bodily organization, which left the body temporarily in sleep and trance and the stupor of drunkenness or disease, and permanently on dying, has been familiar to all thinkers. The idea of life as the result or expression of material combination came much later. Later still came the compound theory of life held by Leibnitz and Descartes and their followers, who believed in a physical life for the body and a purely spiritual life for the mind. From this point of view the body is a machine, made up of mechanical devices and operated by mechanical or purely physical powers, while it is inhabited by a soul which thinks, but takes no part in the discharge of vital functions. In the words of Leibnitz, "The body goes on in its development mechanically, and the laws of mechanics are never transgressed in its natural motions; in the soul everything takes place as though there were no body, and in the body everything takes place as though there were no soul." This view makes life the product or expression of material combinations up to the point of consciousness; above that the soul is the life.

Of the three theories, the purely spiritualistic—that is, that life is due to the indwelling presence of spirit—is at once the oldest and still the most popular. This was the conception of Pythagoras, Plato, Aristotle, and Hippocrates. It has always been the theory of the Christian Church; and it underwent many vagaries at the hands of Christian mysteries, scholastics, alchemists, and other speculative writers during the Middle Ages. At one time it was believed that each and every vital process was the work of a particular spirit, and a man's comfort and character depended on the kind of spirits that pervaded and animated him. Such were the teachings of Basil, Valentin, Paracelsus, and Van Helmont. Stahl summarily dismissed all this infinite host of immaterial intelligent governing spirits save one, the rational immortal soul. This soul, in his view, was the very principle of life. There had grown up in that day a school of chemist-doctors who resolved all the phenomena of life into chemical action. In opposition to those Stahl contended that the real life force was not only unlike the chemical force of ordinary matter, but that the two kinds of force were hostile to each other—life persisting only so long as the vital or soul force was dominant, death being the ultimate victory of the physical forces.

Stahl's immediate successors were soon compelled to reject the idea that vital force was an intelligent force; intelligence was relegated to the soul; but they retained the notion of antagonism between vitality and the laws of mechanics, physics, and chemistry. From this point of view Bichat defined life as "The group of functions which resist death."

This idea of absolute diversity between the laws of living bodies and those which appear in "dead" matter is still a very prevalent one; but advancing science has shown it to be unfounded in reality. If it were true that in living bodies the physical and vital properties and processes are in constant and direct antagonism; or, as Bichat has said, "the physical properties fettered by the vital properties are perpetually checked in the phenomena they would tend to produce," then the intenser the life of any organism the weaker and slower should be the purely physico-chemical operations going on within it. But the exact contrary is the rule. Whatever restrains or lessens the organic processes directly diminishes vital activity; on the contrary, the more active the life the more rapid are the material changes in the organism. In the words of Claude Bernard, the alleged opposition, antagonism, or conflict between vital phenomena and physico-chemical phenomena is an error which the discoveries of modern physics and chemistry have thoroughly exploded. Life works in harmony with the other forces. Is it like them, or entirely different?

Obviously the real nature of life must be sought for in the peculiar phenomena with which life is associated. The essential characteristic of living bodies is nutrition, the product of two factors, one tending to build up the organization, the other to break it down—counting as part of the organism the food supply at any moment in the blood. Every manifestation of life involves, in this sense, organic destruction. Hence arises De Blainville's definition: "Life is a twofold internal movement of decomposition, general and continuous at once. In other words, life is a continuous dying." But there is a period when the formative element of life is predominant. In the young organism the up-building manifestly exceeds the breaking down of the organic structure. And at a still earlier period the phenomena of germinal evolution are the chief, if not the only, manifestations of life. These, however, do not differ in kind from the phenomena of nutrition; indeed, nutrition has been defined as continuous generation. The special agent of this essential life work is the germinal cell; hence arises another definition of life as the cell's impulse of organization, perhaps the closest definition that science has yet arrived at.

Whence arises that impulse? Is it a special, extra-material impulse? or is it only a mode of action of the general force of nature? Are the mysterious properties of the germ the result of molecular combination, as the properties of water arise from the combination of its constituent gases?

Here the final battle of biology must be fought. So long as life is surely known to proceed only from antecedent life, just so long will it be impossible to give a decisive answer to the question, What is life? The mystery of life lies in the evolutive power of the germ. If life is a vital spark handed down from organism to organism from the beginning, then it transcends the ken of physical science and must ever remain a mystery. If, on the other hand, life can be proved to begin *de novo* in suitable mixtures of demonstrably dead matter, as Bastian and other observers assert, that moment life ceases to be the only unique phenomenon in nature, and takes rank among the powers and potencies of ordinary matter. No wonder the controversy assumes at times a bitterness foreign to purely scientific discussions. The issues at stake are of transcendent importance, for upon the supernatural nature and origin of life hang the most revered beliefs, the most momentous theories, the most pretentious systems of the age.

THE DECLINE OF THE IRONCLAD.

There is something which forcibly reminds one of the ancient question of the irresistible force and immovable body, in the modern futile search for impregnable ironclads and unopposable guns. A recent writer in the *Revue des Deux Mondes* very pertinently compares the naval engineering of the present day to the quest for the absolute which occupied medieval astrologers, for in both cases, as fast as progress is made, new possibilities and new necessities seem apparent, until above all rises the obvious impossibility of predicting when the desired goal shall be reached. Neither can the colossal outlay of money and time expended in attempts toward the solution of the problem of guns and armor be said to have afforded other than merely negative results. Great Britain has paid millions to discover that certain armor is not impregnable, or the converse that certain guns are not irresistible, and at the present moment a leading British engineering journal candidly avows that the total result of all experience in armor plating has reduced itself to the quandary of whether it is better to use steel armor, which will resist penetration, but which will be quickly shivered by the projectiles, or iron armor, which will not split, but which will be pierced. In the matter of guns, which now are in advance, it would seem that the limit of the size to which they can be increased must soon be fixed by the capacity of vessels to withstand the concussion and shock of their discharge. The heavier vessels are armored the stiffer they are, the less elastic, and consequently the more liable to injury by racking strain; to gain elasticity by reducing armor is of course to lessen the protection.

So again, the whole question of constructing armored war vessels is about as unsettled as it very well can be. The Inflexible, supposed to combine in herself all the best expedients of advanced naval constructive skill, is a failure, and the verdict of an official board, translated into plain English, is, "Don't build another ship like her." Few concur in the proper mode of protecting a vessel. Some advocate unarmored ends and heavily armored citadel; some, heavily armored ends and lightly armored midship portion; some advise armor all over, even to far below the water line; some propose a mere belt; and so on in every variety.

If it were possible to cover a vessel all over with iron thick enough to stop the largest projectile, the problem would be easy to solve, but to do this is to render the ship unmaneuverable. She would be like a shark that has to turn over to bite, and while the fish turns the intended victim escapes, or if injured, like an armored knight of the olden time, who, when unhorsed, was at the mercy of his enemy, for his armor prevented his running away. In the Austro-Italian battle of Lissa, the ironclad Rè d'Italia became helpless from an injury to her rudder, and a wooden vessel, a mere transport hastily fitted up for action, rammed her and sent her to the bottom at a single blow. A more suggestive instance happened during the late Russo-Turkish war, in the splendid attack of the unarmored Russian gunboat Vesta on one of the largest Turkish ironclads. The battle was fought at rifle range, and in a short time two of the Vesta's guns were dismounted, her rudder was jammed, and a fire near her magazine broke out, while the Turk poured in 15 inch and 7 inch shell as fast as his six guns could be worked. Just as the destruction of the Vesta seemed certain, a lucky shot from her alighted on the Turk's unprotected deck and struck his boilers, and with what steam the latter had left he ran away, the Vesta's injuries unfortunately preventing her following up her advantage.

Such instances as the above, besides the other considerations stated, are sufficient to show the inefficiency of heavy ironclads, without bringing torpedoes into the question at all; but as these terrible engines of war must play the chief part in all future naval conflicts, the disappearance of the heavy ironclad will be the almost certain consequence of their employment. At the time we write, the finest of England's fleets lies virtually at the mercy of torpedo attacks, and there is no concealment made of the anxiety occasioned thereby. The crews are kept constantly vigilant, guns are kept loaded, signal stations established, and every possible precaution taken in the face of the mere possibility that hostilities may break out. It is openly doubted, if the Russians succeed in gathering the torpedo craft, planting the fixed torpedoes, and increasing their movable torpedo armament on the Dardanelles (which measures are known to be afoot), whether the English squadron can make its escape from the *cul de sac* in which it has placed itself. The Austro-Italian war, short as it was, showed the inefficiency of armored vessels. In the Franco-Prussian war the French were unable to use them at all. The Russo-Turkish war has again shown their disadvantages; and an Anglo-Russian conflict, it would seem, can only furnish positive proof of what is already reasonably made certain.

Symptoms of reaction from the ideas which generated the modern ironclad are already visible. Far-sighted Germany, although recognizing the fact that her ironclads are no longer formidable compared with those of later date, refuses to build any more heavily armored vessels. For the protection of her coasts, light draught gunboats carrying large guns will be constructed, and her fleet, it is said, will be used for defensive purposes, never going into action at sea except when forced into it, or under specially favorably conditions. The days of such exploits as those of Farragut at New Orleans and Mobile are gone by, for torpedoes render them impossible. Invasions by fleets are obsolescent, and all signs indicate that the navy of the future will be such defensive gunboats as Germany contemplates, and light swift cruisers whose sole duty will be the destruction of an enemy's commerce.

CONGRESS AND THE PATENT OFFICE FUNDS.

It has been the practice for some years past, says a correspondent, to pay into the United States Treasury all the fees received at the Patent Office, and for Congress to appropriate such money from the general funds as it thought fit, to carry on the business of the Patent Office; the amount appropriated lately being generally more in accordance with the ideas of the particular congressmen having charge of the appropriation bill than with the necessities of the case as pointed out by the amount asked for on behalf of the Patent Office.

The appropriation of $106,680, asked for by the Patent Office for the current fiscal year for printing the *Gazette*, the specifications of patents, patent heads, etc., titles to drawings, etc., was cut down to $65,000, although it was well known from the experience of previous years that the amount of printing required to carry on the business of the office could not be done for that sum, unless the number of patents issued fell off in proportion, of which there was not the least probability. Nevertheless, although the necessity for the whole sum asked for was capable of mathematical demonstration, Congress in its misdirected desire for economy refused to appropriate anything more than the sum mentioned; and as a result the appropriation has all been expended on needed work, which causes the stoppage of the printing of the Patent Office *Gazette* with the issue of March 26, and of the specifications of patents with those bearing date April 2. As the patents cannot be sent out without the printed specifications, the patents which should be issued on the succeeding weeks will have to be suspended until Congress appropriates more money, by the deficiency bill now before it, to carry on the printing.

In the deficiency bill, the $40,000 asked for to finish the printing for the remainder of the fiscal year has been cut down to $30,000, and it may be yet further reduced before passing both houses. To get along with the $30,000, even if that much is granted, the printing of the Alphabetical Index of Patents, which has been in preparation some time, will have to be postponed. This work, when published, will be a great help to inventors and attorneys, and it is believed that every dollar spent on it will be returned to the Patent Office in the sales of copies.

It is now proposed to cut down the examiners' salaries from ten to fifteen per cent, when it is well known that many of the best officers resign even at the present salaries because they can obtain a better income outside the office than in it. If the Patent Office is to be, as it ought to be, provided with a corps of examiners capable of appreciating the nice points of inventions, skilled in mechanics and learned in the law, fair salaries will have to be paid. Economy on this point may save a few thousands to the Treasury, but a single patent wrongfully issued may cost the public many times more than the saving thus effected, and a patent refused that ought to have been granted may delay the introduction of an invention that would save the people generally tenfold the amount saved by the proposed reduction of salaries.

For several months past the "burnt district" of the Patent Office has had nothing but a temporary tarred paper roof on it, although a large portion of the business of the Patent Office, and much of the Interior Department, is done in that part covered by the paper roof, and much inconvenience is felt for want of room. The attention of Congress has been called again and again to the necessity of something being done to remedy this, but thus far without result.

Now, why this mistaken policy of stinting the Patent Office? Is it because the Government is so poor that the money cannot be raised to make the needful appropriations for printing, paying proper salaries, and for necessary repairs? If this were so, and the Government had to pay out its own money, there might be some excuse. The Government, however, is not called upon to pay a penny of its own for either of the purposes mentioned, as it now has lying idle in its coffers over eleven hundred thousand dollars belonging to the Patent Office funds, which the office has received over and above expenses and paid into the national Treasury, every cent of which of right belongs to the Patent Office and should be kept for its use. Congress can find time and money enough to provide tens of thousands of dollars for an unnecessary mint in New Orleans, and appears willing enough to appropriate hundreds of thousands of dollars for the payment of confederate mail claims, but is not willing that the Patent Office—the only government institution that is purely self-sustaining—should control and spend its own revenues. All that is wanted from Congress is that the Patent Office may help itself with its own income, that it may use some of the money that it has garnered up, not from a tax on labor but as the price of protection to inventions, which money should be devoted to that purpose, to the encouragement of inventors, and to spreading information that may help them on their way, and not be allowed to lie in a constantly accumulating hoard, doing good to none.

New Inventions.

Mr. L. P. Taylor, of South Orange, N. J., has invented an improved Type Holder for Hand Stamps in which regularly recurring changes are made. The type box, having one or more compartments, is provided with lifters and followers which raise the type in turn, as desired, in a simple manner.

Mr. Jonathan Miller, of Hinrad's, N. Y., has improved upon the Apparatus for Making Tea or Coffee, previously patented by him, by modifying its form so as to adapt it to be made of stone ware.

An improved Latch, for barn doors and similar positions, has been patented by Mr. B. Hollingsworth, of Sigourney, Iowa. It consists of a pendent bolt dropping into blocks on the door casing and locking the latch proper, which is opened by a string from the outside, as usual. The bolt is raised or lowered by means of a cord, which is carried by pulleys to a convenient and concealed terminus.

Mr. H. L. St. Clair, of Vineland, N. J., has invented an improvement in hand Washboards. The bed, or friction surface of the board, is formed of rollers, which are square or polygonal in cross section. The labor of rubbing clothes on such a surface is obviously less than on a fixed surface. One of the side bars of the washboard is provided with a hinged section, which permits the rollers to be easily put in or removed as required.

A new Fire Escape has been invented by Mr. Sylvester Root, of Kentland, Ind. A drum, having two separated grooves, in which ropes are attached so as to wind in opposite directions, is mounted in a frame which is hinged at the side of the window casing, so that it will swing into and out of the window. The free end of the swinging frame is provided with hooks to catch on a bar which spans the window casing transversely, and serves to support the frame when the drum and ropes are in use.

Mr. E. F. Gordon, of Concord, N. H., has invented a strong and simple Clamp for general use. At the lower end of the standard a beveled head is formed, which fits into a dovetail slot in an iron strip let into the bench. The sliding arm of the jaw is operated by an eccentric lever, which is shaped so as to prevent it from turning when the jaw is under pressure.

A new process and apparatus for Extracting Glycerin from Fats has been invented by Mr. Frederick Sahlfeld, of New York city, who employs steam for the purpose of mixing the fatty matter and chemicals; not by direct action, but indirectly by the use of revolving steam-heated stirrers, the mechanical action and the contact of the surfaces of the stirrers with the fatty material expediting the separation of the glycerin.

An improved Chimney Cowl consists of a pipe closed at its upper end, and having lateral discharge openings near the top, and surrounded by a thimble, between which and the pipe are formed vertical passages for the discharge of smoke and movement of wind. This device has been patented by Mr. J. W. Androvatt, of Prince's Bay, N. Y.

Mr. Moritz Leiner, of New York city, has patented an improved Brush, for bathing and other purposes, composed of a series of round brushes made of bristles retained in twisted wire strands, the brushes being attached to flexible bindings at the ends, and provided with a suitable handle.

A convenient Device for Sizing Rings, intended for the use of jewelers, has been patented by Mr. Edward Davies, of Brooklyn, N. Y. It consists of a dieplate having a number of tapering holes of different sizes, in connection with a corresponding number of tapering punches having annular recesses at the ends, fitting the different sizes of rings, and either contracting or expanding them by driving them into the die holes.

Influenza.

Dr. D. H. Beckwith, in a paper published in the Cincinnati *Medical Advance*, says: "That theory which commends itself to my acceptance is that a deficiency of ozone in the atmosphere will cause influenza, catarrh, hay fever, cholera, scarlatina, and diphtheria, while an increase of ozone in the air will increase bronchial and pulmonary diseases.

"Ozone is defined to be 'oxygen in an active or highly negative state.' Ozone is a constituent in the air, and is remarkable in its properties. It has an odor similar to a spot that has been struck by lightning. In quantities—that is, an excess in the atmosphere—'it will attack the mucous membrane of the throat, nose, mouth, and bronchia,' so says Hartly. Short says, in his 'Chronological History of the Weather:' 'Thick ill smelling fogs are preceded by attacks of epidemic catarrh.'"

IMPROVED MACHINE TOOLS.

[*Continued from first page.*]

which the same automatic movements are repeated, completing the wheel. The spindles run in anti-friction boxes

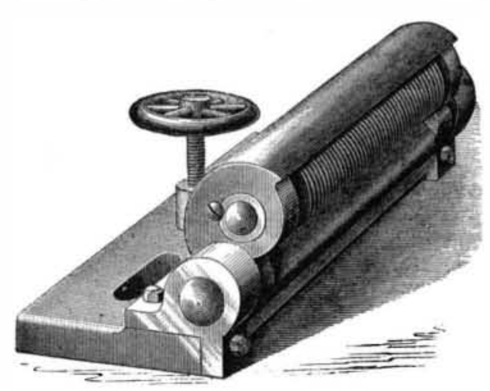

Fig. 4.—GRINDSTONE TRUING DEVICE.

provided with means of compensation for wear. The machine is of neat design and carefully constructed, and is accompanied with complete self-oiling overhead works. Special fixtures for wheels of any given form and size can be readily attached, while, on the other hand, one machine only can be supplied if required. With the two machines upon the one bed the weight, including the overhead works, is about 1,000 lbs. The heads, having what is technically known as a box frame, are very strong and rigid in proportion to their weight, while their interiors can be used as closet room for the cutters.

Fig. 3, page 271, shows an automatic balance wheel turning machine, designed for the automatic turning of the circular rims of balance wheels, such as are used upon sewing machines, small lathes, and other light machinery. The work is performed by two cutting tools, operating upon opposite sides of the wheel at the same time. These tools are automatically revolved in a horizontal plane about the rim of the wheel, in opposite directions, so that one quarter revolution of each tool post completes the half circle, and then both the spindle of the machine and the tool posts automatically cease revolving. The centers around which the tool posts revolve are adjustable, and allow a variation in the size of the wheel to be turned of from 6 inches to 7 inches in diameter, this adjustment being made by simply turning a screw.

The feed works or motion are all inclosed in the base of the machine, and are readily accessible for oiling. The spindle of the machine is of steel, made with large bearings working in boxes, which are provided with means of compensation for wear, and is strongly geared. The cone has two speeds, and is driven by a belt 1¾ inch wide. With the countershaft, self-oiling hangers, etc., the machine weighs nearly 1,000 pounds.

Driving Piles in Sand.

The contractors who had charge of preparing the sheet piling which was to protect the hospital at Berck-sur-Mer, in France, were much troubled in driving the piles by the compactness of the wet sand, and finally made use of tubes which were driven at the same time with the pile, their lower ends being a few inches below the points of the piles; through these tubes water was forced by small hand engines, and so loosened the sand that the advance of the pile was easy and rapid. In the case of the panels of sheet piling, the benefit was even more marked. Careful observations showed that by the ordinary process it took, on an average, 185 strokes to drive a ten inch pile ten feet, while 900 blows were needed to drive the panels. The hammer weighed 1,320 pounds, and had a fall of six and one half feet. The average time required to drive a pile and panel was eight hours and a half. After the device of loosening the sand by the pressure of water was adopted it was found that the average time required to accomplish this was one hour and nine minutes, while to drive a pile and a panel more than fifty blows were never required, and often the mere weight of the hammer was enough to sink the pile.

HYDRAULIC MINING IN CALIFORNIA.

The rich gold placers of California, where for a brief period fortunes were made by the use of the most primitive appliances, such as the pan, the rocker, and the "long tom," soon became exhausted, and it became necessary to turn to the original sources of gold in the quartz veins, or to work, by combined and systematic effort and the aid of modern mechanical improvements, the masses of auriferous gravel which contained too small a proportion of the precious metal to be profitably treated by the early crude processes. Our engravings give a good idea of how the latter is accomplished.

HYDRAULIC MINING IN CALIFORNIA.

In place of the pick and shovel, the disintegrating power of water is employed to break up the gravel, often cemented together and containing huge bowlders, and convey it to the flumes, where the gold particles are separated by riffles, blankets, and other devices depending upon the action of gravity or the attraction of amalgamated plates. The success of operations depends rather upon the cheapness and amount of the water supply than upon the richness of the gravel; so low a proportion as 15 to 20 cents' worth of gold to the cubic yard of gravel being at times profitably extracted; while much richer gravel, in places where water is not abundant or has not the requisite fall, often fails to pay.

The water is conveyed from the upper reservoirs by wrought iron pipes capable of withstanding the pressure of a head of water many hundreds of feet high. The limit of strength of the best canvas hose of the necessary diameter is only about 50 feet perpendicular, and 180 feet when braced by "crinoline" of iron or rope netting; and hence it was soon displaced by the stronger material in all permanent workings. The usual dimensions of the iron feed pipes are from 22 inches to 40 inches in diameter, and 0·06 inch to 0·2 inch in thickness, or from No. 16 to No. 7. The water is led to a cast iron distributing box, permanently fixed, and from thence by short pipes to the nozzles. A great deal of ingenuity has been expended upon the construction of these nozzles, and the forms now in use are very effective and easily directed. The stream discharged from them has frequently a