTIFIC AMERICAN, with other appropriate contents, business announcements, etc. It forms a large and splendid periodical of nearly one hundred quarto pages, each number illustrated with about one hundred engravings. It is a complete record of American progress in the arts.

NEW BOOKS AND PUBLICATIONS.

THE COMBUSTION OF COAL. By W. M. Barr. Indianapolis: Yohn Brothers. 8vo. pp. 306. $2.50.

Mr. Barr has done good service by presenting in plain English such information with regard to the chemistry of coal, and the more recent mechanical devices for the economic use of solid, liquid, and gaseous fuels, as may be of practical utility to the great mass of fuel users. He has not aimed to present new theories or new observations, but rather to bring the knowledge, already established, within the reach of those unprepared by mathematical and chemical training to profit by the excellent but abstruse treatises of Professor Rankine and others. The book is well written, illustrated with a few appropriate cuts, well made, and fully indexed.

VICK'S ILLUSTRATED MONTHLY.—The current number of this floral magazine is full of handsome illustrations and pleasant reading matter. The frontispiece is a collection of small flowered petunias, and it includes every known variety. The grouping is artistic and the coloring exceeding rich. The *Monthly* is devoted exclusively to flowers and vegetables, and every page is filled with information regarding growing plants and roots. The magazine is devoted mostly to the culture of flowers. The magazine teaches the development of the beautiful, and were half its suggestions followed the world would be a garden of roses and the people in it bright and happy. Mr. Vick is an enthusiast and his spirit is seen in all he writes. The *Floral Guide* for 1879 has just been issued; it contains a full page colored illustration of lilies and numberless illustrations of smaller proportions, and representing a great variety of plants, flowers, and vegetables. Both magazine and *Guide* are published at Rochester, N. Y., by James Vick.

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 n to 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) R. G. S. asks for the process of hardening and tempering small steel instruments (dental). A. Heat them to a cherry red and immediately plunge them into a cake of tallow, resin, or beeswax, according to the size of the tool or temper required.

(2) R. R. S. asks: 1. For best and cheapest method of case hardening axles. A. Pack the axles in an iron box with animal carbon, lute the box with clay, and heat it to a red heat. This temperature must be maintained for several hours, according to the depth of the hardness required. 2. Also the best mode of giving axles a fine polish while revolving in centers. A. Make a grinding clamp and line it with lead. Apply fine emery and oil to the axle and hold on the clamp, moving it along the axle as it revolves.

(3) C. P. W. asks for an explanation of the use of the "scale of chords." A. It is chiefly used for measuring angles. Refer to some geometrical work for explanation of the rule.

(4) R. S. H. writes: I have seen wheels made, or rather used, for gumming saws, by fastening emery on to wooden wheels in some way. Can you tell me how to do it? A. Coat the wheels with good glue, and roll them in emery heated to about 200° Fah. Solid emery wheels are far better than the kind you mention.

(5) A. L. writes: I have a flute, the first joint of which is ivory, and where it comes in contact with my lips it is very much discolored. Can you tell me how to color the ivory an indelible black or some dark color, something that will not injure the flute or poison my lips? A. Suspend in a strong aqueous solution of neutral silver nitrate exposed to direct sunlight until black; then wash thoroughly with water.

(6) G. J. V. asks: 1. How to overcome that nuisance, bedbugs. A. Try benzine—a very small quantity will suffice. 2. Am troubled also with rats and mice, which have become too shrewd to be taken in by any device of mine for destroying them. A. Dr. Ure recommends the following: Melt in a bottle by standing it in water heated to about 150° Fah., ½ lb. of lard, to which add ¼ oz. of phosphorus, and ½ pint of proof spirit. Then remove the bottle from the water bath, cork, and violently agitate it for a minute or two. On standing the dilute alcohol separates and may be poured off, while the rest, made fluid by gently warming, is made into a dough with wheat flour and sugar, and flavored with oil of rhodium or anise-seed. Pellets of this dough are placed in the rat holes, and as they shine in the dark and are pleasant to taste and smell, they are readily eaten by rats and mice and prove certainly fatal. There is no danger of fire from the use of this mixture if properly prepared.

(7) H. A. J. asks how to remove the stains from the front of a brick house caused by white paint washing off of the window frames and running down the bricks. Also the green mould that has collected on the bricks, back of an old porch roof, now taken down. A. Apply a strong solution of caustic potassa or soda, and after a few hours wash with plenty of clean water.

(8) R. M. C. asks the best method of making an electro-magnet to sustain a heavy weight by the use of one "carbon" or "Daniell" cell, and how long will either of the above cells sustain its strength on a closed circuit without attention? A. You cannot expect to sustain a great weight with a single small cell of either battery. We think, however, that a magnet having ⅝ inch cores, 2½ inches long, each wound with 10 or 12 layers of No. 20 wire, would give good results with a single cell. The carbon battery will run down in a short time. The Daniell will keep up for three or four months.

(9) G. W. L. asks: If a lead pipe attached to a common lifting pump be flattened one half of its diameter through its whole length, will the pump work as freely and throw as much water in a given time? A. If the pipe, before being flattened, is only sufficient to supply the pump, no.

(10) R. B. asks how to grind in a faucet plug. A. Drawfile the plug, and grind with the sand that is rapped from castings, or with grindstone grit and water.

(11) F. A. S. asks: 1. What is the proportion of the peroxide of manganese, carbon, and gum lac used in the new form of Leclanche batteries described in SUPPLEMENT No. 159? A. Use only enough shellac to cement the particles together. You can determine the proportion by an experiment. 2. Will gas carbon ground fine do for the carbon used in the carbon blocks made of the above mixture? A. Yes. 3. If I take a block of wood made the same size and shape that the rubber blocks are (between the zinc and carbon), and soak it in hot beeswax and coat it over on the outside with beeswax, will it not answer the purpose? A. Yes. 4. What is the size of Righi transmitter for telephones, diaphragm thimble holding the carbon, and size of spring? A. The size given in the engraving on page 186 of current volume of SCIENTIFIC AMERICAN is correct.

(12) E. C. P. asks: What metal expands most when heated (mercury excepted)? A. Zinc, among common metals.

(13) G. W. G. asks for the number of minor planets now known. A. Professor Swift informs us that there are 194.

(14) N. C. L. writes: I have a boat 28 feet long over all, 6½ beam, will draw about 2 feet, it is sharp fore and aft, like a whale boat, very strongly built. I have a steam fire engine boiler, 10 to 12 horse power. I want to make 10 to 12 miles an hour. If I carry 100 lbs. of steam, how large should the engine be? Would 4½x7 inch cylinder be about right? A. 4½ inches by 7 inches would answer, but 5 inches by 8 inches would be better. 2. The boat having a sharp stern, would you advise the use of two propellers, one each side? A. Two screws to be preferred.

(15) S. M. H. writes: 1. I noticed in the SCIENTIFIC AMERICAN, some time since, that antimony could be used in the place of carbon in single fluid batteries. Would you use two antimony plates with zinc between, or two zinc plates with antimony between? A. You will find carbon more satisfactory than the antimony. Use two carbon plates with one zinc plate between. 2. How many such cells would be required for ordinary medical use? A very strong current is not required. A. One cell is sufficient.

(16) C. A. W. asks: 1. In the condenser of induction coil, described in SUPPLEMENT No. 160, are both surfaces of the tin foil counted; that is to say, if each sheet were 1 foot square, would there be 20 or 40 sheets? A. 40 sheets. 2. I wish to make an electro-magnet about 3 inches long; what is the best diameter for core, and also what size wire and how much should I use? A. Half inch cores. If the magnet is intended for experimental purposes, probably six or eight layers of No. 18 wire will answer. 3. I wish to run a line with a friend about 800 feet off. Which will be the cheapest, a line of copper (about No. 20 or 18) or regular telegraph wire? A. Telegraph wire. 4. Which will have the more resistance? A. For the same size, iron has the most resistance; this is compensated for by using a larger wire. 5. How many gravity cells would it take to run it? A. It depends on the arrangement of your line, your instrument, etc. Probably four would answer.

(17) C., Y. & Co. ask for a copper dip, such as used by certain fixture manufacturers on their iron castings. A. Copper sulphate, 3½ oz.; sulphuric acid, 3½ oz.; water, about 1 gallon. Place the clean casting in a tumbling barrel with sawdust, bran, or sand moistened with this solution, and revolve for a few minutes; a longer exposure will spoil rather than improve the film of copper deposited. In place of tumbling the articles, they may be simply rubbed with this mixture.

(18) J. K. asks: 1. If an electric light can be maintained in a vacuum. A. Yes; the Geissler tube, the electric egg, and the Sawyer-Man lamp are examples. 2. It is stated that the wonderful Kansas and Colorado Centennial clock runs a hundred years with one winding up, and that the weight or weights of this clock has a fall of 6 feet and falls ¾ of an inch in a year, and takes less power to run it than a watch. Now, perhaps a clock might be geared to run a hundred years, but the complicated machinery would cause so much friction that it would require a great deal of power. I doubt very much if it would ever stir, the friction would be so great. Now I would like to have the SCIENTIFIC AMERICAN's opinion about this wonderful clock; is it a humbug or is it not? A. There is very little friction in the clock referred to, the escapement and pendulum operate very slowly.

(19) J. C. A. asks: How does the microphone magnify small sounds? A. By varying the electrical current so as to produce in the receiving instrument greater sonorous vibrations than those at the microphone or transmitter.

(20) W. A. R. asks: What is the cheapest and easiest method of etching on glass? And how are the etching fluids prepared, and will the fluids used to etch glass produce the same results on metals? A. Glass is etched by hydrofluoric acid gas or liquid hydrofluoric acid (solution of the gas in water). The former in contact with glass produces a rough surface (as in ground glass), while the latter ordinarily leaves the surface clear. The gas is prepared by mixing together finely powdered fluorspar (calcium fluoride), 3 parts, and 2 parts of strong sulphuric acid, in a shallow leaden dish, and applying a gentle heat. The plates to be etched may be placed over the dish. The operation should be conducted under a hood or in the open air to avoid inhaling the pernicious fumes. The plates are prepared by coating them while warm with wax or paraffine, through which to the surface of the glass the design is cut with suitable gravers. In preparing the liquid acid the mixture of spar and oil of vitriol is placed in a leaden or platinum retort, which is heated, and the gas given off is conducted into a leaden bottle filled with water, which absorbs it. In contact with the flesh the acid produces stubborn sores. The metals are usually etched with dilute nitric acid and niter, or sulphuric acid, sulphate of copper and salt, hydrochloric acid and chlorate of potash. Hydrofluoric acid is not used on metals.

(21) E. D. V. asks: 1. Of how many grains does the drachm consist? A. Apothecaries' weight—1 dr. = 60 grs., or ⅛ troy pound. 2. In patent office formula, when not specified, how are we to understand drachm or dram, as avoirdupois or apothecaries'? The same question concerning the use of the word drachm or dram in these columns. I understand it, when not otherwise specified, to mean always 27 and eleven thirty-seconds grains. Am I correct? My druggist disputes me. A. Usually, the old apothecaries' drachm of 60 grains is understood, although in modern pharmacy (U. S.) the pound, drachm, and scruple have fallen into disuse, while in chemical formulæ the metric system is now almost exclusively employed. The avoirdupois drachm is now seldom used.

(22) N. D. writes: In finishing some stores I want a large quantity of counters, 400 or 500 feet. Black walnut is dear; white wood in wide boards is much cheaper and sufficiently hard and smooth. How can I stain this wood so as to resemble cherry, mahogany, or black walnut? A. Water, 1 quart; washing soda, 1½ ounce; Vandyke brown, 2½ ounces; bichromate of potash, ½ ounce. Boil for ten minutes, dilute with water if necessary, and apply hot with a brush.

(23) A. J. B. asks: 1. How are carbons for batteries made? A. See SCIENTIFIC AMERICAN SUPPLEMENTS, Nos. 157, 158, and 159. 2. How are porous cups for batteries made? A. They are made of potter's clay, baked without glazing. 3. How is the best and cheapest battery made which will do for nickel or silver plating? A. For plating on a small scale use a Daniell or a gravity battery. A full description of these batteries is given in the SUPPLEMENTS referred to above.

(24) H. J. G. asks (1) how to make a good diamond wheel for grinding, polishing, and sharpening diamonds? I would like to make a wheel to fit into my foot power lathe. A. Use a flat soft iron disk. Burnish the diamond dust well into it. 2. What color must I have when drawing the temper of a square center for centering in lathe? A. A brownish yellow.

(25) J. A. D. asks: Can a six horse power engine employed in a cheese factory, at the foot of a hill, be used with advantage for cutting and grinding feed in a barn 35 rods distant, on the summit of the hill? If so, what means of connection should be used? A. You can readily do it by employing a small endless wire rope, allowing it to run over a sheave at the factory, and over another sheave at the barn. Any dealer in wire rope will give you plans.

(26) C. L. V. writes: I have been gathering carnelians and agates for quite a while. Having a nice collection now, I should like to polish them. Will you please tell me if there is any other way or method of polishing them besides cutting them? If so what is the method? A. You may shape your carnelians with a corundum wheel such as is commonly used by dentists, and they may be tolerably well polished on a fine Arkansas oilstone fitted to the lathe.

(27) J. P. J. writes: I wish to build a scow about 60 feet long, and 18 or 20 feet beam, and 4 feet hold, decked over forward and not to draw over 3 feet of water when loaded. 1. Could I put on a stern wheel and successfully propel it by steam, at the rate of 3 or 4 miles per hour? A. Yes. 2. If so, about what horse power engine would it require, or would I have to use two smaller engines? A. One engine, 9 inch cylinder by 2¼ feet stroke, or two equal to this in power. 3. Would an upright boiler answer, and what size? A. Yes; consult a good engineer as to size and proportions. 4. What size should the wheel be? A. 9 to 10 feet diameter. 5. And about how many paddles? A. Ten. 6. Would it be better to have it longer and less beam? Will a square bow answer? A. Longer and less beam would be better; a square bow will answer for a light draught.

(28) A. H. asks: 1. Is crude petroleum superior to coal for smelting iron? A. If it could be practically and economically applied, yes. 2. If so, is it used for that purpose to any extent? A. No. 3. Is iron ore with 60 per cent of iron and 5 per cent of sulphur a good ore for smelting, say with petroleum? A. No. 4. What back numbers of the SCIENTIFIC AMERICAN contain information about petroleum; iron smelting with petroleum, and is there any book published about iron smelting with petroleum? A. See pp. 352, 69, 90, 368, and 85, vol. 39, SCIENTIFIC AMERICAN. We know of no such book.

(29) W. J. H. asks for a compound used to harden iron. A. Heat the iron to a cherry red, dust on powdered yellow prussiate of potash, and plunge in cold water.

(30) "Subscriber" asks if a pipe 12 feet high, 6 inches diameter, be filled with water, the pipe to be made of material just strong enough to hold the water, would a pipe of same height, capable of holding three times the amount of water, have to be of stronger material? A. If of same height, yes.

(31) W. K. H. writes: Let us suppose a 10x12 engine, running at 200 revolutions, 400 feet piston speed, with a 5 foot driving wheel. Then a 10x24 engine, 100 revolutions, same piston speed as above. Now, to communicate the same speed to the driven machinery we must have a 10 foot driver, which exactly balances the leverage gained by the stroke. Am I right? A. Yes.

(32) J. S. S. writes: In "Notes and Queries," April 19 (11), you say: "J. W. W. asks: 1. What degree of centigrade is water at its greatest density? A. 4°, equal 39·2° Fah." In "The Depths of the Sea," by Prof. C. Wyville Thomson, Macmillan & Co., London, 1874, the author says, on page 306, that on the cruise of the Lightning, August, 1868, he found the temperature at the bottom of the sea —1·2° centigrade; and on the cruise of the Porcupine, August, 1869, page 309, he found —1·3° centigrade, more than 5° centigrade lower than the answer to J. W. W. A. The fact that the temperature is below 4° cent. at the bottom of the sea does not prove that the density of the water is greatest there. Water is practically incompressible, and expands both above and below 4° cent.

(33) A. K. writes: I want to make an induction coil like the one described in SUPPLEMENT No. 160. I have made the tube out of maple wood, ⅞ of an inch internal diameter and fifteen sixteenths of an inch external diameter. 1. Will this do? A. Yes. 2. Should it be varnished? A. Yes. 3. Must the hammer be soft iron? A. Yes. 4. How many thicknesses of thin writing paper should I put around each coil or layer of the secondary coil? A. Four. 5. Should it be varnished? A. Not necessarily. 6. What battery is the best as regards strength, durability, and cost? A. Probably the Grenet will answer your purpose best. 7. How many will I need for the coil to get the best results? A. Three, of good size.

(34) A. M. S. writes: Suppose a wood planer to have a cylinder 5 inches in diameter, with 3 knives set at an angle of 45° with the radius, and making 4,000 revolutions per minute. Will such planer cut any smoother or better with the edge of knives projecting only ⅛ of an inch over chip break, than it would with the knives projecting five sixteenths or three eighths of an inch? A. Yes.

(35) S. E. M. writes: I wish to make an ink that will copy several days after writing with it. A. Use a strong aqueous solution of soluble nigrosin (a variety of aniline black soluble in water), containing a few drops of clove oil to prevent moulding.

(36) J. W. P. asks what the Italian statuary or image makers put in their plaster of Paris so as to make it resemble marble. Some of their wares are very finely cast with a fine outside polish. A. Saturate the dry cast with melted (pure) stearine or stearic acid.

(37) B. A. M. asks: 1. Is not aniline red a poison? A. Pure fuchsin or magenta is hurtful, if not poisonous, when taken into the system in any considerable quantity. The commercial aniline red often contains traces of arsenic, owing to the employment of arsenic acid in its production. 2. Are there no means of neutralizing it without spoiling the wine which contains it? A. No. 3. How can it be detected in wine? A. See p. 344, vol. 39, SCIENTIFIC AMERICAN, and pp. 802, No. 54, 503, No. 38, and 637, No. 40, SCIENTIFIC AMERICAN SUPPLEMENT.

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

E. D. B.—It is difficult to determine a plant from such material alone, but we are very positive that it is one of the milkweeds, probably the very widely distributed *Asclepias cornuti*. If so, we may state that numerous partially successful attempts have hitherto been made to obtain from the tough stems of the plant a textile fiber and a paper stock. The plant, although common, is not found in sufficient abundance in a wild state to afford any very great supply. We are not aware of any experiments that have been made to ascertain whether its cultivation would prove profitable; if you have facilities it would be an interesting matter to devote a little land and time to its cultivation to find out this.—D. B. B.—No. 1. The rock is a serpentine. The crystals appear to be alunite and prehnite—quantity too small for proper classification. No. 2. Graphitic granite. Nos. 3 and 4. Hornblende and feldspar. In No. 3 the red crystals are garnets. No. 5. A ferruginous clay containing carbonaceous matters.—No. 6. Doleritic rock. No. 7. Chiefly calcite containing marcasite. No. 8. Coal shale.—L. W.—It is an impure clay—aluminum silicate—containing much lime carbonate, iron oxide, magnesia, and traces of alkaline chlorides. If properly washed it might be serviceable in the manufacture of bricks, tiles, drain pipes, cheap pottery, etc. It cannot be used for soap making, as the per cent of alkalies is very small.—J. A. S.—It is an impure alum—of some value if found in any considerable quantity. An analysis would be requisite to determine its actual value.—C. F.—No. 1. A schistose conglomerate. No. 2. Ferruginous sandstone. Ground, washed, and calcined, this may produce a cheap bright red pigment.

COMMUNICATIONS RECEIVED.

On Motion of Perimetral Points in a Rotating Shifting Wheel. By J. P. B.
On Squaring the Circle. By G. M. A.
On the Polar Sea. By F. G. N.
On Canals. By J. S. B.
On the Hop Plant. By H. W.
On Oilers. By A. B.
On Forgery and Science. By J. E. E.
Wagon Wheel Question. By S. N. M.
On Mosquitoes. By E. P.
On Cipher Writing. By J. W. W.
On Rose Hips. By C. F. E.
On Lunar Calendar. By J. D. S.
On Life Saving Apparatus. By Nauticus.
Machine for Covering Wire. By J. B.
On Telephones and Sounders. By H. H. E.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

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

April 8, 1879,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

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[LETTER.]

Office of the Hancock Insp. Co.,
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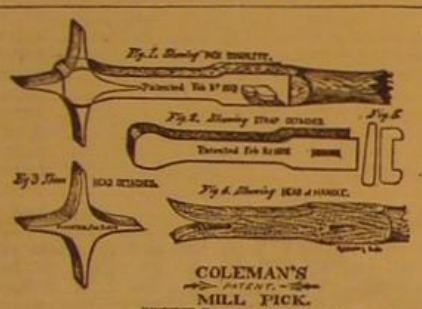

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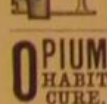

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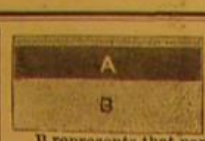

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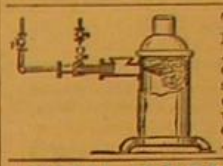

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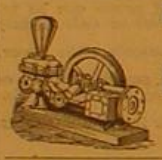

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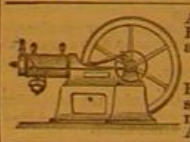

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