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Contents:

(Illustrated articles are marked with an asterisk.)

THE NEW EXPLOSIVE DUALIN.

Beyond a brief notice of the new explosive, dualin, as it is called, we have purposely said nothing about it, preferring to wait and see whether it possessed enough merit to warrant much attention, rather than cumber our space with an account of what might prove, after all, but another example of a long list of compounds which have never attained any practical importance.

If, however, the accounts that reach us are to be relied upon, this compound bids fair to prove of some value. It is claimed for it that it possesses the slow combustibility of gunpowder with the intense rupturing force of nitro-glycerin, that it may be handled with safety, and that it is not liable to spontaneous combustion.

This explosive is the invention of Carl Dittmar, of Charlottenberg, Prussia, who thus describes it.

"Dualin is a yellowish-brown powder, resembling, in appearance, Virginia smoking tobacco. It will, if lighted in the open air, burn without exploding; but, if confined, it may be made to explode in the same manner as common powder. It is not sensitive to concussion; will not decompose by itself, nor cake or pack together; may be readily filled into cartridges; and it matters not whether the place where it is stored be warm or cold, dry or damp. It has from four to ten times the strength of common powder, and is stronger than dynamite. * * *

"Dualin consists of cellulose, nitro-cellulose, nitro-starch, nitro mannite, and nitro-glycerin, mixed in different combinations, depending on the degree of strength which it is desired the powder should possess in adapting its use to various purposes."

The preparation of cellulose, nitro-starch, nitro-mannite, and nitro-cellulose, involves distinct processes, which will be found described in another column.

How future trials may affect the popularity of dualin, if it can at present be said to have acquired popularity, we can not undertake to say. It is only fair to say that in the opinion of some good judges, it is decidedly inferior in power to dynamite, though it is said to be cheaper. It will explode in contact with flame which does not ignite dynamite. On the contrary, it may be used in temperatures which freeze dynamite and render the latter incapable of being directly exploded. But dynamite may be used when wet and may even be exploded under water in drill-holes, while dualin, like gunpowder, is, we are informed, useless when wet. This fact gives dynamite an immense advantage over dualin for mining and engineering purposes.

The claims of dualin to take front rank as an explosive can not yet be conceded, but there is little doubt that it is far better than many other compounds which the last few years have brought forth. Before it can gain the full confidence of miners and engineers, it must undergo many more trials than have yet been made. It is, however, only just to say that reports from the Hoosac tunnel, where it has been successfully tried, are highly favorable.

We learn that experiments were made in the United States, January 5th, 1870, in a quarry near Washington City, belonging to the Messrs. Lewis & Hall; January 18th and 19th, at Hoosac Tunnel; and January 22d, at Roxbury, near Boston, Mass.

The attested results of these trials leave no doubt in our minds that dualin is much safer than nitro-glycerin. It is also stated that such experiments as have been performed with this explosive in Europe have given the most satisfactory results.

THE CULTIVATION OF TIMBER.

"When you have nothing else to do plant a tree; it will grow when you are sleeping." This advice we think may be extended to times when people are not at leisure, and to the United States Government as well as private individuals. Why not make a business of planting trees? We are well aware that in many cases trees have been planted and grown with success, by private individuals and on private estates, but the fact remains that large areas of public domain are to-day entirely without timber, and the sources from which lumber can be derived to supply the needs of this territory upon its future settlement, are undergoing a drain which will ultimately exhaust them.

If there exist reasons why the agricultural department of our Government could not, if disposed, greatly increase the value of the public lands by rendering nude portions tree-bearing, they are not now obvious to us.

Our continent possesses a variety of forest trees of industrial value, exceeded by no area of similar extent. Certainly in all this variety there may be found some adapted to vigorous growth in almost any climate, or any soil capable of sustaining vegetation.

THE LAW OF "VIS VIVA."

One of the best definitions we have seen of the term *vis viva* is that it is "the measure of mechanical work developed by motive forces or inertia, *in variable motion.*" When the full import of all its terms is comprehended, this definition will be found to accord with the notion of force as precedent to motion. So long as this notion of force prevails, so long must the term *vis viva* or its equivalent be a necessity in the intelligent conception of the laws of motion.

Let us briefly examine this definition with a view to clear away some of the vagueness with which this subject is attended in the popular mind.

What is meant by mechanical work? Certainly, this can be expressed in terms of its accepted unit the foot-pound. A foot-pound is a pound raised one foot without regard to time. This is the *unit of work.* It is not a unit of force, as it is sometimes erroneously considered. More or less force will be required to perform it, according as the time in which it is done is shorter or longer. Power is force in relation to time. The mightiest force requires time to produce an effect. The most infinitesimal force will produce an effect in time.

All this is inseparable from the idea of force as existing independently of matter and antecedent to motion. A mechanical effect is *motion produced*; motion involves the idea of distance traversed, distance traversed involves the idea of time in which it is traversed. But distance traversed does not necessarily imply mechanical work performed. It is only when a resistance is overcome that work is accomplished. A body moving in absolute space performs no mechanical work, though it move with a constant velocity forever. Let it, however, encounter some other body having less motion and it performs work. It increases the motion of the mass which it strikes against, or some of its particles, or it may produce both these effects. The mass-motion produced is mechanical work. The effect upon the striking body is no less work. Its motion is decreased by the impact.

Increase or decrease of mass-motion is, properly speaking, *mechanical work*, and we shall find upon strict examination that this is all implied by the term. But as no increase or diminution of motion can take place in a body without its receiving or imparting motion from or to another imparting or receiving body, it follows that *vis viva* practically relates only to transmission of motion from one body to another, in *space and time.*

It will be seen that the idea of *vis viva* is, therefore, essentially different from the term momentum, which is simply the amount of motion a body possesses, considered with relation to definite periods of time and definite distances, and which is expressed by mass or weight multiplied by the time it traverses a definite distance. Momentum has no reference to the amount of motion a body can impart or receive in time and space.

The terms "motive forces" and "inertia" convey the idea of material forces or matter in motion. The expression, "in variable motion," seems unnecessary, since the very idea of imparting or receiving motion implies variable motion. The expression MV^2 (mass or weight multiplied into the square of velocity) is the mathematical symbol of *vis viva*; that is the measure of the mechanical work developed by a moving body—or in other words the change of motion produced by it on another body in space and time—is measured by its mass multiplied into the square of its velocity.

It must be further observed that *vis viva* is not a measure of force, but of the mechanical work performed, or the change of mass motion produced.

Whether we accept the notion of the existence of occult force which acts upon matter, or accept the doctrine that there is no force which the human mind can recognize other than moving matter, there still remains the necessity for an expression of the law of the transmission of motion. One thing is certain, a body cannot transmit motion it does not possess, and if momentum expressed by MV (mass multiplied into velocity) be the absolute amount of motion a body possesses, it certainly cannot impart the motion expressed by MV^2 or its mass multiplied into the square of its velocity. Evidently there must be some limitation to the interpretation of one or both of these expressions, which will reconcile their apparent conflict. This limitation is, we think, to be found in the fact that in momentum definite spaces and times are considered with uniform motion, while in *vis viva* the motion considered is a variable one, one in which motion is constantly received or imparted; and that MV^2 determines the space through which a body will move before it comes to rest, when opposed by a resistance capable of absorbing all its motion. MV, or momentum, is the expression of the motion of a body neither imparting or receiving motion, and therefore performing no work. Momentum is an absolute expression when the factor of time in the velocity is constant. *Vis viva* is a proportional or relative term only.

Thus a body moving uniformly through a definite space in a definite time, has a momentum expressed by its mass or weight multiplied into its velocity. While passing through the space, or when it has passed over the space, it has the power to overcome a certain constant resistance, and to move a certain distance before it imparts all of its motion to a resisting medium. Its relative or proportional power to move through such a resisting medium or to overcome an attractive force is its *vis viva* (MV^2) as compared with other bodies moving through similar media or opposing an equal attractive force. It is not an absolute expression of the quantity of motion in a body, like momentum. It has reference only to space traversed, while motion is being absorbed by resistance.

WHAT OYSTERS EAT.

Not long since a journal which claims to instruct the public in regard to the preservation of health, came out with a sweeping denunciation of oysters as an article of diet. What little of argument could be gleaned from the whirlwind of denunciation with which the use of oysters as an edible was assailed amounted to this. Oysters are nasty. Whatever is nasty is injurious to health. *Ergo*, oysters are unwholesome diet.

In whatever particular oysters are generally nasty, or whether they are particularly nasty in general was not, to our thinking, made out very clearly; but the subject has since received more scientific treatment at the hands of the Rev. J. B. Reade, F.R.S., who has been investigating into the private, domestic, and personal habits of these delicious "sea violets." The Rev. J. B. Reade, F.R.S., has been interviewing a large number of oysters, and has read a paper before the Microscopical Society giving the result of his researches. Oysters are proverbially reticent, but they have at last been made to reveal the secrets of their prison houses.

It may not be generally known that the question of what constitutes the food of marine animals which exist at great depths, is at the present time much mooted among naturalists. We do not take it upon us to say whether the discoveries of Mr. Reed are calculated to add to the zest with which most people swallow this prince of bivalves; but he found in the stomach of every oyster he examined "myriads of living monads, vibrios in great abundance and activity, and swarms of a conglomerate and ciliated living organism, which may be named *Volvox ostrearius*, somewhat resembling the *V. globator*, but of so extremely delicate a structure that it must be slightly charred to be rendered permanently visible."

The oyster is not therefore a vegetarian; he doubtless swallows his *Volvox ostrearius*, his vibrio, or his monad, with as great satisfaction as we humans swallow him when he lies delicately quivering on the half-shell, with the added savor of a drop or two of lemon juice. But he does not confine himself to the few plain dishes we have mentioned. Mr. Reade has been able to make out the following bill of fare:

"*Actinocyclus senarius, Ceratoneis fasciola, Coscinodiscus minor, C. patina, C. radiatus, Dictyocha aculeata, D. fibula, D. speculum, Gallionella sulcata, Navicula entomon, Tripodiscus Argus, Xanthidium furcatum, X. hirsutum, Zygoceros-rhombus, Z. Surirella*, and two new species of this genus."

Mr. Reade does not add to this attractive list that "all other delicacies will be served in their season;" but he does say, that the oyster, like creatures of a larger growth, lives on the food which is successively in season; and he finds that even a different shore is marked by a decided difference in the infusorial contents of the stomach. The "Scotch Natives" are characterized at the present time by innumerable circular forms, resembling the Coscinodiscus. Others are nearly destitute of these living rotatory disks, but they are much richer in more interesting species; and in addition to the silicious shelled infusoria which are received into their stomachs, they also occasionally furnish examples of calcareous Polythalamia adhering to the inner surface of their shells.

Who knows but that as science advances oysters may be fattened on selected food, as pork designed to be extra fine is fed on corn. Who knows but that the coming oyster may be recommended to the palates of gourmands as prime Coscinodiscus or New Jersey Volvox?

A PLEA FOR THE SOCIETY FOR THE PREVENTION OF CRUELTY TO ANIMALS.

The man who professes Christianity and belies his profession by a total want of sympathy for the mute and patient servants who, for small reward, minister to his daily wants; who can stand unmoved by compassion and see animals maimed and tortured at the caprice of wanton cruelty; who can witness such acts without his breast swelling with righteous indignation—is either a self-deluded formalist, or a consummate hypocrite.

There are many who profess Christianity in the State of New York; yet how many of these will feel a blush of shame or hurl a word of protest, at the despicable movement now on foot against the Society for the Prevention of Cruelty to Animals.

The attempt to repeal or limit the wholesome laws under which this society has been able to do so much good, is made in the interest of brutal men by brutal men representing the brutish element of our metropolitan population.

It is a burning disgrace to the State and a blot upon our civilization, and can never succeed except through the apathy of those who should stand in solid array against such action. Every pulpit should protest, and every generous voice be raised in denunciation of this outrage.

It has been charged that the fanaticism of Mr. Bergh has led to this movement. We deny it. That gentleman has, indeed, been in earnest in his good work. He has bravely stood up against deprecation, misrepresentation, and calumny, and has succeeded in spite of the indifference of the courts, in bringing some thorough scoundrels to justice. That is what is the matter. He has compelled the horse railway companies to treat their overworked beasts a little more humanely, at the sacrifice of a very small portion of their enormous profits. That is the extent of his fanaticism. It is not Bergh, it is Beelzebub who is the source of this mischief, and let the blame rest upon him and the very large portion of his family who render this city such a pleasant abode for the order-loving and the law-abiding.

We are glad to see that the press has generally denounced the attempt to destroy this noble organization, and we do not doubt that there is still humanity enough left to sustain it in full possession of its present powers.

SYSTEMATIC THINKING.

Charles Reade and Wilkie Collins are two of the most famous and brilliant novelists of the present day. Each of these men has contributed much to the amusement and something to the instruction of mankind. Each has given to the world a special boon. Reade has invented a word, and Collins a phrase, each of which is one of the most forcible of its kind.

In a late number of "Put Yourself In His Place," now appearing serially in the *Galaxy*, Reade has given us the word "*vicaria.*" Henry Little having, by a systematic course of thinking, wrought out of his inventive brain some new and valuable improvements in saw-grinding machines, applies for a patent, and is fairly crushed by what he calls the "*roundabout swindle.*" He complains to his good friend, Dr. Amboyne, that by the treatment he had received "one would think an inventor an enemy of the human race," and proposes to burn his models and renounce invention altogether. His account of the matter is certainly not complimentary to the English method of transacting patent business.

To the disgusted inventor the doctor thus quaintly discourses: "That system of go-betweens, and deputy-go-betweens, and deputy-lieutenant-go-betweens, and of nobody doing his own business in matters of state, really is a national curse and a great blot upon the national intellect. It is a disease; so let us name it. We doctors are great at naming diseases; greater than at curing them:

Let us call it VICARIA.
This English malaria.'

Vicaria is good; better than our familiar synonym, "red tape."

"When we are not occupied in making machinery," Wilkie Collins makes Mr. Franklin Blake say to Betteredge, in his novel, "The Moonstone;" "when we are not occupied in making machinery, we are (mentally speaking) the most slovenly people in the world." This was Mr. Franklin Blake's way of setting forth what he was pleased to term "the curious want of system in the English mind." We think Mr. Franklin Blake did injustice to the English mind, but the phrase "slovenly minded" is a master stroke.

People who think unsystematically are slovenly-minded people. The facts and ideas stored away in their upper chambers are all topsy-turvy. No sooner do they turn over something in the hope of finding another something than they cover up still another something, which, in its turn, will soon be wanted and rummaged after. Their heads are not well-arranged libraries, but garrets filled with rubbish. If they commence to think upon any subject, they shift it about, taking only glimpses of it here and there. They do not, like the systematic thinker, take a subject to pieces as a watchmaker does a watch, and lay the parts all in order under glass covers, but pitch them into all sorts of by places and corners, and generally getting bewildered in trying to replace them, become hopelessly muddled and give it up.

A great deal is said now-a-days about the power of modern thought; but it would be well to remember that all the thinking which bears fruit, is systematic thinking. Many a young man imagines himself to be thinking when he is merely day-dreaming. Thinking implies an active state of mind calling up images, holding them fast, and arranging them in order; not a passive condition in which troops of ideas, or shadows of ideas, flit across the mental vision like figures in a kaleidoscope.

Thinking, worthy of the name, is work—systematic, calm, and connected; and the man who has not got his mind so disciplined that he can thus command it, is not yet a thinker.

That systematic thinkers are so few, is attributable in a great degree to early bad training. Not one teacher in fifty in our primary schools deems it of importance to teach children *how to study*, and a less proportion are competent to do this if they would. The most of them think their duties are comprised in keeping an orderly school, hearing recitations, assisting pupils to do hard sums, and allotting tasks. Especially in the latter do they excel. Memorizing is with most of them a name for mummery—a thing to be done by holding the head on one hand, swinging first one foot and then the other, and forcing the lips to repeat a formula until they will run of themselves long enough to get through a recitation, by very force of momentum. And this laborious, meaningless task, they think, is study. In other words, study is to them the teaching of the lips to move from force of habit, while the mind may be wandering any where and every where.

Thus a vacant wandering habit of mind is secured with the spelling lesson, and ground in with the rules of grammar; and unless by rare good chance, the unfortunate overtasked and mentally disgusted young intellect meets in its onward progress some one who can show it the mistake, or has native genius to discover it without help, it grows into habitual slovenly-mindedness.

After all, teachers are no more to blame than parents who demand that progress shall be measured by pages of a book, rather than by power to think.

CONCERNING PATENT OFFICE MATTERS.

A correspondent of *Work and Play* gives his experience in regard to Patent Office matters, in the following practical observations, which we commend to the attention of our readers:

"The Patent Office is near the Post Office, and both about a mile from the Capitol. On the lower floors of the huge building designated as the Patent Office, are the numerous rooms occupied by the various officials, and above are immense halls filled with glass cases, in which are deposited models of inventions for which applications for patents have been made. Every person, without regard to age or sex, is equally entitled to a patent. In order to procure a patent, it is not necessary for the inventor to go to Washington; in fact, it is much better that he should not; because, not being conversant with the rules and practices of the Patent Office, he will probably make some blunders, and fail to comply with some of the red-tape requirements, and thereby make himself unnecessary trouble. There are, in the larger cities, many patent soliciters or agents, whose business it is to transact business with the Patent Office; and if they are honorable men, they can do it much better than the inventor. A man having invented a machine or piece of mechanism which he wishes to patent, first makes a miniature edition of it, which is called a model. A model for the Patent Office must not be more than one foot long or high, so that some large machines must be very much reduced. This model is taken to some patent agent or soliciter, to whom is explained its whole operation, and all the points wherein it differs from other similar machines. The agent must then make complete drawings of the model, such as to fully illustrate every part and its operation. The law requires two sets of these drawings, and, therefore, one set having been made on paper, a copy is made on tracing muslin, and, by means of letters of reference on these drawings, a very full and complete description of all the several points of the invention is written. This description is called the specification, and at the end of the specification the whole is summed up in a nutshell, and this is called the claim. When the agent has all these prepared, the inventor is obliged to make oath that he is the original and first inventor of the machine or device described, and then the model, drawings, specifications, and fifteen dollars are sent to the Commissioner of patents at Washington; but the Commissioner sees very few of the applications, for, although directed to him, they go into the hands of men called examiners.

"The applications for patents are divided into classes, thus: all inventions relating to guns, pistols, cannon, etc., are in one class; everything connected with farming in another, and so on. For each class there is a special set of examiners in a room by themselves. When an application for a patent saw-horse comes in, the models, drawings, and specifications are given to the proper examiners, and in turn the case is taken up by them and investigated. They refer to all the patents that have been granted on saw-horses, examine, if necessary, the models in those huge glass cases in the hall above, examine the reports of English and French patents, and if, after all possible search, they can not find anything similar, the patent is allowed, and the inventor is notified that if he will send twenty dollars more, his patent will be granted. But if something is found that an examiner thinks looks like the saw-horse in question, then the application is rejected, and all the fond hopes of the inventor are dashed to pieces; and that is just my condition at the present time. Ordinarily, there is so much business on hand, that cases must wait several weeks and even months, before they are examined; but when in Washington, Mr. F. saw the examiner having charge of the class into which my case would come, and he said he was so nearly up with his work, that my turn would come very soon; and a few days ago I received notice through Mr. F. that the application was rejected, because something similar had been found in some old English book. I don't think that is fair; I didn't know anything about it, and I do not believe there was ever one in this country; but the law says that I must not only be the original inventor, but also the first inventor, and of course, if some one in England has invented it before, I am not the first; but it is a bad law, and if I ever get to Congress I will have it changed."

THE LIGHTEST MACHINE.

Probably the lightest engine ever constructed was the invention of Mr. Stringfellow, that received the prize of £100 sterling from the Aeronautical Society. It is a one-horse power engine and weighs 16 lbs.; the diameter of cylinder is two inches, stroke of piston three inches; works under a pressure of 100 lbs. to the square inch, and makes 300 revolutions the minute. We are reminded, in this connection, of some curious observations that have been made on the power exerted by birds in flying. It has been calculated that a goose accomplishes the work of 400-horse power in flying, but by an arrangement of its wings is actually obliged to exert a far smaller power. According to de Lucy a mosquito weighs 460 times less than the grasshopper, and has proportionally 14 times as much surface exposed by its wings. The sparrow only weighs a tenth as much as the dove, and yet its wings have twice the surface. The sparrow weighs 339 times less than the Australian crane, and possesses wings that have seven times the surface. These curious investigations have been made in the interest of aeronautical science.

MR. RUTHERFURD'S STAR PHOTOGRAPHS.

By means of a 11-inch objective this distinguished astronomer has obtained photographs of several groups of stars. One of these groups, comprising 43 stars in the constellation of pleiades, some of them of the 9th magnitude, was obtained after an exposure of three or four minutes.

By means of a very delicate micrometer Mr. Rutherfurd has been able to measure the arc of the angle which separates the stars of this constellation. These results have been compared by Dr. Gould with those formerly obtained by Bessel, and confirm the remarkable accuracy of the latter's work. By means of photography Mr. Rutherfurd can obtain, in one night, results that cost the German astronomer the labor of ten years. Mr. Rutherfurd has also taken photographs of the solar spectrum, showing a large number of lines not mapped by other investigators. There was in this instance also a remarkable confirmation of the accuracy of Kirchhoff's chart of the spectrum, mapped from actual observation and experiment.

Materials for Telegraphic Insulators.

Ebonite insulates much better than glass, and is far less apt to become damp than even porcelain. It is the best material yet known for the insulation of electrical apparatus. Compared with porcelain or earthenware, it less easily becomes wet in mist, but more easily in rain. Rain forms detached drops upon a surface of earthenware, but covers ebonite with a continuous film. Thus the latter acts with most advantage when it forms the inner cup of a compound insulator, and is protected by earthenware from the direct action of rain.

The surface of ebonite becomes rough and spongy, so as to retain dirt, and it matters not how perfect the substance of the insulator may be if its surface is defective.

But although ebonite will not maintain a high state of insulation for a long period, it may be advantageously used in certain cases to secure freedom from accidental interruption; for it is not liable to be broken, nor does it seem to afford temptation to stone throwing.

The best material for an insulator is a really good porcelain, thoroughly vitrified, so as to insulate perfectly even when unglazed. Its value arises principally from its polished smooth surface, which resists the formation of a continuous film of moisture, does not retain dust, and is washed clean by rain.

The objection to porcelain is, that considerable skill is required to select it, and to distinguish between a good and an inferior sample. As it is a compound of several substances, it is difficult to secure uniformity of composition, and much is left to the care and honor of the manufacturer.

Though a good glaze does not deteriorate by age or exposure to the weather, it is difficult to distinguish between a good and a bad glaze by inspection or electrical test, and it is quite possible that a glaze which appears good and insulates well, may crack by age.

Brown stoneware is both excellent in quality, cheap, and durable. Its surface is not equal to that of porcelain, so that it never insulates so well as the best specimens of the latter, but the glaze never cracks. Again, it is not a compound; so that when a manufacturer possesses a suitable clay, and takes care in its preparation, the uniformity of his ware may be depended on. It is also comparatively easy to distinguish its quality, and to detect faults in its manufacture.

Small pieces of ware are more easily burned, and therefore more likely to be perfect than large ones. There is, therefore, a great advantage in forming an insulator of separate hollow pieces or cups, placed one inside the other and fastened with cement; if one is defective there is a probability the others will be sound, and if the pin or bolt be covered with an insulator (such as ebonite), insulation will not be destroyed if the earthenware be entirely useless.

All insulators should be tested before they are used. Part of the glaze should be ground off to test the body.

They should be placed in a trough of dilute sulphuric acid, or salt and water, allowed to remain several hours, and tested with 250 cells and a delicate horizontal galvanometer, to prove if the bolt is perfectly insulated from the liquid in the trough, the edge of the insulator being slightly greased to prevent the water spreading over it. The acid must be very carefully washed off after the tests. From its power of repelling water, grease greatly aids insulation in damp weather; paraffine, again, enormously improves it; so that in testing samples it is necessary to ascertain carefully that they have not been coated with these substances.

In order to learn the comparative value of different kinds of insulators, they should be fixed upon standards in sets of not less than 10, exposed to the rain equally on all sides, and tested when the weather is uniformly wet. Almost any insulator will suffice in fine weather, while that which tests best in slight rain may not give the same result in extreme wet, when the insulation is most tried.—*Handbook of Practical Telegraphy.*

The Mormon Tabernacle.

It deserves the name of wonderful. Its like does not exist in our land, if anywhere. It is an edifice two hundred and