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DISGUST.

A remarkable and ingenious analysis of the sensation of disgust and the causes to which it is owing, has recently appeared in the *Revue des Deux Mondes*, over the signature of M. Charles Richet. We regret that our limited space precludes notice of the wealth of illustrative instances which the author brings forward to negative the old saying, and to reach a result which shows that, if "there is no accounting for taste," there is at least a very plausible accounting for *dis*taste. The reasoning, however, of which we have prepared the following summary, is well worth consideration:

There exists in nature, for man as well as for all other living beings, certain substances which are alimentary and others which are not. There exists also a special sense which warns us of the nutritive value of different substances. This sense depends upon the sense of taste. Milk, sugar, and meat are aliments, and taste testifies to the fact, inasmuch as it is agreeably excited by all three. Nor could the contrary be true. Nature could not have inspired us with repugnance for that which should and does constitute our nourishment. Moreover, and besides the sense of taste, by a very simple association of ideas, the senses of smell and sight are affected so that these aliments gratify us both by their odor and aspect.

Co-ordinate with taste exists a totally opposite sense, namely, disgust. This is a sort of pain which, if it is too prolonged or too intense, leads to nausea. But if taken in its restricted meaning, it is simply the perception of a disagreeable odor or flavor. Thus bitter and fetid substances produce disgust. If by an effort of the will we eat such bodies, then nausea supervenes. Similarily sight and feeling may also produce in us disagreeable sensations comparable to the foregoing, so that there may be recognized, first, gustative and olfactory disgust, and second, visual and tactile disgust, all of which produce similar effects.

It is certain that the exterior objects themselves are not inherently disgusting; but are so only in their relation to ourselves. For if our organs were otherwise constituted, we should experience other sensations. Fetidity, bitterness, or ugliness are not essential qualities of objects. Such attributes are a portion of our own perception. This is evident from the fact that certain objects disgust some animals, while the same are a source of pleasure to others. The odor of decomposition is insufferably disagreeable to human beings, yet it is delightful to flies, vultures, and carrion crows. Objects disgusting to one person are not necessarily so to another. Laplace ate spiders and enjoyed them. A king of France sickened at the odor of strawberries. Digger Indians eat grasshoppers. A recent Chinese traveler gives an instance of where the inhabitants, while devouring a meal of decayed fish, turned in violent disgust from roast duck. The toad is to many people repulsive. Yet it is not essentially hideous. "The female toad to the male toad," says Voltaire, "is an ideal of beauty." Nothing is ugly or fetid in nature; but things seem so only because they are in a certain relation with our organization.

Despite the mass of contradictory facts which envelope it, there appears to be an underlying law which connects this instinct of disgust to the instinct of self-preservation. How the first is to be acquired is to be explained only as a fact of heredity. The struggle for existence and natural selection have given to our ancestors an accumulation of instinctive sentiments, each appropriated to the protection of certain organs. Bitterness no more exists in strychnine than does pain in a knife or redhot iron. Yet strychnine seems to be bitter and the knife cut painful; and in these sensations nature provides us with a safeguard against the dangers of both. Similarly, reptiles dangerous to man inspire us with an extreme repulsion. Foul gases and purulent liquids, by affecting the three senses of taste, smell, and feeling, likewise by the disgust produced, warn us of their perils. But instinct is, nevertheless, blind. Quinine, for example, which it recognizes as bitter and distasteful, is often salutary and beneficial.

As a consequence of this hereditary acquisition of instinct, it follows that the substances not met with in nature cannot have any action on our senses if their constitution is totally different from those with which we or our ancestors are or have been familiar. Suppose, for example, that a plant should be discovered containing a dangerous but hitherto unknown alkaloid. As this might have some properties of, and hence the taste of, other alkaloids, such as quinine or strychnine, we should thus be warned; but if, on the contrary, it had all the chemical properties of sugar, then its savor would be sweet, and we could not tell whether it was or was not a healthy and useful aliment. The same is true of artificial bodies: the cyanides and prussic acid are found but in very minute quantities in nature, yet their taste is not disagreeable. Carbonic oxide, a most dangerous gas, is without odor, and is unrecognizable to the senses. It is not a natural product, inasmuch as it is due to incomplete combustion; hence, as it must be artificially made, the ancestors of our race never encountered it.

Besides this law of nocuity, there is another which may be termed that of inutility, as being at the foundation of disgust. Everything useless is revolting. The products of secretion, for example, are repulsive to sight and smell, when the organism rejects them as useless. Milk, on the other hand, is agreeable both in taste and odor.

Disgust, lastly, may be produced by mere recollection, without any actual sensual impression. When we speak of a toad, we think of a toad and the idea may be disgusting; but if, while speaking, we consider the toad from a special point of view, as, for example, its habits, its physiological nature, its use to the farmer, etc., then the sentiment of disgust vanishes. Similarly, in works of art, where the dominant idea may be one which naturally would cause disgust, yet the idea may be so combined with others that the feeling is not experienced, but, on the contrary, the general impression is agreeable.

To sum up, disgust is an instinctive sentiment of self-protection, variable with the species, and according to the alimentation, habits and education of individuals. It is the consequence of heredity, but it is an imperfect instinct, since it judges simply by form and appearance.

ANOMALIES IN THE TEMPERATURE OF THE BOILING POINT.

It has been observed that the mere contact with certain surfaces retards the boiling. For instance, in a metallic vessel water boils with perfect regularity, and at a temperature properly corresponding to the pressure to which it is exposed; the vapor bubbles which develop on all points of the walls of the vessel are very small and follow one another with perfect regularity. In vessels of glass and porcelain, to the contrary, the vapor bubbles develop only at few points, which are always the same. The bubbles are large, and do not follow one another with rapidity. The temperature of water boiling in glass vessels is also higher, often as much as 2° Fah., than the temperature of water boiling in metallic vessels under otherwise the same circumstances.

The boiling of sulphuric acid takes place in glass vessels only with intermittent impulses. The temperature rises above the regular boiling point, until at the bottom of the vessel a large vapor bubble is formed, the appearance of which is always accompanied by a lowering of the temperature. Such irregularities in the boiling are easily avoided by throwing platinum wire on the bottom of the vessel containing the liquid.

Water deprived of air, and enclosed in a glass tube from which the air has been exhausted, boils only at a very high temperature. A water hammer, which is arranged as described, may sometimes be heated to 275° or 300° Fah. without the water boiling; when, however, the boiling commences it is so sudden and explosive that the glass tube bursts in fragments.

Dufour found that a liquid may be heated far above its normal boiling point without actually boiling when it is surrounded with another liquid of higher boiling point, in which it will not dissolve. If water is gradually poured, drop by drop, on linseed oil heated to 220° to 230° Fah., the drops fall slowly through the oil without showing the formation of any vapor, while this only takes place when they come in contact with the bottom of the vessel, when they boil away violently, and steam passes rapidly upward through the oil. By mixing some fatty oil with a liquid may be obtained, which, when hot, has the same specific gravity as water, and in which globules of water, of various diameters varying from $\frac{1}{25}$ to $\frac{1}{4}$ of an inch, will remain suspended without rising or falling. By careful heating the temperature can be raised to 250° and even to 340° before the water commences to boil. When, however, a drop of water so heated comes in contact with the side of the vessel, or with a solid body, such as a wooden or glass rod, it boils at once away with great violence, almost explosive.

That this property is not confined to water but to other liquids has been proved by various trials. So, for instance, when chloroform, which, when heated by itself, boils at 142°, is poured in a solution of chloride of zinc, brought to the same specific gravity by proper dilution, the chloroform globules will remain suspended and the solution of chloride of zinc may be heated to 200° or 212°, before the chloroform will boil; but also here the contact of any solid body will cause it to flash into vapor.

All these phenomena are explained by the fact that liquids adhere very strongly to certain solids, and more to glass than to metal. But that liquids adhere still more to other liquids, even when they do not intermingle (such as water to oil or chloroform), is proved by the last mentioned interesting experiments of Dufour, in which the water globules suspended in a mixture of two oils of the same specific gravity, also demonstrate the mutual adhesion of the water particles, in the same way that in the experiment of Plateau the suspension of oil globules in a mixture of water and alcohol, of the same specific gravity, demonstrates the mutual adhesion of the oil particles. But the experiment of Dufour is the most remarkable, demonstrating as it does how the effect of heat in separating the liquid particles and changing them into vapor needs the contact of solid bodies to be effective, and may be counteracted to a certain degree by withdrawing the liquid from the contact of any solid body, by supporting it floating in another liquid.

SUN SPOTS AND FAMINE.

It has been surmised that some relation exists between sun spots and prevalent weather on the earth, and the theory has been proposed that periodic variations in climate bear some relation in recurrence to the cyclical periods when the sun spots are most or least numerous. Dr. Hunter, Official Director-General of Statistics, has recently directed the attention of the government of India to this alleged connection between the periods of maxima and minima sun spots and the amount of rainfall at corresponding times in the Madras Presidency, where a great famine is now impending. General Strachey, however, in a recent communication read before the Royal Society, after a careful examination of the recorded rainfalls in Madras, Calcutta, and Bombay for the past 64 years, comes to the conclusion that no real connection has been established between rainfall and sun spots, and shows that, even if such were apparently the case as regards Madras, the same would be true in Calcutta and Bombay, whereas the rain tables of those localities show no such coincidence.

THE AGRICULTURAL VALUE OF WORMS.

In 1837 Mr. Darwin, in a paper read before the British Geological Society, explained how the formation of vegetable mold which forms a covering several inches in depth on the surface of productive land was directly due to the common earth worm. The soil, he stated, was simply the non-nutritious matter contained in the earth originally eaten by the worm and rejected by it, and the accumulated deposits of large numbers of worms produced the extensive layers commonly found. Quite recently Herr Von Hensen has investigated further into this subject and has confirmed Darwin's conclusions while supplementing with many of his own. An abstract of his investigations appears in the XIXth Century.

He states that the adult worms come to surface at night and, with their tails in their burrows, collect the twigs, leaves, etc., which serve as their food. This material is heaped around the orifice of the burrow and is drawn in piece by piece, the leaves in time becoming macerated and decomposed, and thus rendered suitable for the worms eating. The investigations were conducted in a garden having a layer of mold 9 inches deep and a subsoil of yellow diluvial sand. The worm tubes were not easily traced in the mold, but were perfectly clear in the sand, running vertically downwards to a depth of from 3 to 6 feet. On the walls of these burrows the black masses of excrement of the worms were plainly visible. Some tubes were entirely filled with this substance, the black color of which was diffused into the adjacent soil. In about half the inhabited tubes, plant roots had entered, following their course. By extended observations the author states that the roots of annuals can only penetrate into the subsoil through channels opened out to them by earth worms, and he observes that this penetration must be of service to the plant, as the subsoil retains moisture longer than the surface layer of the mold.

In order to ascertain the precise part taken by the worm in making this vegetable mold, two worms were placed in a glass vessel filled with sand, on the surface of which was spread a layer of fallen leaves. The worms set to work at once, and after about six weeks the surface of the sand was found to be covered with a layer of mold nearly half an inch deep, while many leaves had been carried to a depth of three inches. Worm tubes ran in all directions through the sand; some were quite fresh, others had a wall of mold an eighth of an inch thick, others again were completely filled with mold. In short the soil of the vessel was already perfectly well prepared for the growth of plants.

Herr von Hensen finds that, although the earth worm weighs only about 46 grains, it produces in four hours nearly 8 grains of excrementitious matter. On an average he finds about 34,000 worms to an acre of ground. Their combined weight is therefore over 220 pounds and they produce about 37 pounds of mold in 24 hours. Besides this, they produce a uniform distribution of the mold, open up passages in the subsoil for roots, and render the subsoil fertile.

THE INTERNATIONAL RIFLE CONTEST.

The most accurate marksmanship ever exhibited in a public competition was displayed by the American and British teams in their recent contest at Creedmoor. The figures made not only by the American team which won, but by the losing British team, have never before been equaled. On the first day the American score stood 1655, out of a possible 1800, and the British 1629; on the second day the totals were respectively 1679 and 1613, giving, for full scores, Americans 3334 and British 3242. The Americans beat their own winning score of last year, over the Scotch, Irish, Canadian, and Australian teams, by 208 points.

The ranges were as usual 800, 900, 1,000 yards, each rifleman having 15 shots over each range. As a bullseye counts as 5, the highest possible figure which can be made by each man is 450. The largest individual scores were made by Messrs. L. C. Bruce and C. E. Blydenburgh of the American team. Mr. Blydenburgh counted 429 out of the possible 450 on his six targets, and Mr. Bruce 425. The leading British total, made by Sir Henry Halford, ranks seventh as compared with the American list.

It is generally conceded that the American team owe their success not merely to superior skill but to better weapons and more perfect organization than were possessed by the English.

METEORIC HEAT.

In our abstract of the proceedings of the British Association at Plymouth, in last week's issue, we noted Sir William Thompson's rather untenable idea of the possibility of the importation of life from other planets to our earth by means of a meteorite. The supposition was that as some germs are known to be able to withstand a comparatively high degree of temperature, and as in fact the exact degree fatal to all forms of life is not definitely known, therefore it was possible that some germs might stow themselves away in a deep crevice of the meteorite, and so be transported to earth none the worse for the heat to which they might be subjected during the voyage.

The velocity of meteorites has been found to be between 51,200 and 512,000 feet, or say, on an average, 30 miles per second. Assuming this last mean, M. Govi, in a recent communication to the French Academy of Sciences, has shown that a meteorite striking our atmosphere at a distance of about 95 miles from the earth, where the pressure about equals ·04 inch of mercury, would lose, through the resistance of this highly rarefied air, half its velocity, which would be reduced to about 89,600 feet, or say 15 miles per second. If the meteorite continued into the atmosphere until it reached a point where the pressure was ·4 inch of mercury, its velocity would then be reduced to 18,931 feet, or between 3 and 4 miles, and finally, if it succeeded in attaining a region where a pressure corresponding to 4 inches of mercury prevailed, its velocity would be only 1,619 feet per second.

The consequence of this loss of motion is development of heat proportional to the mass multiplied by the square of the velocity. Now M. Govi has calculated that, even at that extreme height where the barometric pressure is equivalent to but ·04 inch of mercury, the heat developed by the loss of motion of the average meteorite amounts to three million calories, equivalent to that required to raise 6,600,000 lbs. of water 1·8° Fah. As the heat developed increases as the meteorite enters further into our atmosphere, it is somewhat improbable that any such body ever reaches our earth until it has been subjected to a temperature much more than sufficient to destroy any form of organism.

INFLUENCE OF LIGHT ON THE ELECTRIC CONDITION OF METALS IN SALINE SOLUTIONS.

Metal plates were placed by Herr Hankel, one in a porous battery cup (closed by a cork) the other in a transparent exterior vessel. The vases were filled with solution and en closed in a blackened box in which was an aperture which could be closed at will, or before which colored screens could be placed.

With two plates of polished copper, plunged in water, the plate on which the sunlight fell was negative. The action of colored rays reached its maximum in the blue. When the copper became more or less strongly oxidized or covered with salts, the plate, at first positive, then became negative and kept its sign when the light was altogether suppressed. The action is ascribed principally to the feebly refrangible rays, while the dark blue or violet rays render the plate negative. Polished copper in sulphate of copper became first negative and then strongly positive.

Other metals gave the following result: Clean plate of polished silver, in water, negative; lightly silvered platinum, positive; silver covered with platinum, strongly positive; tin, negative; brass acted like oxidized copper; amalgamated zinc, in solution of $ZnO.So_3$, strongly negative; ordinary zinc, nearly neutral (hence the action of the battery is due to the oxidized copper); and platinum, weakly positive.

The author has also studied the action of heat on the zinc-copper-water element, of which he states the electric motive force becomes augmented, while it is enfeebled by light.

The New Metals Neptunium and Davyum.

Herr H. Herrman, who for many years has been investigating the metals of the tantalum group, announced not long ago his probable discovery of a new metal, which he believes to be a fourth member of the above named group, and to which he gives the name of neptunium. The mineral, in which evidence of the existence of the metal is said to have been found, came from Haddam, Conn., and was reputed to be tantalite, though on examination it proved to be a mixture of columbite and ferro-ilmenite. Only 40 grains of the hydrated acid of the new metal were obtained, not sufficient for its isolation. The atomic weights of the metals of the tantalum group, including this new discovery, are as follows: Tantalum 176, neptunium 118, niobium 114·2, and ilmenium 104·6. Their densities are: Tantalum 10·7, neptunium 6·5, niobium 6·5, and ilmenium 5·9. Ilmenium was supposed to be obtained by the same chemist from a Swedish mineral, which he called yttro-ilmenite several years ago; but its existence, in view of the subsequent researches by M. Marignac, is now considered doubtful, and hence it is generally omitted from the list of elements.

The second new metal, davyum, was discovered by M. Sergius Kern, of St. Petersburgh, Russia, who ascribes it to the platinum group. It was discovered in separating the metals rhodium and iridium from some platinum ores. It has been isolated in the form of a hard silvery metal, slightly ductile, extremely infusible, and having a density of 9·385 at 77° Fah. It is named after Sir Humphrey Davy, and the discoverer thinks it may occupy a place between molybdenum and ruthenium in the system of elements, arranged according to Mendeleeff's law of periodicity.

Influence of Wine Bottles on Wine.

It has recently been determined in France that wine may be injured through the glass of the bottles in which it is contained being too alkaline. According to analyses given in the *Revue Industrielle*, glass for wine bottles should yield per 100 parts: silex, 58·4; potash or soda, 11·7; lime, 18·6; clay and oxide of iron, 11; other ingredients, 0·3. Glass in bad bottles has been found to contain, silex, 52·4; potash or soda, 4·4; lime, 32·1; clay and iron, 11·1. It seems that the wine suffers principally from excess of lime. Thus, in glass composed of silex, 45, soda, 15, lime, 30, and clay, 15, for example, the wine became thick and lost its aroma. The best bottle glass contains from 18 to 20 parts lime and 59 to 60 silex; the worst, 50 to 52 silex and 25 to 30 lime.

Stationary Meteors.

To the Editor of the Scientific American:

A few minutes after ten o'clock on Friday evening, September 7, 1877, Mr. John Graham, of Bloomington, Ind., had his attention arrested by a sudden light in the heavens, and on looking up he saw a stationary meteor between *Aquila* and *Anser et Vulpecula*, about R.A. 295°, declination 15° N. It increased in brightness for a second or more, and disappeared within less than half a degree east of the point in which it was first seen. Immediately after the extinction of the first, three others, separated by intervals of three or four seconds, appeared and vanished in the same place, with the exception that one disappeared about as much west of the radiant as the first did to the east of it. Mr. Graham's curiosity was excited, and he continued to watch till, after an interval of a few minutes, a fifth meteor, corresponding in appearance to the preceding, was seen in the same place. The meteors were about equal to stars of the first magnitude. The facts indicate that a stream of meteoric matter was moving at the time almost exactly towards the observer. Two or three isolated instances of stationary meteors have been recorded; the phenomena of the 7th inst. are, however, quite extraordinary.

I have stated the observations as given me by Mr. Graham, who pointed out the position in which the meteors were seen. DANIEL KIRKWOOD.

Bloomington, Ind.

One Reason why the Moons of Mars were not Sooner Discovered.

Mr. George R. Cather, in recounting the reasons given by Professor Newcomb before the American Association for the Advancement of Science, at Nashville, why the satellites of Mars were not sooner discovered, makes the suggestion that these satellites are of recent origin, and says: "This may be groundless, yet it is but fair, if there could be such a probability, let its weight be ever so little or great in the solution of the question, it should be stated for what it is worth. But as a reason, it is of greater importance than at first glance may be imagined; for if it is admitted as a remotely probable reason, it suggests the profoundest problem of the age—that is, that the satellite systems of the planets have been supplied by the asteroidal belt of our planetary scheme—a theory I propounded several years ago, and which since has become a solid conviction of my mind, as careful investigation of our planetary structure has confirmed me in this opinion."

A Tree that Rains.

The Consul of the United States of Columbia in the Department of Lereto, Peru, has recently called the attention of President Prado to a remarkable tree which exists in the forests adjoining the village of Moyobamba. This tree, known to the natives as Tamai-Caspi (rain tree), is about 58 feet in height at full growth, and the diameter of its trunk is about 39 inches. It absorbs and condenses the moisture in the atmosphere with astonishing energy, and it is said that water constantly exudes from its trunk and falls like rain from its branches. So abundant is the water supply that the soil near by is turned into a marsh. The tree gives forth most water when the rivers are dry during the summer season, and when water generally is scarce. Its cultivation is proposed throughout the arid regions of Peru.

Bodily Recoil.

The curious fact has recently been pointed out by Mr. J. W. Gordon, in the *Journal of Anatomy and Physiology*, that at every beat of the heart, the whole body is projected a small but perfectly observable distance in a direction from foot to head—that is, so that any pressure exercised by the feet would undergo a diminution, while a pressure exercised by the head would be increased. When the heart contracts a quantity of blood is propelled down the aorta; while at the same time, the whole body is caused to recoil with a velocity which bears the same ratio to the velocity of the blood as the weight of blood driven out bears to the weight of the body.

When the Birds Wake Up.

A French ornithologist has lately been investigating the question of at what hour in summer the commonest small birds wake up and sing. He states that the greenfinch is the earliest riser, as it pipes as early as half-past one in the morning. At about half-past two the blackcap begins, and the quail apparently wakes up half an hour later. It is nearly four o'clock, and the sun is well above the horizon, before the first real songster appears in the person of the blackbird. He is heard half an hour before the thrush; and the chirp of the robin begins at about the same length of time before that of the wren. Finally, the house sparrow and the tomtit occupy the last place on the list. This investigation has altogether ruined the lark's reputation for early rising. That much celebrated bird is quite a sluggard, as it does not rise until long after the chaffinches, linnets, and a number of hedge-row birds have been up and about.

The American Association for the Advancement of Science.

The Nashville session of the above named body adjourned on September 4, to meet again on the third Wednesday in August, 1878, at St. Louis, Mo. Professor E. C. Marsh, of New Haven, was elected to preside at the next session. Full abstracts of the principal papers lately read will be found in current issues of the SCIENTIFIC AMERICAN SUPPLEMENT.