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NEW YORK, SATURDAY, OCTOBER 16, 1869.

Contents:

(Illustrated articles are marked with an asterisk.)

THE HYDROSTATIC PARADOX.

Such has been the term applied to the enunciation of the truth, that any column of water, however small, may be made to raise any weight, however large, experimentally shown in the familiar piece of apparatus known as the water bellows. This proposition is theoretically correct, although there are practical limits to its application. Why it should be considered paradoxical, however, any more than the action of a lever, has always been a puzzle to us. Theoretically, it is just as true of the lever, that any weight, however small, may be made by its means to raise any weight, however large, as of the water bellows, or the hydrostatic press.

In either case, on the principle of "virtual velocities," the weight of the body which raises, multiplied into the distance it moves, will always equal the weight of the body raised multiplied into the distance it moves, friction being supposed to be nothing. And, practically, in all cases, the weight which raises must be enough heavier than would be found by this equation, to overcome the friction of the apparatus, whether bellows or lever.

Some of our correspondents are puzzling their heads over the theory of hydrostatic pressure as applied to the press of Brahma, and we are in receipt of not less than a dozen inquiries in regard to this subject. We will endeavor to answer these inquiries definitely in this article. The subject only becomes obscure, when we attempt to get back of nature's laws, to find out *why* things are as they are. We shall confine ourselves to the simple question of *how* they are. The equilibrium of fluids was ascribed by Pascal to the principle of virtual velocities above mentioned. This principle or law of nature has been thus enunciated: "Forces in equilibrium must be to each other as their velocities." It may be added, that when any two forces are so related to each other that the motion which each tends to produce is in an opposite direction to that of the other, and so that the distances through which each would move, if an additional force were made to aid either, would be inversely as the forces themselves, then unless an additional force be made to aid one or the other of the two forces thus related, neither will produce motion.

An example of two forces thus related would be two springs, one having a strength equal to the support of two pounds, the other a strength equal to the support of four pounds, attached to fixed supports, and acting upon the ends of a lever six feet long, resting upon a fulcrum placed two feet from one end and four feet from the other—the two-pound spring acting upon the longer arm, and the four-pound spring upon the shorter. In this case, no motion would take place unless one of the springs were assisted by an additional force. The two forces would be in equilibrium.

Now, when a small column of water supports a larger column, their weights are two forces, exactly so related. Neither column can descend without the other ascends, *i.e.*, moves in an opposite direction, and the distances through which the columns would move would be inversely, as their weights. That either may move, an additional force must be applied to at least one of them, which will cause a motion in both. But an infinitesimal additional force applied to one column would be sufficient to destroy the equilibrium, unless some resistance or counteracting force should immediately impede the motion of the other column. Moreover, the properties of fluids are such, that the weights of any two columns of fluids, connected at their bases by a fluid medium, invariably sustain the relation we have described, unless some other force acts upon one or both columns.

It is unnecessary for our present purpose to complicate the question by a consideration of columns of unequal diameters in different parts, the columns here spoken of being those of uniform diameter throughout.

Further, although this law of virtual velocities has been the subject of many explanatory efforts, we know no more about it to-day than we do about the nature of gravity. All we can do is to recognize its existence as we do that of gravity, all else must be merely fruitless speculation.

The hydrostatic press of Brahma, applies an additional force to one of two fluid columns in equilibrium, to not only destroy the equilibrium, but, also, to overcome a counteracting force or resistance opposed to the motion of the opposite column. We have said the two forces in two such columns when no additional force is applied, are the weights of the columns; but as the weights of the columns are to each other as their sectional areas, these areas may be used as the representatives of the two forces, and it will be more convenient to so consider them. But as these areas, when geometrically similar, are to each other as the squares of their diameters, we may operate still more conveniently by making these the representatives of the two forces.

Let the small column of a hydrostatic press be one inch in diameter, and the large column be two inches in diameter. When these columns are in equilibrium, the weights will be to each other as their sectional areas, which are to each other as the squares of their diameters, or as one is to four. Here we have a force of one balancing a force of four, simply because they are so related, that if motion should take place by the action of an additional force on either column, one must move in an opposite direction four times as far as the other. It follows that, as the motion produced by this force must be transmitted through the fluid medium connecting the two columns at their bases, and as this medium is the condition which establishes the peculiar relation between the two forces, the ratio between the force applied and the resistance it will overcome must be exactly the same as existed at first between the two columns, so that if a force of six pounds be applied through a piston resting on the top of the smaller column, it will balance a weight of twenty-four pounds applied through a piston resting on the top of the larger column; and any less force than twenty-four pounds, applied through a piston, to the top of the larger column, would be raised one inch for every four inches the smaller piston descends.

It also follows, that the quantity of fluid displaced from under the smaller piston is exactly equal to that injected into the larger cylinder, and that the stroke of the small piston must always be through a greater distance than the movement of larger piston in the same time, the distances being inversely as the forces. The principle which underlies the action of of this machine, namely, the principle of virtual velocities, is as immutable and as inscrutable as the existence of matter and force.

We have here, also, a reason why great hydrostatic power, generated by a small column of water in such a press cannot be made to generate a motion any more rapid than could be produced by the motion of the small column itself, and as a further and final deduction, the greater the difference between the diameters of the pistons, and the greater the consequent power of the press, the slower will be the motion of the larger piston.

All of these facts have been proved by experiment, and we have shown that the law of virtual velocities is sufficient to account for them.

THE WANDERING OF PHOSPHORUS IN PLANTS.

Phosphorus, long known as a chemical rarity costlier than gold, but at present one of the most extensively used of chemicals, is prepared from bones. However, bones can only be regarded as organs of collection, as originally it is derived from the earth. Phosphorus is not found in a native or uncombined state, since its affinity for oxygen is very great. United with this latter element it mostly forms phosphoric acid, which again is met with in union with such bases as soda, lime, magnesia, etc.

These compounds are termed phosphates, and are widely distributed over the globe, although they rarely occur in large masses on one spot. They occur in the soil—in most limestones, and in many clays and marls—which fact accounts for their value as fertilizers. Nearly all iron ores contain traces of phosphates; these are reduced in the process of smelting, phosphorus being set free; hence its presence in cast iron, wrought iron, and steel. The excellent Russian iron from the furnaces of Prince Demidoff, near Nischnetagilsk, according to Schafhäutl, owes its qualities to a trace of phosphorus. Still, this admixture is not always desirable, since, if exceeding certain limits, it makes the iron cold-short.

Phosphorus is also a component part of our own body; it exists there not only as phosphoric acid, but also in a de-oxidized condition united with organic substances; as, for instance, in the fatty matters of the brain, whence the well-known sentence of Moleschott, "No thought without phosphorus!"—a sentence, it may be stated, that has been the subject of considerable abuse. However, it is not only in the brain that phosphorus is met with, for, according to Ronalds, a part of the phosphorus of the urine, from which this element had first been separated, occurs also united with an organic compound.

How does the phosphorus pass into the human body? Through plants especially. To them the part has been assigned to withdraw it from the soil and to prepare it for the food of man. Before phosphorus was known to exist in the animal kingdom, its presence in plants had been considered as an acknowledged fact; indeed, phosphorus was found in them before it had been ascertained in the urine of man. The number of vegetables greatly increased in which the element in question was met with; it remained unknown for a long time that it had to be ranked among their constituent parts, and even when this could no longer be doubted, its origin remained an enigma. Although Fownes had already stated that many volcanic minerals contained phosphorus, this assertion was not regarded as true. To modern times it was reserved to throw light upon this subject. In the molybdate of ammonia, chemistry now possesses an exceedingly sensitive reagent for phosphoric acid, which is so very important for the growth of plants. It has been ascertained by Forchhammer that a soil in which phosphoric acid can scarcely be detected, contains of this material not less than 790 pounds per acre, to a depth of one foot. Is it therefore surprising that phosphates occur so frequently in mineral springs and rivers? It seems that the phosphates in plants serve especially for the formation of the albuminous bodies, that are so all-important for the building up of the human framework. With regard to the wandering of phosphorus in plants, we present the following interesting facts of Corenwinder:

Young plants always yield ashes rich in phosphorus. However, after the maturity of the seeds or fruits (for which phosphoric acid is especially needed), the stems and leaves are found to contain only traces of this acid; and when all the seeds have reached perfect maturity, the stems, leaves, and roots are generally devoid of phosphorus. This element appears to occur in an intimate combination with the albuminous principles of vegetables. Indeed, if these are dissolved with water or other liquid, the phosphates pass also into solution, while they become insoluble, when the albuminates are coagulated by boiling water. The vegetable organs which lack phosphorus, seem also to be free of albuminous substances, at least not a trace of phosphates could be met with in the woody pericarp of certain fruits, as in the almonds and hazelnuts, the ashes of which yield principally silica and lime.

The exudates of plants generally contain no phosphoric acid; at least such is the case with manna and gum-arabic. It is known that in exhausting the pulp of young roots with water, fibrin is obtained, which contains pectose and the incrusting substances. It follows, therefore, that the skeleton of vegetables owes its solidity not to the phosphates, as is the case with that of the animals. The leaves that remain in the forests during winter yield ashes rich in iron, silica, and lime, but free of phosphorus. It is also worthy of note that, although analysis has as yet failed to discover phosphates in the sea, the maritime plants contain considerable quantities of this substance.

Corenwinder, at least, has searched in vain for phosphoric acid in the water of the North Sea, as well as in the boiler sediments of vessels crossing the ocean. The pollards of flowers and the spores of cryptogams are rich in acid of phosphorus; this being especially the case with the pollards of *Lilium candidum.* It is remarkable that the ashes of pollards and those of the semen of animals are nearly alike in their component parts, they being both rich in phosphoric acid!

From all we know, it is certain that the presence of phosphates in plants is necessary to the formation of the organic substances in question. For agriculture it would be highly important to know whether there exists a relation between the quantities of the phosphates and those of the albumenoids, but unfortunately very little is known about this subject, and it will demand manifold and extensive researches before satisfactory information will be obtained. But such researches are very desirable, for it should be the duty of agriculturists to look rather to the production of highly albuminous matters, than to endeavor to bring certain organs of plants to a high state of development without regard to their nutritive value.

THE EXHIBITION OF THE AMERICAN INSTITUTE.

A writer in the New York *Tribune* has given expression to singular views in regard to the character of American inventors. He says that "with some notable exceptions, they have exhibited their powers of invention with reference to secondary rather to general principles; more by using the discoveries of other people than their own." "Of course," he continues, "we shall be told that there are but few general principles, while the details may be considered as infinite, and we shall be reminded, too, that upon Dr. Franklin's discoveries in electricity almost a whole science has been founded—that steamboat navigation, the use of ether in surgery, the mowing machine, are ours, and the power-printing press, the telegraph, and the sewing machine, were all conceived beneath the skies of this new world. We grant that these, and others which could be named, are proud achievements, and their application to so many of the wants of daily life gives them especial prominence; still, we ought to consider that, in compass, acuteness, and perseverance, the English mind is unexcelled, for to it we owe the discovery of the use of steam, the invention of the steam engine, of the power loom, of the spinning jenny, and of the locomotive and railway, all of which required the application of grand principles, and they are of such immense utility that they have an influence upon almost every being on the face of the globe. However, the art of printing from movable types clearly was a necessary preliminary, and it would seem that the German nation was not to be deprived of some share in the great work of modern progress."

The writer of this paragraph has evidently not comprehended the distinction between invention and discovery. Invention is the application of general principles to the construction of new machinery or the development of new processes. Discovery has nothing in common with it. The former either discards experiment, or uses it only to verify the truth of previous conceptions arrived at by a process of pure reasoning. The latter progresses only through experiment—theory only pointing out probable paths of discovery in which to conduct experimental research.

The inventions alluded to by this writer were all, in this regard, secondary, or based upon general principles previously discovered.

While we grant to England a large share of honor, both for discovery and invention, we not only accord to Germany and France equal shares of honor in the development of general principles, upon which England and America have based their inventions, but we unhesitatingly assert that, when the age of these nations is taken into account, America has led them all, both in discovery and invention.

The length of this article will forbid entering upon an argument to prove the truth of this claim, but we shall not hesitate to take up the gauntlet in its defense at a future time should it meet with denial.

Ample illustration of the originality and comprehensive character of American inventive genius may be found in the

MACHINERY DEPARTMENT

of the American Institute Exhibition, to which, after two weeks' enforced delay, we now invite the attention of our readers. Much of the delay was caused by the tardiness of exhibitors, and also to the fact that the unexpected magnitude of the display in this department took the managers by surprise. Preparations to transfer a portion of the machinery to the main floor were necessitated; the structure specially erected for this purpose proving too small to place all who desired room. This compelled extension and modification of the original plan, the erection of new lines of shafting, etc.; but at last all these obstacles are surmounted, and every machine, we believe, which demanded power has been or will be accommodated.

THE BOILERS

which supply the main driving engines with steam are three, known as the Root, the Harrison, and Salisbury boilers. The former is made and exhibited by the Root Steam Engine Co. of New York. It was illustrated and described on page 273, Vol. XX., of the SCIENTIFIC AMERICAN, to which the reader is referred. The Harrison boiler is of peculiar construction, being composed of hollow cast-iron globes or shells communicating with each other in all directions, by short tubes, so as to permit of a free circulation, around and between these globes and tubes the heated gases of combustion play. Immense heating surface is secured in this way, while each of the globes may be considered as a separate small boiler, having only the same liability to explode that would attend an isolated boiler of the same size and construction. There can be no doubt that these boilers will endure, with safety, enormous pressures, and their steam-generating power is said to be highly satisfactory. This boiler is made and exhibited by Joseph Harrison, of the Harrison Boiler Works, Philadelphia.

The Harrison boiler has attached to it Berryman's Patent

LOW-WATER ALARM,

constructed on a novel principle, and evidently a very sensitive instrument. It consists of a globe and steelyard, with counterpoise. When the water is at the proper hight the globe stands full of water, and its weight counterbalances the weight on the steelyard. As soon as the water falls too low, steam immediately replaces the water in the globe, and the counterpoise falls a short distance, opening a whistle valve, which gives an alarm. The same instrument might easily be adapted to control the feeding of a boiler by means that will readily suggest themselves to engineers.

The Salisbury boiler is a new claimant for public favor, and we hear it spoken well of. We are, however, unable to give details of its construction. At the present writing it had not yet been used to supply steam to any of the engines, though we were informed that Rider's engine mentioned below would be driven by it.

These boilers are placed outside the main building under an open shed, the managers not permitting any fires on the floor of the building in which the exhibition is held. In this shed are also placed some of the engines exhibited, which we will notice in passing.

Adjacent to the Root boiler stands the Roper

IMPROVED CALORIC ENGINE,

Illustrated and described on page 257, Vol. XX., of this journal, to which we refer the reader. We have no doubt that this engine deserves to rank among the best of its class now in market, and as a small, portable, safe motor, it may be advantageously applied where steam is out of the question.

Here stands, also, the portable engine invented by William Baxter, of Newark, N. J., illustrated and described on page 353, Vol. XX., of this journal. It is quite evident from the interest taken in this engine by engineering visitors to the Fair, and the warm encomiums bestowed upon it, that this engine is to occupy a prominent place among improvements of a similar character in this country. The engine is placed disadvantageously on account of the conditions of the lease above specified, but notwithstanding this drawback it will make its mark. It consumes the smoke so thoroughly, and employs such a small quantity of steam, that notwithstanding the exhaust enters the smoke-pipe, no sign of either smoke or steam can be seen issuing from the end of the smoke-pipe. It is driving two blowers, requiring four-horse power, as tested by Neer's dynamometer, and does this work with a surprising economy of fuel. These blowers will be more particularly noticed in a subsequent article, together with others on exhibition. On the

MAIN FLOOR

of this department are placed a number of large horizontal engines, which are well finished, and the peculiarities of which are well known to engineers, we shall not, therefore, in our notice of these, enter much into details, but confine ourselves to such general remarks as suggested themselves to us in the brief time we could allot to each of them. The designs of these

STEAM ENGINES

show much taste and skill, and most of them are highly ornamented in their finish.

The Fishkill Landing Machine Works exhibit a thirty-horse horizontal engine having tapering, cylindrical, and, consequently, balanced valves, so adjusted that their wear can be taken up by a set screw. The ports in these valves are formed analogously to those of the gridiron slide valve. The movement of the valves is obtained by a system of plain and bevel gearing, the induction valves being actuated by a differential cam, which, through the action of the governor, gives the required cut-off. The exhaust valves are worked by a simple eccentric, driven by the same gearing which imparts motion to the differential cam.

The Novelty Iron Works horizontal engine, illustrated and described on page 161, current volume, of the SCIENTIFIC AMERICAN, will be exhibited although not yet in place.

A stationary engine of eighty-horse power made and exhibited by Babcock & Wilcox, of New York, is a good engine. The motions of the valves are shown through glass plates. The peculiar features of this engine were fully described and illustrated on page 257, Vol. XVII., of this journal, to which we refer the reader. The cut-off valves are actuated by the steam itself. The governor is of peculiar construction, by which all variation, consequent upon the movement of the balls in an arc of a circle, is obviated, these balls having a parallel motion instead of the ordinary one. The valves also have a constant travel under all circumstances by which many advantages are secured. Altogether this engine will repay careful examination from engineers visiting the department.

The Delamater Engine Co., of New York, exhibit a very handsomely designed horizontal engine of the Rider's Patent, and also an upright engine constructed on the same general principle. In this engine the cut-off valve ports are cut obliquely to the longitudinal axis of the main valve, on the back of which plays the cut-off valve face is convex, and the seat is turned out to the true arc of a circle. The form of the valve is triangular in plan, and the two oblique parts in the seat are placed relatively at the same angle as the corresponding sides of the valve. A partial rotation of this valve on its spindle, therefore, opens or covers these ports sooner or later in the stroke, and the motion which performs this partial rotation is derived from the governor. The cut-off may be made, therefore, at any point of the stroke desired, the parts employed to accomplish these results being very few and simple.

William A. Harris, of Providence, R. I., exhibits one of the celebrated Corliss engines of eighty-horse power. It would be entirely superfluous to dwell upon the construction of this engine, which is well known to engineers throughout the civilized world. There is no doubt in our minds that in economy, beauty of finish, and a happy combination of all the essentials to a perfect steam engine, it ranks among the first, not only in America but in the world. The reader will find some remarks upon this engine in the SCIENTIFIC AMERICAN for October 24, 1857, setting forth the advantages gained by the Corliss improvements; and during the twelve years which have succeeded the engine has had a history which its inventor may justly regard with pride.

The engines exhibited this year show that American engineers are giving most careful and earnest attention to economy in the production of steam power, and although the number shown is not large, it may safely be said that they represent all that is best in American steam engineering practice.

Charles E. Emery, General Superintendent of the Fair (partially known to our readers through a series of articles on "Modes of Testing the Power and Economy of Steam Engines," published in Vol. XIX. of the SCIENTIFIC AMERICAN), informs us that a competitive test of these engines will be made ere the close of the Exhibition. The judges have not, however, yet been appointed.

We also notice in this connection Tupper's

FURNACE GRATE BARS,

exhibited by L. B. Tupper, of New York, an illustrated description of which will be found on page 360, last volume of this journal to which the reader is referred. The bar is designed to secure the best draft, while its great depth enables it to conduct away the heat from the upper surface and prevent the grate from rapidly burning out. Ample provision is also made for expansion and contraction.

Another good thing appears to us to be the

FIRE-PROOF CEMENT,

exhibited by the inventor, Mr. Barnum, of Troy, N. Y., intended as a non-radiating covering for boilers, steam pipes, etc. It is much cheaper than felt, in our opinion more efficient, and is said to be more durable. We are informed that it has been adopted in the Bessemer Steel Works at Troy, and is giving good satisfaction.

One of the most important machines now running at the exhibition is

LYALL'S POSITIVE MOTION LOOM.

A description of this loom, published on page 17, current volume, of the SCIENTIFIC AMERICAN, with engravings showing its operation has been more extensively copied in American and foreign scientific and mechanical papers and periodicals than probably any article of a similar character ever published in this country. This is a sufficient evidence of the importance of the improvement, which we stated in that article, was consequent upon its radical character.

The statements we then made in regard to it have all been sustained in practice, insomuch that some would-be authorities on mechanical subjects who took exceptions to the radical character of the invention, and even its originality, have been compelled to acknowledge all the points claimed in our descriptive article. We do not hesitate to pronounce this loom the chief attraction of the Fair to the manufacturing public. There are two on exhibition, one of which is running on dress silk and the other is weaving drugget six and a quarter yards in width. The operator of the drugget loom is a young girl, who is able to manage it with perfect ease, and can control its speed at will, the character of the work being the same no matter how low the speed may, within any reasonable limit, be carried. This is the only loom in the world which can weave goods of any required width.

Any one examining the beautiful silk texture, in the smaller loom, will be convinced of its value as a silk loom. We must however pass from this interesting feature of the department to a cursory review of the collection of

WOOD-WORKING MACHINERY,

undoubtedly the best ever displayed at any one exhibition in this country. One of the first improvements that catches our eye in this department is the

BLIND STILE MORTISING MACHINE,

invented and patented by Leonard Worcester, and exhibited by the agent for its sale Mr. Martin Buck, of Lebanon, N. H. It does its work automatically, rapidly, and excellently; and fully sustains all that was claimed for it in a descriptive illustrated article, published on page 152, current volume, of our journal.

John J. Sanders, of New York, exhibits a combined

SAWING AND MITERING MACHINE,

very substantially constructed, and capable of performing a great deal of work very accurately. It was illustrated and described in our issue of October 7, 1868.

The method of setting and securing the planing bits, or cutters, in this machine is peculiar and very effective; it can be also applied to any tenoning, grooving, or planing machine, as it leaves a clear throat for the discharge of chips, unimpeded by bolt head or other devices, and does not necessitate the slotting of the bit which is simply a plain plate.

Geo. L. Cummings, of New York, exhibits a

FLUTING MACHINE

for banisters and all similar work, the peculiarity of which is, that the cutter-head, once set, remains immovable, the work being lowered away from the cutters by an adjustable center. By this means perfect uniformity in the work is secured. We were much struck with the simplicity and beauty of this machine. This gentleman also exhibits a saw table with a circular grooving saw, which works equally across or lengthwise of the grain, the saw being set inclined to the arbor. He also exhibits a 6-inch four-sided molding machine which is evidently capable of doing good work and a good deal of it.

C. B. Rogers & Company, of New York, display a set of improved

SAW ARBORS,

with self-oiling boxes. These arbors are made of the best English steel, and are elegantly finished. The boxes are cast on a solid bed, which connects the two together in such a manner that it is impossible for them to get out of line. They also exhibit an upright shaping machine, very neat and strong, with iron frame self-oiling steps and boxes. Also a pin and dowel machine with power feed, in which the operator has only to start the rod into the head and it will come out finished. Also a patent molding machine, working four sides at once, capable of making every variety of moldings, from the largest and most complicated down to the smallest. This machine also does double surfacing and matching to 10-inch, planing and matching staves, planing siding, sticking stair rail, etc. They also show a slat-sticking machine for blind slats, small moldings, etc., which works four sides simultaneously the same as the larger machines. An entirely new machine also exhibited by them is an

OUTSIDE HEAD-MOLDING MACHINE,

which works four sides at once, and does work from twelve inches deep by 9 inches wide, down to any required size. They claim that this machine will stick 20,000 feet per day. All of the machines exhibited by this firm are highly finished and substantially made.

A. S. & J. Gear & Co., of New Haven, Conn., and Concord, N. H., exhibit an elegant and substantial

VARIETY MOLDING MACHINE,

a simple and perfect piece of mechanism for planing and cutting straight, waved, circular, and elliptical moldings, spiral work, and all irregular forms. The forms produced are of endless variety, graceful and elegant, and scarcely more expensive to produce than plain moldings. This is one of the most attractive machines displayed.

Among

PLANING, TONGUEING, AND GROOVING MACHINES,

the principal firms represented are: John B. Schenck & Son, Matteawan, N. Y., and S. A. Woods, of Boston and New York.

Some recent improvements on the Schenck Woodworth Machine were illustrated and described on page 241, last volume, of the SCIENTIFIC AMERICAN, to which the reader is referred. As now constructed it is a massive and powerful machine, easy to take apart and clean, and kept in perfect running order without difficulty.

The Woodbury's patent planing, tongueing, and grooving machine is also a good machine, and worthy of special mention. This is exhibited by S. A. Woods, of Boston and New York, who also exhibit a very complete

SAW-GUMMING AND SHARPENING MACHINE,

the working parts of which are constructed upon a tringular iron frame, upon the top of which is suspended a swing frame, the back end having a driving shaft (forming the hinge with tight and loose pulleys; from this, power is transmitted to the arbor upon which is secured a vulcanite emery wheel. The arbor on which the saw is placed is so arranged that universal motion is readily obtained to accommodate any size or shape of tooth desired. The wheel is held away from the saw by means of a coil spring, under the swing frame. The frame is pressed down, bringing the wheel in contact with the saw with one hand, and the saw turned on the arbor with the other—thus the slightest touch can be given to the tooth of the saw without injury. The position of the operator is such that he can look directly across the tooth of the saw, and judge correctly when it has received the finishing touch.

The same firm exhibit a set of self oiling saw arbors with patent self-oiling boxes, by the use of which sufficient oil can be applied to run a saw for months, and all waste of lubricators is obviated.

A large variety of

CIRCULAR, SCROLL, GIG, AND ENDLESS BAND SAWS ARE EXHIBITED,

among which we notice Grosvenor's adjustable saw bench, with both cross-cut and slitting circular saws, exhibited by J. P. Grosvenor, of Lowell, Mass., and a combined gig and circular saw, by Hassenpflug Brothers, of New York, to be worked by hand power

Beach's Patent Scroll Saw, exhibited by C. B. Rogers & Co., of New York, is one of the best scroll saws we have ever seen. Perfect tension of the saw is attained and maintained, this tension being secured by direct connection, and equalizing the power on both halves of the stroke. The saw may be run at great speed, and should either pin in the saw break, the saw stops instantly and can, in no case, be either doubled or broken.

McChesney's Gig or Scroll Saw, exhibited by Thos. L. Cornell, Birmingham, Conn., is also a very convenient machine and well made.

We were very much pleased with the Talpey's Self-feeding Hand-slitting Saw Machine, exhibited by the sole manufacturer, William H. Hoag, of New York, a most perfect-working, effective machine, requiring very little power. The power is applied from a winch, through a very simple and compact system of gearing, forming a very unique and ingenious device. This is one of the best things shown.

The Safety Band Saw, exhibited by the inventor and manufacturer, J. T. Plass, of New York, attracts much attention. It obviates all danger of injury to the operator in case of breakage. The details of its construction may be found, with illustration, on page 129, current volume, of this journal.

First & Pryibil, of New York, also exhibit an endless band saw machine, made entirely of iron except the table; a very well made and elegant machine. They also exhibit an improved gig saw machine, which for all kinds of work is probably one of the best machines constructed.

In conclusion, we may express our conviction that in the perfection of wood-working machinery, this country ranks first in the world. The machines exhibited show a commendable regard for perfect workmanship, so essential to durability in all rapid-running machines, and the display is a credit, not only to the exhibitors, but to the institution under whose auspices this exhibition is held.

ANNUAL REPORT OF THE PRESIDENT OF THE WESTERN UNION TELEGRAPH COMPANY.

In some respects, this is a remarkable document. This Company have a capital stock of $41,063,100, including sinking fund, amounting to $494,800, which deducted from the otal capital stock, leaves a balance of $40,568,300, on which a dividend was paid last July. The net profits of the year ending July 1, 1869, were $2,801,457·48, less than seven per cent on this capital.

During three years, from the commencement of 1866, the net profits of the company have been $8,015,432·06. Out of these profits, $4,134,879·10 have been expended in the construction of new lines, purchase of telegraph property, redemption of bonds, purchase of real estate, interest on bonds, sinking fund, and miscellaneous expenditures, leaving a balance for dividends of $4,044,595·34.

No one will be disposed to think these profits too large; but we have no doubt that the profits on all telegraph property in the United States might be made much larger by a general and large reduction of tariff. The present rates, while they do not afford the companies, on an average, seven per cent interest on the capital invested,—many of the smaller companies netting far less than this,—are still so high that the telegraph is not, as it ought to be, a rival to the postal system, in the transmission of messages. Until such a consummation can be approximated, large profits on telegraph property cannot be expected.

Another obstacle to progress has been, want of uniformity in the tariff of charges in different sections of the country. On this head, the Report under consideration gives us information, not only as to the cause of non-uniformity, but the influences which tend to perpetuate it. It says:

"This peculiarity was the result of the great number of separate organizations, having tariffs upon various bases, which required adding together at the termini of two or more lines, so that, upon a dispatch, which was transmitted a few hundred miles, two or three rates were sometimes charged. For instance, a few years since, there were five telegraph companies owning the lines connecting Portland, Maine, with Cleveland, Ohio, and the tariff between these two places was ascertained by the addition of the local rates from Portland to Boston, Boston to Springfield, Springfield to Albany, Albany to Buffalo, and from Buffalo to Cleveland. The same system prevailed throughout the United States until after the consolidation of the lines made it possible to transmit messages between places thousands of miles apart without the necessity of booking or re-checking at intermediate points. This result necessitated a remodeling of the tariffs, and the work has been going on uninterruptedly ever since; but when it is considered that a complete revision of the system required a separate tariff book to be made out for over three thousand other offices, changing and equalizing the rates to more than three thousand other offices, the immense labor and responsibility incurred in the undertaking may be imagined.

"Various plans have been considered for simplifying and equalizing the tariffs, but some practical difficulties developed in all of them. The existence of rival lines, built by speculators, whose profit is in their construction, and which essay to do business at rates less than the cost of the service, necessitates the reduction of our rates upon certain routes disproportionately, and prevents the adoption of a general rate strictly proportioned to distance.

"Considerable reductions in the rates for both private and press dispatches have been made within the past year, amounting in some cases to fifty per cent, and while these abatements have taken place to the greatest extent in those sections of the country where there are rival lines, the tolls over some of these routes being less than the cost of service, yet they have not been confined to these points, the rates having been decreased at more than one thousand offices where there is no opposition. A new tariff of rates is now preparing and will shortly go into operation, based upon air-line distances, irrespective of the routes over which the lines run.

"The following inventory shows the number of stations, miles of line and wire, and amount of machinery belonging to the Company:

"The Western Union Telegraph Company has 3,469 stations; 52,099 miles of line; 104,584 miles of wire; 103 miles of submarine cables; 2,607 instruments for reading by sound. 1,334 recording instruments; 3,807 relay magnets; 4,180 transmitting keys; 132 repeaters; 19 printing instruments; 710 switch boards; 1,887 cut-offs; 1,666 lightning arresters; 14,929 cups of main battery; 7,210 cups of local battery; 9 punching machines for the 'Fast' system, not in use."

A peculiarity of this apparatus will be observed to be, that it nearly all belongs to the Morse system; but we cannot believe, with this report, that "the time will probably never come when this system will cease to be the leading system of the world." We grant that no device yet designed to supersede it has done so, and that it still is used on "95 per cent of all the telegraph lines in existence." We grant its simplicity and "peculiar adaptability to the telegraphic traffic of the country," but the man who hazards a prediction of permanency in regard to any mechanism employed in any department of industry or science in the 19th century, is certainly a bold prophet.

But we have not space to review this report further at this time. Some interesting remarks upon fast methods of telegraphy we reserve for a future number.

RETURN OF C. F. HALL, THE ARCTIC EXPLORER.

On the 26th of September, Mr. C. F. Hall returned to New Bedford, after completing the second of the Arctic explorations which were undertaken by him, for the purpose of ascertaining the ultimate fate and collecting the relics of Sir John Franklin's expedition. The method adopted by Mr. Hall in prosecuting the search, though at first sight it might appear extravagant, was, in reality, about the most likely to lead to success. Discarding the use of strongly built ships and costly equipments, he determined on a land search, trusting mainly to sledges as a sufficient means of transit, and to such food as might be had among the natives, for subsistence. He seems to have had, in early life, received no special training for an enterprise of this kind, and, it is said, that he had not even been to sea; yet, with indefatigable zeal and with an adequate conception of the magnitude, difficulties, and perils of his self-imposed task, he went to work manfully, systematically, and patiently, to qualify himself for it. He departed from New London on his first journey, which was rather of a tentative character, on the 29th of May, 1860, and returned to the same port on the 13th of September, 1862. The result was satisfactory. Besides making some geographical corrections, he found that he could endure the rigorous climate and live as the Esquimaux lived; he acquired their language and became familiar with their character and customs and, moreover, from information he then received, he was enabled to limit his field of inquiry, and even had grounds for believing that some of the crews might be still alive. In 1864 he published an account of this journey, and in the same year he set out on his second expedition, now completed.

The latest account made public of his recent exploration is a letter written by himself while at Repulse Bay, to his friend, Mr. Henry Grinnell, and is dated June 20th, 1869; the leading facts in which may be thus briefly stated:

There now can remain no doubt of the fate of Franklin's companions; none of them reached even Montreal Island. Their bones lie scattered along the coast of King William's Land. Now a solitary grave was found, and again a place of encampment showed that whole companies fell and died there. What adds peculiar horror to this part of the narrative is the fact that were it not for the inhospitable and cruel character of the natives, some, at least, of Franklin's company might have been restored to civilized society. They were starved to death. The explorer considers that a summer search by a strong expedition, in King William's Land, would probably be rewarded by the discovery of the manuscript records which had accumulated during the Franklin expedition. He says that he had been informed by the natives that the records were deposited in a vault a little inward or to the eastward of Cape Victory. The refusal of his companions to abide by him, and the great probability of his meeting the fate of the gallant Crozier, alone prevented his making the summer search himself. About 150 articles, which belonged to the lost voyagers, were brought home by him, and there are hundreds of relics still in the hands of the natives. This letter closed with an account of a mutiny, on which unfortunate occasion he was obliged to shoot the ringleader.

THE NATURAL ADVANTAGES OF TENNESSEE FOR THE PRODUCTION OF IRON.

It has been the practice of many writers on political economy to regard pig iron as representing aggregated labor more than almost any other industrial product; a view which is probably correct, although superficial thinkers might be led by such a statement to overlook the importance of certain natural advantages essential to the profitable production of this most valuable material. These advantages are the existence of ore of the right quality, fuel, and limestone, so situated that they can be brought together at little cost.

Pittsburgh lies in the center of enormous beds of coal, of which her extensive iron works consume much, and waste a great deal. Limestone can be quarried and placed at the mouths of her furnaces, at small cost, but a large proportion of the ore used is brought from Lake Superior in the crude state. An air-line distance of about six hundred miles, increased by the tortuous routes of transportation to an average of, say, a thousand miles. This, notwithstanding the country all about abounds in ores of various qualities, but many of which can only be worked to advantage by the admixture of the Lake Superior ore.

If ore could now be discovered at Pittsburgh of precisely the quality brought from Lake Superior, and in an inexhaustible supply, it would largely add to the already immense mineral wealth of that locality.

It is also evident that there must be a brilliant future in store for any locality in this country, combining all the advantages named, with open avenues of communication by water or rail to the commercial centers of the United States.

Such advantages are claimed for sections in Tennessee, Northern Georgia, and Southern Alabama. A letter from George T. Lewis, Esq., published in the *Republican Banner*, of Nashville, Tenn., sets forth minutely the natural advantages of these regions, more particularly, however, of the vicinage of Nashville, and on the line of the Nashville and Chattanooga Railroad; and it must be confessed that he makes out a good case.

Assuming that the figures given by Mr. Lewis are reliable, the entire cost at which a tun of pig iron can be produced on the line of the above-named railroad, and delivered at Nashville, is $19, or $10·50 less than the same quality of iron can be made at Pittsburgh.

The following estimate of the cost of manufacturing, assuming cost of furnace to be $100,000, and its capacity to be 6,000 tuns per annum, is submitted:

Mining, loading, and transportation of 2 tuns ore	$4·00
Mining, loading, and transportation of 80 bushels coal	6·40
Quarrying, loading, and transportation of 1,000 pounds limestone	50
Superintendence, labor, etc., per tun	4·00
Wear and tear per tun	50
Interest on investment per tun	1·00
Incidentals per tun	50
	$16·90

The item $4 per tun embraces employés, viz.:

	Per annum.
1 Superintendent	$3,000
1 furnace manager	1,200
1 bookkeepeer	1,590
1 engineer	1,200
1 assistant engineer	800
1 blacksmith	1,200
1 assistant blacksmith	600
1 founder	1,200
4 filers	2,400
4 keepers	2,400
2 guttermen	1,000
2 cindermen	1,000
2 weighers	1,000
6 yardmen	3,000
Extra labor	2,500
	$24,000

Or $4 per tun.

The great advantage claimed by Mr. Lewis is the quality of the ores (hematite and fossil ores) while the coals he affirms show by analysis seventy per cent of carbon with less earthy matter and sulphur than the bituminous or "furnace coals" of Wales, Newcastle, Western Pennsylvania, and Ohio, and the limestone is of a quality unsurpassed for use as a flux.

By his showing the cost of a tun of pig iron at Steubenville, Ohio, from Lake Superior ore is $29.

The cost of a tun of pig metal made at Brazil, Northern Indiana (the ores from Iron Mountain and Pilot Knob, Missouri, and Lake Superior) is	$28·45
The cost of a tun of pig metal made at Pittsburgh, the Birmingham of America (ores from Lake Champlain and Lake Superior) is	29·50

On the other hand, the cost of a tun of pig metal in Nashville is as follows:

Mining, loading, and transportation of 2 tuns ore	$6·00
Mining, loading, and transportation of 80 bushels coal	9·60
Quarrying, loading, and transportation of 1,000 pounds limestone	1·00
Superintendence, labor, etc., per tun	4·00
Interest on investment per tun	1·00
Wear and tear per tun	50
Incidentals	50
Total	$22·60

These statements are certainly worthy of serious attention. The mineral wealth of this region has long been known, in