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Contents:

(Illustrated articles are marked with an asterisk.)

SOMETHING ABOUT LUBRICATORS.

What is a lubricator? A common reply to this question would be "anything that has the power of reducing friction." But how these things act to reduce friction is a matter upon which we have no absolute knowledge, though there are some facts whereupon to base theories. While, as our readers are aware, we believe it to be the proper function of abstract theory to guide actual investigation and experience, and that the indulgence of the habit of theorizing on hypothetical premises generally proves unprofitable, it may not in this instance be amiss to base a theory upon a belief generally prevailing, though not demonstrated,, relating to the molecular structure of fluids.

The hypothesis is that the particles of liquids and fluids are spherical, and so smooth and hard as never to wear by attrition. This conception is about the only one the mind can make of bodies in which the particles are capable of moving with perfect freedom throughout the mass and among each other.

Viscosity of liquids is attributed to the cohesion of molesules, rather than to interlocking through irregularities in form. The latter will not satisfactorily account for all properties of viscous liquids. A quantity of ordinary fine lead shot approximates feebly the character of a similar quantity of liquid. The spheres of lead lack, it is true, the hardness and smoothness attributed to the molecules of fluids, but if we suppose fine shot to be obtained infinitely hard and smooth, such shot would flow almost like a liquid, and the physical properties of a mass of them would not vary greatly from those of some liquids.

These shot could be used as a lubricator, and the investigation of how they would act to reduce friction will give a clue to the probable way in which all lubricators act.

In the first place, being infinitely hard and smooth, the surfaces of the spheres cannot in the least interlock. They, therefore, slide over each other with the greatest facility. Placing a layer of these spheres between two plane material surfaces and moving one surface, we should see each of the shot rolling along under its burden, thus changing sliding friction to rolling friction, and notably reducing the power required to move the given surface. The sporules also flow into and thus rectify irregularities of the bearing surfaces. This is lubrication.

Placing the shot in the same way between an ordinary journal and its bearing, we should find difficulty in keeping them in place; but could they be retained, there would still be the same conversion of sliding into rolling friction. The tendency of the shot to gravitate to the lowest point in the bearing, would gradually force out all of them except a single line or row, which would then sustain the weight of the journal and would so far indent the metal as to cease rolling. The conversion of sliding friction into rolling friction and the lubrication would practically cease, and it would be necessary to supply more shot.

If now we could supply some bond of union between the shot, sufficiently strong to overcome in great measure their tendency to gravitate, and could also supply a bond of attraction between them and the journal, without detracting materially from their power to flow about among each other, the journal would carry them along in its revolution against the action of gravity, and so long as the shot would remain unchanged in character, the journal would remain lubricated. The attraction of cohesion and adhesion are just such bonds, and it is because oils possess these attractions in higher degree than water and some other liquids that the former are better adapted to lubrication than the latter. There is no better lubricator than water when it is convenient to keep it constantly supplied to bearing surfaces. As examples we may refer to Girard's *Palier Glissant*, illustrated and described on page 6, Vol. XXII, of this journal, and to the water bearing of Shaw's propeller pump, illustrated and described on page 118, current volume. In these applications of water to lubrication, the water is forced between the bearing surfaces by hydrostatic pressure.

We see then that, for general use, lubricators must possess a certain amount of cohesive and adhesive attraction. But they must also have the power to retain their cohesion and fluidity under the action of moderate heat, heavy pressure, and contact with metals and air. The oxygen of the air attacks many kinds of oils, rendering some acid and others resinous; and moreover some oils of mineral extraction are contaminated with acids, used in their rectification, which attack metallic surfaces, the oxides of the metals thus produced increasing friction mechanically. The oxides of metals have the power of saponifying vegetable and animal oils, and no doubt this combination often takes place when oils of this kind are used on rusty bearings.

The soaps formed by the union of the saponifiable parts of oils with metallic oxides are hard and insoluble, and are, therefore, much less perfect lubricators than the oils themselves. Some oils, more particularly those extracted from petroleum, are volatile, and evaporate as soon as journals become slightly heated. Oils possessing these defects are unfit for purposes of general lubrication.

Probably nothing else has ever been discovered that possesses in so high a degree all the properties desirable in a lubricator as good pure sperm oil. There have been, however, some close approximations to it in oils extracted from petroleum. Many of the latter are, however, very inferior. Some excellent lubricating oils are also obtained from various seeds. The olive and the castor bean furnish oils very good for lubrication. Olive oil is, however, too expensive for general application to this purpose.

But as no amount of theory can take the place of actual test in mechanical science, we are glad to notice in this connection some recent and important experiments made by Mr. A. H. Van Cleve, General Purchasing Agent for the Camden and Amboy Railroad, relative to the value of different lubricating oils. A full report of these experiments will be found in another column, and we call our readers' attention to it as being perhaps as important a contribution to our knowledge upon this subject as has yet been published.

Of late graphite has been prepared so pure, and has been reduced to so impalpable a powder as to enable it to enter as a competitor with oils for purposes of lubrication. It is probable that the action of this substance on bearings is not analagous to that of oil in the conversion of sliding into rolling friction, but that it acts beneficially because its coefficient of friction on metals and wood is so much smaller than that of metals on metals or metals on wood.

As yet its value as a lubricator is not generally admitted, although we have seen the strongest testimonials in favor of an article called plumbago grease, manufactured by a house in this city.

The "metalline," about which such incredible stories were told a year or two ago, and about which we hear nothing latterly, was prepared in part from graphite. It is possible that this substance (graphite) in a perfectly pure state, or mixed with other substances, may eventually take its place among standard lubricators in general use for machinery; but it has yet to earn its reputation.

TO SMOKE OR NOT TO SMOKE.

The use of tobacco is an evil, or it is not an evil. In the enormous and increasing consumption of this plant it has become a question of very great importance what effect upon the general standard of health is produced by it. The agitation of this subject has been increased during the last two years, and pamphlets, essays, and lectures have developed in full strength the arguments for and against tobacco using. As smoking is the most popular and most powerful method by which the stimulant effect of the plant is obtained, it is principally upon this habit that the battle is waged.

We have from time to time presented some of the arguments on both sides of the question, our object being to assist in arriving at truth in so important a matter; and though our confirmed taste for smoking and the natural desire to find it a harmless practice have led us to peruse, with peculiar care, all that has been said in its favor, we avow that neither reading nor experience has convinced us that the general use of tobacco is other than an unmitigated evil.

The *Dublin University Magazine* for September of the present year contains by far the most comprehensive review of the subject that has met our notice, and it is the purpose of this article to place some of the facts, stated in this paper and gleaned from the experience and observation of a very large number of eminent physiologists and pathologists, before the American public in a more prominent manner than they would otherwise appear.

Every page of this remarkable paper is so replete with references that from it might almost be compiled a bibliography of the history, uses, and abuses of "the weed."

The first thing that forces itself upon our attention is the enormous consumption of tobacco. The *Food Journal* states that as much money is spent upon tobacco in England as upon daily bread, yet England undoubtedly consumes less of this narcotic, in proportion to its population, than Germany or the United States. The consumption in England has very nearly doubled in twenty years. The annual consumption in Asia, Europe, America, and Australia, as computed by the eminent German statistician Ausland from the most reliable data obtainable, is not less than 970,000,000 pounds. This affords food for comment, but we will confine ourselves to facts and authorities.

M. Barral, who made the official report on specimens of tobacco exhibited at the Paris Exposition, in his surprise at the footings of his estimates of annual production, remarks: "The enormous figures which have passed before the reader's eye testify to the facility with which people fall into excessive expense for the gratification of a pleasure which has for its principal aim to kill time and to stupefy the mind."

The active principles of tobacco are nicotine, a concrete oil called tobacco camphor, and an empyreumatic oil. The two last are active poisons, but not so deadly as the first, which, according to Taylor, is one of the most virulent poisons known. One drop of it kills a rabbit in three minutes and a half. We need not quote other authorities on this point, as all agree with Taylor as to the character of these substances.

The disease called locomotorataxy, which is a general paralysis of the nerves, is a disease that was unknown forty years ago. Now it has become quite common. Martin ascribes its origin and prevalence to the use of tobacco.

Dr. Richardson, himself a smoker, says: "Smoking produces disturbances—(*a*) in the blood, causing undue fluidity, and change in the red corpuscles; (*b*) in the stomach, giving rise to debility, nausea, and, in extreme cases, sickness; (*c*) on the heart, producing debility of that organ and irregular action; (*d*) on the organs of sense, causing, in the extreme degree, dilatation of the pupils of the eye, confusion of vision, bright lines, luminous or cobweb specks, and long retention of images on the retina; with other and analogous symptoms affecting the ear, namely, inability clearly to define sounds, and the annoyance of a sharp, ringing sound, like a whistle or a bell; (*e*) on the brain, suspending the waste of that organ, and oppressing it if it be duly nourished, but soothing it if it be exhausted; (*f*) on the nervous filaments and sympathetic or organic nerves, leading to deficient power in them, and to over secretion in those surfaces —glands—over which the nerves exert a controlling force; (*g*) on the mucous membrane of the mouth, causing enlargement and soreness of the tonsils—smoker's sore throat—redness, dryness, and occasional peeling off of the membrane, and either unnatural firmness and contraction, or sponginess of the gums; (*h*) on the bronchial surface of the lungs when that is already irritable, sustaining the irritation and increasing the cough."

This authority, however, claims that the diseases caused by tobacco are functional, not organic or specific. This does not matter much, except as encouragement to those who desire to recover from ill health resulting from smoking.

M. Decaisne recognizes a functional disease of the heart (narcotism of the heart) as caused by tobacco, distinct symptoms of which were observed by him in twenty-seven out of thirty-eight, boys aged from nine to fifteen, who smoked more or less.

It is a fact well established that before adult age the use of tobacco produces more serious disturbance than later in life.

M. Beau notices eight cases of *angina pectoris* caused by the use of tobacco.

Professor Lizars records several cases of cancer of the tongue and lips caused by the use of the pipe. The writer has known one such instance, and never wishes to see another example of such terrible suffering resulting from a worse than useless habit.

Dr. Taylor says those who suffer from functional disorders are ready "to attribute the derangement to any other cause than the real one."

Experiments made by Dr. Druhan seem to indicate that tobacco poison in an overdose may produce effects which render even small doses dangerous ever after.

Dr. Corson corroborates the opinion of M. Beau as to *angina pectoris*.

But we will make no further citations. If tobacco has any applications useful to mankind, we are satisfied that smoking, chewing, and snuffing are not of them. We may use tobacco to kill the insects which infest our rosebushes and conservatories; but, if we will continue to poison ourselves with it, let us make no pretences about it. We do it to gratify a depraved appetite from which we are irresolute to break loose. Let us neither believe nor pretend to believe that it is a blessing. If tobacco poisons our bodies, let it not also corrupt our morals and make hypocrites of us.

THE CONDITION OF MECHANICS AND LABORERS IN ENGLAND.

The condition of the working classes in England has become so low and degraded that the attention of thoughtful men of all shades of opinion is attracted to it; and it is a serious question to know what remedy to apply to save a vast population from sinking to a depth of corruption and misery unparalleled in the history of modern civilization.

A plan has been proposed by Mr. Scott Russell, the architect of the Crystal Palace, the Great Eastern and other large works, to form two Committees, "a Council of skilled workmen," and "a Council of legislators," to whom shall be referred the discussion of the whole question and the suggestion of proper remedies.

Mr. Russell says: "While there is no finer breed of working men in the world than the British skilled workman, there

is no civilized country in which his interests are so little cared for, and in which the institutions, laws, and customs are so unfavorable to his material well being and to his moral development." This is pretty strong language, but it appears to be confirmed by the observations of other reformers. As the result of careful inquiry among workmen, and extensive visitation of manufactories and dwellings, both in England and on the Continent, the chief evils to be remedied were classified under the following seven heads:

1. The want of family homes, clean, wholesome. and decent, out in pure air and sunshine.

2. The want of an organized supply of wholesome, nutritious, cheap food.

3. The want of leisure for the duties and recreations of family life, for instruction, and for social duties.

4, The want of organized local government, to secure the well being of the inhabitants of villages, towns, counties and cities.

5. The want of systematic, organized teaching, to every skilled workman, of the scientific principles and most improved practice of his trade.

6. The want of public parks, buildings, and institutions for innocent, instructive and improved recreation.

7. The want of adequate organization of the public service for the common good.

While the English legislators and Council of skilled workmen are discussing the seven points raised by the above classification, it may be well for us to consider how far we are better off than our neighbors across the water. We recently took up the first topic—the want of family homes out in pure air and sunshine—and tried to show that it was the duty of capitalists to see that the homes of mechanics were in the open air and made as comfortable as possible.

Such a result can only be attained in New York by a system of rapid transit, for it is in vain to look for decent dwellings and wholesome air in the crowded tenements of the city. The question of cheap food is of hardly less importance, and as it is possible by organized effort to feed a vast army with nutritious meat biscuit, good bread, and fresh provisions, we have the best of information that an organized supply of wholesome food is profitable for our working men. If half the effort were to be made, to form our workmen into associations for the purchase of provisions, that there is to inveigle them into time-consuming, wasteful and extravagant political clubs, a vast amount of good could be accomplished; and if the late Commissioners of Public Parks had used the organization of their office for the protection of the men under their employ, instead of setting them an example of prodigality by spending nearly five million dollars in a little more than a year in doubtful experiments, they would have earned the thanks of the whole community. Our mechanics have so long felt the want of leisure for recreation and amusement that, when they do have a holiday, they hardly know what use to make of it. They are as graceful in their efforts at fun as an elephant would be in a china shop. They have had no experience at amusement, and do not know where the fun comes in. It is not their fault, but the misfortune of the circumstances in which they have lived; and it is high time that workmen were secured proper time for the recreations of family life, and for social duties. Our German citizens possess the secret of obtaining their share of amusement in the most economical and innocent manner.

It was partly in consequence of a knowledge of this fact that Prince Albert joined so heartily with Mr. Scott Russell in all of his efforts to alleviate the condition of the English poor. Prince Albert had witnessed the merry gatherings of mechanics and humble tradespeople on the Continent, and the sombre and sad fate of the English workmen could not fail to attract his notice by the contrast it afforded. We inherit too much of the English trait in this matter, and can afford to take more kindly to amusements of a proper character than we are now accustomed to do. The want of systematic teaching to every skilled workman is a topic which has been fully discussed in our columns. The loss to manufacturers, in teaching their workmen by experience, is one of the heaviest discounts to be made from the profits of any enterprise in the country. No way of acquiring knowledge is so costly as this. We have heard a large manufacturer say that it had cost him five hundred thousand dollars to teach his workmen how to conduct his business, a greater part of which sum could have been saved if the men had had an opportunity to acquire a knowledge of the scientific principles upon which the business was based. And this knowledge could easily have been taught them in our public schools.

The English are very right in demanding systematic, organized teaching to workmen of the principles involved in the practice of their trades. And a good form of protection for us would be to meet skilled labor by something better, and to do this we must look well to our schools.

The want of a suitable public park is not so much felt in New York. Our Central Park is visited by many thousand persons, and is of incalculable value to all classes of citizens, the rich as well as the poor; but "buildings and institutions for innocent, instructive and improving recreation" are quite as much a want and a necessity with us as in England. The present appears to be the time of great awakening for the aid and improvement of laboring men of all classes.

For those who work with their brains, life assurance societies have been organized,—for the toilers with hands, we trust that cheerful homes, wholesome food, suitable leisure, and systematic teaching will grow out of the agitation of the question, in this country and Europe.

THE lowest education that teaches self control is better than the highest that neglects it

PROTECTION TO AMERICAN INDUSTRY.

The city of New York and the country at large owe a debt of gratitude to Mr. Peter Cooper, which entitles the opinions of that gentleman, upon any public question, to the most respectful attention. A pamphlet from his pen upon the subject of "Protection to American Industry" has reached our table, and is, we understand, being widely circulated.

While we concede to Mr. Cooper a high place among philanthropists, we cannot accord him equal rank as a political economist; and though we are in favor of "protection" as we understand it, we find, in this pamphlet, neither any new argument, nor any old one so repeated as to add to its force. In fact, the chief weight and importance possessed by the essay lies in the influence of the name of its author.

The principal part of the document is occupied with an arraignment of the English government for its crimes against colonial commerce. The present embarrassment of commerce and trade are attributed to the inflation of paper money. The nations are considered as engaged in what Mr. Cooper styles "a commercial war," in which, if we would conquer, we must adopt "a policy that will maintain the National Government and pay the nation's debt out of duties on imports. The heaviest duties should be laid on all articles of luxury, and the lightest duties on all articles that will aid in securing a diversified employment to our people."

This is, we think, a fair synopsis of the essay, which is, as we have intimated, mainly a historical *resumé* of the acts of commercial greed committed by the English nation, and which greed, upon the maxim that "all is fair in war," we understand Mr. Cooper to counsel us to imitate, at least so far as will maintain and vindicate "the political and financial power" of our nation.

It will be seen that Mr. Cooper makes the great mistake of most old school business men, namely, that paper currency is the origiu of our commercial depression. We think it can be proved (though we shall not attempt the proof in this article) that a self regulating paper currency is the best for all commercial purposes. The trouble has been that instead of thus being self regulating—that is, convertible into interest bearing bonds at will of the holder, and *vice versâ*—the supply has been increased or diminished, fitfully, in the interests of speculation; at one time being abundant, at another scarce. The demands of trade are not met by such a currency.

The taxation of imports to the highest extent, within the limits of absolute prohibition, is what is meant by protection, with the tariff advocates of Mr. Cooper's school.

It would be well for all who so fluently propose remedies for commercial disease by tariff tinkering, to reflect that all taxation must, of necessity, be laid upon waste or consumption. Production cannot be taxed, because it can shift any burden of taxation to the shoulders of consumers. A single instance will suffice to illustrate. The present internal revenue tax on matches is added by the manufacturer to the cost of the article, and a profit on the whole is exacted from consumers, so that the manufacture is really improved by the impost. If the burden should be so great that the manufacturer could no longer sell, his stock on hand will begin to deteriorate. On this waste he will pay the tax.

This law of political economy is fundamental. It depends upon the very nature of the relation between buyer and seller. No attempt to change it can ever succeed. To equalize taxation among individuals, therefore, implies the equalization of waste, or consumption. Those who waste or consume most will be taxed most by any imposition levied upon the necessaries or luxuries of life. This being admitted, it is evident that it matters nothing whether imported articles be taxed, or whether domestic products support all the burden so far as expense of living is concerned. So long as the burden must be borne we may carry it as well on one shoulder as the other, notwithstanding the outcry that protection implies increased cost of the necessaries of life. But it matters very much indeed which is taxed, when one has to compete in the market with the other. In each case the consumer will pay the tax, but if importations are checked, he consumes home made goods, and thus encourages home production.

The encouragement of home production means the absence of the competition of labor living on one plane, with labor living on a lower plane of civilization, to which free trade would inevitably force down the laboring classes of this country. As "commercial war" exists, the operation of free trade would be simply to drive the manufacturing population into agriculture, at wages approximating those of the English farm laborer.

The mistake that production can be taxed leads to other fallacies, which we will not discuss in this article. The pamphlet of Mr. Cooper serves a certain purpose in the furtherance of the cause of protection, but its inherent weakness. will, we fear, furnish the opponents of the doctrine with a mark for the shafts of satire which will greatly neutralize its effect, even with those who follow the prestige of a name rather than convictions derived from sound premises and correct logic.

SCIENTIFIC INTELLIGENCE.

OLIVE OIL AS A PURIFIER OF CARBONIC ACID.

In the manufacture of carbonic acid for mineral waters and soda fountains, in consequence of impurities in the limestone employed for the evolution of the gas, certain disagreeable empyreumatic oils and offensively tasting gases are apt to go over; and, unless separated in some way, they will impart an unpleasant flavor to the mineral water. To obviate this difficulty, E. Pfeiffer suggests saturating pumice stone with olive oil, and passing the gases through it in the usual way. The oil absorbs the bad gases, and can be regenerated for subsequent use by heating it to expel the absorbed impurities. After becoming quite impure, it is still suitable for the manufacture of blacking or for application as a lubricator. It is said that Mallett employs this method to absorb the hydrocarbon products in his process of obtaining ammonia directly from coal tar. As much of our limestone contains organic matter, which gives a peculiar smell to carbonic acid made from it, this method of purifying the gas by passing it through olive oil is worthy of trial.

PRACTICAL USE OF THE CARBONIC ACID RESULTING FROM FERMENTATION.

The same ingenious inventor has devised a plan for economizing the waste carbonic acid resulting from the fermentation of wort, the manufacture of vinegar, from champagne vats, and the like. The fermenting vessels are covered, and, by means of exhausters, the air is drawn off and is found to contain from twenty to twenty-five per cent carbonic acid. This can serve for the manufacture of bicarbonates, and, if the gas were to be condensed, could be converted into a motive power, employed in the manufacture of soda water, or used for artificial refrigeration. At any rate, there would appear to be no reasonable excuse for wasting so much carbonic acid. If somebody would only devise a practicable plan by which the enormous amount of carbonic acid, produced by gas burners or exhaled from the lungs of large audiences in our churches, theatres, and public halls, could be drawn off, got out of the way, and devoted to some purpose more useful than suffocating and poisoning multitudes of people, he would confer a great boou on mankind, and would be cordially welcome to any remuneration he could make out of it. In other words, why cannot somebody devise a system of ventilation that will be accepted at once as feasible, and thus put a stop to complaints on this subject?

ACTION OF SULPHUROUS ACID ON PHOSPHATES.

B. W. Gerland has been making some important experiments on the action of aqueous sulphurous acid upon phosphates, which have developed some points of great practical importance, especially in their bearing on the manufacture of artificial composts and soluble phosphates. He finds that aqueous sulphurous acid does not, like the strong acids, wholly decompose the phosphates, but transforms them into soluble modifications. The ordinary bone phosphate, called tribasic, is easily soluble in sulphurous acid, and if the solution be hastily boiled and evaporated in open vessels, a crystalline double salt, a mixture of tribasic phosphate with a sulphite of lime, will separate. This new and remarkable body is said to be quite permanent, and, in reference to its use as a disinfectant and upon farm land, is certainly deserving of especial notice. If we can, by means of sulphurous acid, decompose the phosphates, we shall avoid the expense of sulphuric acid, which must first be made from sulphurous acid, and obtain a product not so difficult to handle, and capable of a greater variety of uses than the superphosphate made in the old way. The author has studied the behavior of sulphurous acid towards other phosphates, but, as the results are purely theoretical, we omit them.

PURE OXYGEN FOR INHALATION.

Eliot recommends for the preparation of oxygen gas, to be used in medicine, the employment of a mixture of equal parts of peroxide of barium and peroxide of lead. By pouring dilute nitric acid upon these salts, there is a violent effervescence and a copious evolution of pure oxygen gas. For greater security, the gas may be afterwards washed in water. As very little heat is necessary, the operation can be performed in any stout bottle, thus dispensing with the usual retorts.

A MEASURE FOR THE INTENSITY OF LIGHT.

Dr. Vogel proposes *nitroprussidiron* as a suitable salt for determining quantitatively the intensity of light. For the preparation of this reagent, dissolve chemically pure oxide of iron, best obtained from the oxalate, in hydrochloric acid, and evaporate nearly to dryness to expel the excess of acid; and after filtering, add an aqueous solution of nitroprussidnatrium in the proportion of three of the iron to two of the latter. There is usually a slight precipitate produced by this mixture, which can be collected on a filter; but this operation must be performed in a dark room. We have now a liquid excessively sensitive to the action of sunlight. By exposing a small quantity of a known specific gravity to the action of light, a precipitate of Prussian blue will instantly begin to fall; and, on redetermining the specific gravity in the dark chamber, its decrease will be found to be proportional to the precipitate; and we have thus the data for measuring the intensity of light. It was found by Dr. Vogel that that the liquid, exposed for forty-eight hours before a kerosene lamp, was not in the least affected, but a piece of magnesium wire, when burned, immediately produced a precipitate. By employing a long instrument graduated in millimeters, it would appear to be possible to measure the intensity of the light by the number of millimeters occupied by the precipitate. The invention has an important bearing upon photography.

OZONE ETHER.

A correspondent asks if there is any way by which ozone can be preserved dissolved in a liquid. Such a preparation is recommended by Dr. Richardson, which, however, is said by Böttger not to contain any ozone, but something equivalent to it, namely, binoxide of hydrogen. By agitating ether in a flask with binoxide of barium, adding gradually perfectly pure and very dilute hydrochloric acid, occasionally cooling and subsequently allowing the ether to settle, we obtain a liquid which has been recommended as a disinfecting, bleaching, and cleansing agent, and as a test for chromic acid, which it instantly turns indigo blue.