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Contents:

(Illustrated articles are marked with an asterisk.)

THE MECHANICAL EQUATION.

A true balance, with equal weights in the pans, may be said to be the type of a mathematical equation, the equality being indicated or verified by the horizontal position of the beam. Another type of the mathematical equation may be found in the double inclined plane, with a pulley at its apex, having a cord with equal weights attached to its extremities, passing over the pulley, and the weight resting upon the inclined surfaces. In this type of the equation, the horizontal position of the base of the inclined plane is the verification of the equality of the weights suspended from the cord.

No element of machinery exists in which one or both of these types of the mathematical equation is not found, and it might be shown that all the changes in the relations of parts on either side of the fulcrum of the balance are types of the changes and transformations which the members of an equation may undergo without affecting their relation of equality. A very interesting series of analogies might be thus traced, but this would be foreign to the purpose of this article, the intent of which is to show that, in the construction of machines, Nature permits no permanent violation of the grand mechanical equation which underlies her works. Man may disturb, but Nature will ultimately restore, equilibrium.

To show this in the form of a demonstration, of course, wrecks the hopes of perpetual-motion seekers, who suppose that they can add to, or multiply one side of the equation without increasing the other. Nature has provided for all this beforehand. She has uttered her fiat, that masses of matter shall all tend to a common center, that heated bodies shall transfer their heat till all reach a common temperature, and that, during the transfer, only a portion of this heat can be converted into mass motion. She has affirmed that "what goes up must come down," with a force exactly equal to that which raised it, and that, if a body be raised, or carried away from the center to which it is attracted, and its return be resisted, the force with which it would have returned, if left free to move, shall be transmitted through its support to the attracting body, and expended in changing the path of motion of that body through space. She has said that the parts of every body when left free to move must balance themselves around a common center of gravity, and, this accomplished, must forever cease their motion in relation to that center unless disturbed by some external force. She has laid down the law, that when two bodies are so connected by any medium, solid or fluid, that the motion which each tends to produce is in an opposite direction to that of the other, so that the distances through which each would move, if an additional force were made to act on either, would be inversely as the weights of the bodies, they shall not move unless some additional force be made to act upon one or the other of them.

Thus she has established her perpetual mechanical equation, which is forever opposed to perpetual motions in the sense of self-moving machines.

She has also established her mechanical equation in the transfer of motion by the law, that no motion of any kind shall diminish in one mass without an equivalent increase of motion in some other mass, or the conversion of mass motion into heat, which last is considered by many able thinkers to be only a mode of motion. If heat be really motion, then she has said "let no portion of matter, no infinitesimal part of the great aggregate of motion in the entire universe be lost;" and she has also as unmistakably decreed that no addition to either matter or motion shall be made.

We have said a demonstration of these truths would wreck the hopes of perpetual-motion seekers. This is, however, not the time nor the place for such a demonstration, which would only be a repetition of what has been written over and over again in books on physics, and taught in the lecture room, since physics became a science. In whatever way Nature has been importuned, whether by experiment, or the logic of mathematics, she invariably has responded that she will permit no violation of the laws above enunciated.

Whoever, then, invents a self-moving machine must begin by the discovery of some new law which annuls all hitherto discovered laws of motion and force. Let these dreamers cease their attempt to coerce matter into disobedience, and by experiment and study try to acquaint themselves with Nature's unchangeable statute book, and they will soon drop their chimeras, and turn their attention to something practical.

This week we publish the last of our series of articles upon Perpetual Motion. The illustrations contained in those articles exhibit every principle tried since the search began. All have been shown absurd and impracticable, and if the record of the vain search serves to show inventors the folly of its pursuit, the end we sought will be accomplished.

DANGERS OF PETROLEUM OILS. REPORT OF THE HEALTH BOARD OF NEW ORLEANS. A LAW REGULATING THE SALE OF SUCH OILS RECOMMENDED

Copies of the reports of the Board of Health of the city of New Orleans for 1869 and 1870, have been forwarded to us, and our attention has been particularly called to portions pertaining to the sale of petroleum oils, and accidents resulting from their use. Although we have said much upon this topic, we believe it to be our duty and the duty of the press generally to continue agitating it, until some adequate measures of reform shall be adopted. We therefore willingly give place to the very interesting and even startling facts made public in the reports referred to.

In the report for 1869 is given a statement of the qualities of seventy different specimens of oils used for illumination, obtained of various dealers throughout the city.

Fourteen specimens gave a flashing point from 110° Fah. to 120°; nineteen from 100° to 110°; fifteen from 90° to 100°; thirteen from 80° to 90°; seven from 2° to 28°; one gave the flashing point at zero, and one even flashed at 2° *below zero*. Only thirty-three out of the seventy were fully up to the New York standard of safe oils. In nine specimens the oil itself ignited at temperatures below 90°. One specimen of heavy oil, adulterated with benzine, flashed at 28°. Thirty-seven specimens were of a quality which the Massachusetts law requires to be branded "unsafe for illuminating purposes."

A lamp was filled with oil from No. 47 of the table, lighted, and allowed to burn for two hours; upon being purposely permitted to fall and be broken, the whole mass of oil instantly took fire.

Lamps filled from Nos. 1, 2, 3, and 5, when allowed to fall and break, burst into flame, and when water was poured on the flame, the oil continued to burn until entirely consumed.

Two specimens, No. 32 (Virginia brand) and No. 33 (Downers oil), were experimented with in the same manner. The wick continued to burn, but the oil did not take fire, and could not be lit, though tried repeatedly. This would be the result with any oil whose "flashing point" is 110° and upward. An oil whose flashing point is 110° does not itself take fire and burn till its temperature is raised to about 135° Fah.

The Board express the belief that the admixture of light oils is very general, and add that this mixing of heavy oil and naphtha may be done by persons ignorant of the rapid and great deterioration which is effected by adding small portions of naphtha to an excellent high fire-test oil. Their experiments prove that good oil is rapidly contaminated and rendered dangerous by the addition of small portions of benzine, and if burned in lamps of brittle material or bad construction, continually exposes to accident those who use it.

The following observations are worthy the consideration of all consumers of such oils:

There is probably more danger of explosion of a lamp or can containing a mixed oil than of one containing pure benzine, because the latter evolves vapor with such rapidity, as in most cases, immediately and permanently to expel all atmospheric air from the vessels containing it, although this volatility adds to the danger of fire.

Those using coal oil, can, by simple means, protect themselves from the worst oils. Pour into a cup or saucer a tablespoonful or two of the oil to be examined, and apply an ordinary match, lighted. If the oil does not take fire it may still be an unsafe oil; but if it does take fire, the oil is a very dangerous one. It is necessary to remind the experimenter that great care must be used in so simple a matter as this seems, as the flame may communicate by vapor or otherwise to vessels containing bad oils, and give rise to fire and personal accident.

The report for 1870 gives a tabulated list of thirty-four explosions, which occurred during the year in New Orleans. By these explosions seven females and one man were burned to death, and twenty persons more or less burned, of whom the greater number were women, some of whom were disfigured for life.

The names of the oil with which explosions occurred are given as follows: *petroline, puroline, black diamond, sunlight, septoline, anchor oil, etc.* Our readers will now see the force of our warning them to "beware of fancy names," given in a recent article entitled "Kerosene Murder."

The Board complete their report, by a draft of a law, two excellent provisions of which are: that persons selling oils not up to the prescribed standard shall not be able to collect pay for the same by legal process, and that they shall be liable to pay for all damages resulting from the use of such oils for illuminating purposes, with costs of suit for the recovery of the same.

We would not be understood as meaning to say that all oils sold under fancy names are essentially bad. There are notable exceptions, of which we may mention Pratt's "Astral Oil," an article which we have used for several years, and found to be excellent in all respects. Moreover, we have never heard of an accident arising from its use. The adoption of this name, however, might raise doubts in the minds of purchasers who have been cheated by other fancy names, and as we know such doubts have no foundation in regard to this particular oil, it is but just to make an exception in its favor.

A GOVERNMENT BUREAU OF MINES.

An extraordinary proposition has been laid before Congress: to create a mining fund by the issue of $50,000,000 in bonds by the Government, for the purpose of subsidizing mines of the precious metals, in amounts not exceeding $250,000 to any one mine, and to the extent of $25,000,000 a year for all mines. As it is only proposed to lend the money to the mines, and to allow the Government to participate in the profits of the venture, the direction and working of the subsidized mines will be put in the hands of government officials; in other words, the United States Government will go into the mining business on shares. The proposed bureau is to be under the control of an officer who is to receive a salary of $10,000 a year, and be known as the Chief of the Mining Bureau. Subordinate to him will be five chiefs of division, at salaries of $7,500 each, with deputies at $5,000, clerks at $2.000, and messengers at $1,000 each. These officers are to constitute the executive corps, and will be stationed at Washington. On the field will be a corps, to consist of attorneys, inspectors, and supervisors, at salaries of $5,000 each, assisted by associates who are to receive half that sum per annum.

The standing army of laborers, the medical staff, the commissary department, the chaplains, the drill sharpeners, commission merchants, assayers, brokers, and mechanics are not mentioned in the bill, but it is understood that the trifling expense of supporting them will be borne from the profits of the business, and not in any way fall as a tax upon the country.

It is proposed to discover and "to bring into being" 200 new mines every year for ten years, until the maximum of 2,000 mines has been reached. "If the working days of the mining year are reckoned so few as 250 only, the average annual yield of ore per mine should be set down at 25,000 tuns, and the aggregate product of the 2,000 mines, at the prodigious total of 50,000,000 tuns! Taking the average net returns at only $12·50 per tun, the profits receivable, over all expenses, from the 2,000 gold and silver mines, sum up $325,000,000!"

Such is the enthusiastic statement of one of the advocates of the scheme, and, according to him, the bill ought to be called a way of paying the national debt, and extinguishing all taxes. It would solve at one blow the whole question of tariffs, income tax, and the like, and fill the coffers of ths Government with untold wealth.

NARROW GAGE RAILWAYS.

We are in receipt of a pamphlet on this subject forwarded to us by Paul, Brothers, of Akron, Ohio, containing general arguments in favor of a system of narrow gage railways which they style "*our system.*" Upon what grounds the gentlemen referred to claim the system as theirs does not appear. This matter has been discussed for years, and the question of gages is not a new one. We should suppose any one might exclusively claim a system of sawing boards twelve feet in length as consistently as Paul, Bros., can claim a narrow gage railway system. We find, however, in this pamphlet, a pretty fair statement of argument in favor of narrow gages; and though we have already expressed our own views upon the subject in brief, a review of this argument will not be out of place.

The pamphlet is opened by the statement of the generally unprofitable nature of railroad investments, and the fact that these investments are, for the most part, made with a view to obtain indirect advantages through the stimulation of business along the route, the development of resources, and enhancement of the value of real estate.

The question is then asked: "Is it not worth our while to inquire what the reason is, that we cannot as well build railroads with a view to direct returns upon capital invested as when we put our money into any other business?"

The attempts to economize through the use of cheaper iron and inferior construction and care have proved failures. The average number of trains run over the New York State railroads is only one half their capacity, and this average is mostly made only on the great trunk lines, the majority averaging far below this, a large portion being only able to secure traffic for from four to six trains per day. The point is now taken that it is folly to construct roads whose capacity for business is four times as great as the business done.

It is maintained that the only way to reduce the capacity of these roads down to their traffic is to narrow their gages. This would at the same time, it is claimed, reduce their cost in the following items, viz., the moving of masses of earth and rock; the curves, by shortening the radius; the right of way; the weight of iron; the cross ties, ballasting, bridging, culverts and masonry, engines, cars, and machinery; and commissions in raising the capital, by reducing the capital required.

These are the points made in the pamphlet, and we are

perfectly willing to concede them all, with the reservation that the reduction will, in our opinion, be much less than is estimated by the authors, whose figures we have not space to give.

The arguments are not new, and the most of the various items of reduction were spoken of by us in a recent article. We will not therefore go over them again at this time. Much may be said on both sides of the question, but there can be little doubt that narrower gages might be profitably adopted, on a very large proportion of American roads, at least until such time as the growth of business along their lines shall render increased carrying capacity necessary.

THE AMERICAN ECLIPSE EXPEDITION.

As is well known, an appropriation of about $30,000 was made by our Government, to be expended, under the direction of the Chief of the Coast Survey, in making observations in Europe upon the total eclipse of the sun, in December last. Some of the members of the expedition have returned to the United States, and we find, in the *American Gaslight Journal*, a preliminary account of the results obtained, from the pen of one of the most distinguished observers, Profeseor C. A. Young, of Dartmouth College. The observers were scattered over the continent, on the track of total obscuration, and it was well that this arrangement was made, as, in some localities, the weather was so unfavorable as to defeat the objects of the expedition.

Professor Winlock's party, of which Professor Young was a member, was placed at Jerez, some thirty miles north of Cadiz, and they were fully provided with the best instruments. They first determined accurately their geographical position, by the use of chronometers and a 46-in. transit. The photographic apparatus comprised two telescopes, equatorially mounted, with clock work, one of eight inches aperture and the other of six inches; a horizontal telescope of five inches aperture, and about thirty feet focus, with a plain unsilvered mirror of glass to reflect the sun's rays into the tube. Four spectroscopes of peculiar pattern were mounted in a way to produce the best effects, one of them with a battery of two prisms, another with a dispersive power equal to thirteen prisms. In order to fix the scale of reference, Geissler tubes, filled with hydrogen, mercury, magnesium, and sodium, were employed.

The experience acquired in the two recent total eclipses, was of great service in pointing out the precautions to be observed in this, and greatly facilitated the preparations requisite to be made.

The day and night previous to the eclipse was very fine, but early in the morning it clouded up, and even rained from time to time. The party made all their preparations, however, and before the first contact, at 10.25 A. M., there were many patches of partly clear sky, but there was always, even when clearest, considerable haze; not enough, however, to prevent photographs of the partial phases from being taken. At the moment of total obscuration a small rift in the clouds passed over the sun, and permitted the observer to see the sublime phenomenon in a satisfactory manner. Within five minutes after the end of the totality, the sky was wholly clouded, and the astronomers did not see the sun again till just at evening, after a heavy storm of wind and rain.

During the totality, one good photograph of the corona was obtained, with a six-inch glass and a one and a half minute exposure. A fine copy of this was exhibited at the last meeting of the Lyceum of Natural History, by Professor Morton, where it attracted great attention. No attempts were made to photograph the prominences, as they can be seen and studied at any time; but all efforts were concentrated on the corona. This peculiar phenomenon appeared more extensive than in 1869, but much less definite in its outline. The form of the corona was roughly quadrangular, nearly square. There was no prominence on the sun's limb which could compare with the "anvil" of 1869, but there were many small ones which were bright and active. By means of the spectroscope, two or three iron lines were observed, also two barium lines, and a magnesium line, and at the base of the chromosphere, a thin layer, in whose spectrum the dark lines of the ordinary solar spectrum are all reversed.

Professor Young is of opinion that the observations tend to confirm Kirchoff's theory of the constitution of the sun, and the origin of the dark lines in the ordinary solar spectrum. Such are the results obtained by the Spanish branch of the expedition, as contained in the preliminary report of Professor Young; but, doubtless, the official report of Professor Winlock will add somewhat to the information. It is to be hoped that some one will give us a digest of the results obtained by all the expeditions, in popular language, in order that the facts may be incorporated in our text-books, and be made common property. That a line was observed at C, another at 1474, another just grazing D, is all very well for the knowing ones, whose lines have been cast in pleasant places, but for our purposes we want these expressions to be translated into popular language.

PEAT FUEL FOR LOCOMOTIVES.

Now that the peat excitement has died out, and capitalists have had time to recover from the chagrin of poor investments, it is possible to take a rational view of the application of this fuel to the various purposes of trade and manufactures. If we could have believed the stories told by persons who had large bogs to sell, there is nothing in the earth that is capable of so many useful applications as peat. It was asserted that candles could be made from the paraffin contained in it, of a better quality than from any other source; the gas from the distillation of peat was richer than the product from the best cannel coal; the absence of phosphorus and sulphur made it the best fuel for metallurgical purposes; its heating power was considerably superior to coal; it left no clinker, ash, soot, or incrustation, on the grate or in the flues; and no such sparks were emitted from it as from wood. In fact, coal was a drug in the market, alongside of peat. This, of course, was an exaggerated statement of the case, and, in discounting it, many persons have gone to the other extreme of too greatly undervaluing a really important fuel.

The scientific experiments made upon peat, in Germany, have shown that, when properly prepared and compressed, it is admirably adapted for use in locomotives. We have seen it in constant use on the railroad from Berlin to Dresden, and on the roads through Bavaria, as well as in other parts of Europe. We procured specimens at the time, and still have them in our collection. The thorough manner in which the peat was cleaned and dried previous to being compressed, had much to do with its value as a fuel, while it did not increase its cost as much in Europe as it would in this country. There was no question in the minds of the engineers that the absence of sulphur, arsenic, and phosphorus was a decided advantage, as the flues and grate-bars were less liable to corrosion than with ordinary coal. The same observation was made in reference to the application of peat for metallurgical purposes. The metals obtained from it were found to be unusually pure. As a fuel in glass making and in chemical laboratories, the experiment proved to be quite successful. In cases where a uniform heat is required, it has been found that peat can be advantageously used.

We understand that in this country, also, peat has been successfully employed in locomotives; and where it can be obtained at reasonable cost, we have no doubt that it offers many advantages over other fuel. The disinfecting properties of ground peat are of the highest order; and in the earth-closet system it has particular value. This use of it in making compost heaps has long been known, but less attention has been bestowed upon it than it deserves.

It is well to bear in mind the really valuable properties of peat, and to encourage its industrial application.

THE LIFTING CURE.

The various ways by which men have sought to be healed of their diseases, are almost beyond enumeration. People seem to be more superstitious upon this subject than almost any other, and well they may be, for in nothing is there greater mystery than in the origin and nature of diseases. The therapeutic action of drugs is also surrounded with mystery, so much so that it may be said our knowledge (if it can be called knowledge) of the effects of drugs internally administered, is almost entirely empirical, and confined to their pathological effects. No certain clue to the chemical or other changes which take place in drugs, or in the system, previous to final effects, has been obtained in regard to the larger number of remedial agents comprised in the *materia medica*. In regard to many of them, the effects are a matter of hot dispute. Some will maintain that the administration of a particular drug in particular cases is attended with great benefit, while others will maintain it to be absolutely injurious.

When, therefore, anybody asserts that any remedy for disease has proved itself efficacious, and can point to a large number of those who, having been treated by it, assert that they have received great benefit through its use, surely this remedy has as good ground for popular favor as any pronounced officinal. The "proof of the pudding" has been, in both cases, "in the eating of it."

The new lifting cure has been tried by a great many persons afflicted with various chronic complaints, who are loud in its praise as a method of treatment for such complaints. It is our purpose in this article to briefly state the nature of this "cure," and the method of its application.

As its name implies, it is a lifting exercise, very light at first, if the patient be much debilitated, and very gradually increased with the improvement in health and strength of the patient. The *rationale* of the peculiar effect produced by this exercise, can scarcely be said to be known; but it is claimed by all we have seen and conversed with, having experimental knowledge of it, as compared with other modes of exercise, that its effects are singularly marked, and entirely different from those of any other kind of muscular effort. Those in charge of various establishments we have visited claim that the effort seems to arise through the invigoration of the spinal cord—the grand trunk line, so to speak, of nervous communication from the brain to all parts of the human system.

The great point seems to be to secure longitudinal pressure upon the spinal column without shock. The apparatus employed is therefore so constructed as to prevent the weight being lifted all at once, the full exertion being only applied at the end of the lift, and the power exerted being gradually increased from the first beginning of the effort, till the weight is raised, when the effort is sustained uniformly for a few seconds, in holding the weight suspended, and then gradually diminished to the end. The patient then rests for a short time, alternately lifting and resting until the exercise is completed. Thus, neither shock nor sudden strain is possible, no matter how great the exertion may be.

Records shown us at the various establishments visited, exhibit an astonishing increase of power on the part of debilitated patients. It would seem from these records that an extraordinary increase of nervous energy and muscular force is imparted through some mysterious effect on the nerve centers. The immediate effect of the exercise upon excessively nervous persons is sedative; a feeling of calmness and quiet pervades the system, and a good sleep may be nearly always obtained by lifting before going to bed.

The machines used are for the most part Butler's, Reilly's, and Mann's. In Butler's machine, the patient stands upon an elevated platform—the platform resting on elliptic springs—and lifts the weight by a rod attached to a cross piece held between the legs. Every joint of the machine, and even the weights, have springs of rubber or metal placed between the solid parts—even the legs of the frame standing on springs, so that in lifting, all these springs have to be compressed by the amount of weight lifted before the weight is elevated.

The Reilly machine is, we believe, a "side lifter," that is, the weight is lifted by two connecting rods, one on each side of the exerciser. The principle of elasticity is also carried out in this machine.

The Mann machine is called a "reactionary lifter." The final weight to be raised is that of the body of the exerciser, the effort necessary to accomplish this result being graduated by an ingenious system of levers with adjustable fulcrums, the elastic principle also being observed.

We are not prepared to pronounce upon the relative merits of these machines. The reactionary lifter invented by Mr. Mann is much cheaper and more compact than the others, and we cannot see any reason why the effects of its use should vary in any important particular from those of the more expensive machines.

ALASKA.---CLIMATE AND PRODUCTS.

The question as to the advisability of the purchase of Alaska was much discussed at the time of the sale, and has been ably defended by its promoter, the Hon. W. H. Seward. With the policy of the statesman we have nothing to do; but our readers will be interested in knowing some facts as to our late acquisition, which is now one extremity of the scale of our varied climate. The weather in the interior is several degrees colder on the average than that of the coast, of which latter the mean temperature is about 40° Fahr. Very high winds, heavy and long continuing rains, and dense, damp fogs, are the chief characteristics of the seaboard, while at Sitka, the capital, the inhabitants have only been able to count thirty-five days, during the past year, on which they have not had rain or snow. The latter falls in enormous quantities, and Dr. W. T. Wythe reports that he has seen the ground, thirteen inches below the surface, frozen hard at midsummer.

With such hyperborean weather, it is to be expected that the general health suffers extremely. Lung diseases are the scourge of the country, bronchitis is endemic, and variations in the atmosphere are made known to the people by the fluctuating condition of the catarrh. Influenza and pneumonia are, of course, common; the latter occasionally turning to the typhoidal diseases. The Alaskan rheumatism is powerful against all the usual remedies, and tuberculous diseases and phthisis have their own way. The *lues venerea* is common, and is exterminating the natives of one region of the country. All these diseases are doubtless encouraged by bad and insufficient food, and scarcity of vegetables, fresh meat, and antiscorbutics.

These peculiarities of the locality are not likely to attract the labor and capital of the emigrant, nor is it to the interest of Alaska that the country should be densely populated. Its only value is as a hunting ground, and the subsistence afforded by this means, cannot be enough for a large population of Americans and Europeans, accustomed to the comforts and refinements of civilized life. The chief part of the furs procured in Alaska is sent to England, a small fraction only being sold in San Francisco, and the price in Europe being much higher than in California. In December last, a parcel of 60,000 seal skins sold in London for $300,000. The furs brought to San Francisco from Alaska last year valued over $2,000,000. This figure may be taken as the total value of the Alaskan exports, as it represents all the shipment, for consumption in this country and Europe, of the sole product of the territory.

THE SUTRO TUNNEL.—A bill is before Congress to aid the construction of the Sutro tunnel, with the proceeds of the sale of the mineral lands. It provides that all moneys received by the United States from the sale of mineral lands must be used in fostering the mining interest, and be known as "the Mineral Land Fund." As soon as the Sutro Tunnel Company shall have completed 500 feet of its tunnel, it is to receive $50,000, and for every additional 500 feet, a like sum. As there are a large number of Chinese miners in California, who might be tempted to turn the direction of the tunnel downwards towards the Celestial empire, in consideration of the $50,000 per 500 feet, the aggregate amount to be advanced under this act is limited to $3,000,000. The President of the United States is to appoint three commissioners to look after the interests of the Government, and hold the property as a first mortgage.

CARE OF TEETH.—Put a piece of quicklime the size of a walnut in a pint of distilled water. Clean the teeth frequently with this fluid, washing the mouth well with clean water afterwards. The application will preserve the teeth and keep off the toothache, and will harden the gums.—*A Correspondent of the English Mechanic.*

THE manufacture of reaping and mowing machines has attained such large proportions as to make it one of general interest. The annual production is now estimated at about 125,000 machines. Few facts more clearly demonstrate the immense wealth of the farmers of our country than that they expend each year about $20,000,000 in the purchase of implements of this one class.