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Contents.

(Illustrated articles are marked with an asterisk.)

THE STRENGTH OF INSECTS.

It is said that he is a philosopher who can accept the inevitable without repining. There are times in our lives when the most unpleasant things are forced upon our attention, and we fail with our best efforts to rid ourselves of them. As warm weather advances, we need no argument to convince us that the insects which destroy our vegetation, offend us with their presence, and even without permission cause our own blood to course through their veins, are among the inevitables. To accept these without complaint or repining would surely give us undisputed title to the name of philosophers; and if we could find anything of pleasure instead of annoyance in our involuntary contemplation of them, we would be doubly worthy of the appellation. That they all serve some useful purpose, cannot be denied; and if we knew their whole history we should doubtless be fully convinced of this. Some of our greatest pests, as flies and mosquitoes, have already been shown quite clearly to be our friends rather than our enemies.

Besides their practical benefit, there is no little interest in noticing the great physical force which they exert. We call a man, a horse, a lion, or an elephant strong; but it is very easy to see that, proportionally, insects are the strongest animals that live. They manifest their strength in running, leaping, flying, and sometimes in other ways. Some insects have been known to run so rapidly that, if a man of ordinary size should make as good time, proportionally, he would run more than twenty miles per minute, or sixty times the ordinary rate of a railroad train. A locust with the aid of its wings will leap 200 times its own length; to equal which, a man would need to leap nearly a quarter of a mile. A flea, without wings, will leap the same relative distance; and it has been estimated that, if a horse should jump as far in proportion to its weight, it would scale the Rocky Mountains in a single leap. Most insects jump by means of their hind legs and the latter part of the hind body; but one family of beetles—the *elateridæ* or spring beetles—leap vertically when on their backs, by use of a spine on the hinder part of the thorax which fits into a cavity behind it, and which, when forcibly closed and acting like a spring, throws the beetle several inches into the air. While in the very act of writing this, one of this family pays me a visit, and shows its power by making several springs at least six inches in hight, which is about twelve times its own length. Some dragon flies are among the strongest on the wing. They can be seen flying about pools of water after smaller insects for hours at a time, turning, wheeling, going sideways, and in nearly every conceivable direction, and never seem to think of being tired. And, what is very remarkable, they have the power of changing at right angles the direction of their flight, and so suddenly that one can hardly ever be quick enough to hit or capture them. The *Entomological Magazine* speaks of one of these that flew on a vessel at sea when the nearest land was the coast of Africa, 500 miles away. A humble bee has been seen to follow a rail car going twenty miles per hour, against a strong wind, for a considerable distance; and it even went faster than the car, as it flew to and fro and in various zigzags around the vehicle. Some beetles have a flight swifter, considering their size, than any bird; and Linnæus mentions a butterfly that sometimes travels more than a hundred miles on the wing at one flight; he also says that an elephant having the force of a horn beetle would be able to move a mountain. All have doubtless seen a beetle move a candlestick or lamp in his efforts to escape from underneath it; and he has been compared to a prisoner in Newgate shaking the building with his back. Pliny said, long ago, that, if we compare the loads of ants with the size of their bodies, "it must be allowed that no other animal is endowed with such strength in proportion."

Some interesting and ingenious experiments for measuring the strength of insects have lately been made by a Belgian naturalist named Plateau. He first tested their power of raising weights while walking on a level surface. His novel method of doing this was to harness the insect by a horizontal thread running over an easily-moving pulley, at the other end of which was attached a scale pan for holding sand. To keep the insect in a straight direction, he fenced it in between two parallel strips of glass; and to keep it from slipping, he covered its track with coarse muslin. As the insect moved forward, it pulled the thread over the pulley and raised the pan, and the experimenter poured sand into it until the insect could move no longer. The insect and the sand it had raised were then weighed, and the relation between the weight of the two was obtained. He found that the insect could raise forty times its own weight; while by a similar method a man could raise only five sixths of his weight, and a horse only one half or two thirds of his. By repeating each experiment three times and employing a vast number of insects of various sizes, and comparing his results, he came to the conclusion that the smaller insects in the same group invariably raise the greater weight in proportion to their own weight.

He then tried their leaping power, by fastening the wings and elytra, and by suspending under the thorax (by a thread) bits of lead set in wax. He increased the weight till the insect could no longer raise it. Then, by his determinations as before, he found that, while the largest crickets could raise in this way only about one and a half times their own weight, the smaller ones could raise three or four times theirs.

To test the pushing power of insects, he placed some of them in a long cardboard tube blackened on the inside and admitting light only by a transparent glass at one end. To this glass was attached a lever which drew the scale pan over the pulley, as in the first experiment. The insect, in its endeavors to escape, pushed against the glass, moved the lever, and thus raised the weight. As results of these experiments, he found that, in inverse ratio to their weight, the pushing power varied from three or four to eighty or ninety times the insect's weight.

The power of flight possessed by insects was tested by fixing weights to the body in the same way as in leaping. He found that they employ much less force in flying than in other efforts of strength; perhaps this is because, unlike birds, they are not intended to carry weights through the air. Beetles raise in flight from one sixth to twice their weight; flies, three times their weight. A drone weighs four times as much as a bee, and drags less than fifteen times its weight, while the bee drags twenty-three or twenty-four times her weight. But in flying, the bee raises nearly her own weight, while the drone raises a weight equal to only half its own.

By these experiments, he found that his law applies equally well, whether the strength is exerted in walking, leaping, pushing, or flying. He finds that it also applies, in a measure, to the entire class of insects taken together, as well as to the same group of insects taken by themselves. There are some exceptions to this, however, which are probably due to differences of structure. By dividing all the insects into three groups—lightest, medium, and heaviest—he finds that the law holds good. Then the relative force is represented by the numbers 26, 19, and 9 respectively. The fact seems to be that the strength of an insect increases with the surface of a section, and not with the volume of its muscles. This would make the weight increase faster than the motive power, and be consistent with the law that the smallest are strongest. It takes but a moment's reflection to see the wisdom of this arrangement. Of course the hardness of the soil, the weight of the grains of sand, and all the resistance to be overcome are equally great to the small as to the large insects, and it needs greater relative strength to give the small ones a fair chance in the "struggle for existence" with their larger associates.

But these facts and conclusions give rise to other questions which are not so easily answered. Since insects are stronger than other animals, on what food do these small Cæsars feed that they are grown so strong? Is their physical organization formed on different mechanical principles? Have they power of creating or utilizing greater force from the food they eat? Their food, being animal and vegetable, does not seem to differ materially from the food of other animals; and they seem to use the same mechanical powers in their motions. They are, in the perfect state (in which state they manifest their great strength), as a rule, very small feeders, and some eat even nothing. As their strength must come from the food they eat, the question as to how so much can come from so little is as interesting as it is difficult. So far as we know, no attempt has ever been made to determine the laws of the relations between the amount of food consumed and the strength which it generates. The difficulties are perhaps not insurmountable; but one great disturbing element would probably appear in the fact that insects may store up force in their earlier stages which they use in the perfect state.

RAPID TRANSIT IN NEW YORK.

A commission, appointed by virtue of a recent law of the State legislature, is now holding sessions in this city to determine upon the best plans for city steam railways. Formerly it was considered that the underground method was by far the best for a narrow and crowded city like New York, as it occupies no portion of the street surface, is out of sight, occasions no disturbance by its operation, and furnishes the most abundant accommodations for speed and the largest traffic. In those days the proud New Yorker had determined to have the best and most substantial railway works that could be built. But that was prior to the Tweed and other robberies, before the debt of the city had been swelled to over a hundred millions of dollars. Cheaper structures, it is now supposed, will answer, and on this account the elevated plan has come to be looked upon with special favor.

At a recent sitting of the Commissioners, no less than thirty different plans for rapid transit were presented, all of which were for elevated tracks except one, the latter being for a canal railway between the buildings, with bridges or tunnels for the street crossings.

All of these elevated plans involve the placing of bridge structures of some sort, in several of the principal streets; and there appears to be a peculiar unanimity among the citizens on the subject. Nearly every person is in favor of such roads, but no one wants it to run in his street or in front of his store or dwelling. The Sixth avenue people think that an elevated railway is greatly needed, and will do their share toward its construction, provided it is erected on Seventh avenue. The Seventh avenue people are equally in favor of the bridge, but are ready to rise in arms if their magnificent thoroughfare is disfigured with it; they are clearly of opinion, however, that Eighth avenue is the proper place for it.

The road must also cross the town somewhere, and those who reside on 42d, a fine broad street, are in its favor, provided it is erected on their neighbors' premises, a quarter of a mile distant, say, on 37th street; and they are of opinion that the constant passing of cars and locomotives in front of the second story windows of their friends down there will improve their prospects and healths, which now suffer by reason of too much quietude and seclusion.

To satisfy the public will be an apparently difficult task for the new Commissioners; but we wish them success. They will doubtless find out, before their labors are finished, that the building and equipping a first class substantial railway for rapid transit, capacities being equal, is just as expensive on the elevated as on the underground plan.

In the neighboring city of Brooklyn, the projected elevated street railway is also accepted with pleasure by the people. "But when the route of the proposed road is mentioned there is," says the New York *Herald*, "at once a persistent and screeching dissent Property holders on Myrtle avenue come forward and scream against building the road on that avenue."

A CITY ONE HUNDRED AND EIGHTY THOUSAND YEARS OLD.

In the current number of the *Overland*, a Californian geologist reviews the geological evidence of the antiquity of a human settlement near the present town of Cherokee in that State, and estimates the age of that most ancient of discovered towns to be not less than 180,000 years!

The data for all such calculations are necessarily uncertain, as they are derived from the present motions of the continents and present rates of erosion: still, from the changes that have taken place since the pioneers of prehistoric California left their traces on its ancient sea shore, there can be no doubt that thousands of centuries must have come and gone.

The traces in question are numerous stone mortars, found in undisturbed white and yellow gravel of a subaqueous formation, not fluviatile, underlying the vast sheets of volcanic rock of which Table Mountain is a part. In one instance a mortar was found standing upright, with the pestle in it, apparently just as it had been left by its owner. In some cases the mortars have been found at the depth of forty feet from the surface of the gravel underlying Table Mountain. The distribution of the mortars is such as to indicate with great positiveness the former existence of a human settlement on that ancient beach when the water stood near the level at which they occur: a time anterior to the volcanic outpouring which Table Mountain records, and anterior to the glacial epoch.

The recent geological history of that region may be briefly summed as follows:

Previous to the placing of the mortars in the position in which they have been found, the early and middle tertiary sea level had receded to the position of the coal beds underlying Table Mountain, fully one thousand feet below the level of Cherokee. Subsequently, in the pliocene period, there was a further subsidence of about fifteen hundred feet, something like six hundred feet occurring after the mortars had been abandoned. All this, as has been noticed, took place before the volcanic outflows which covered up all the ancient *detritus* of the region, including that of the ancient rivers (whose gravels have furnished so much of the gold of California). The geological age of the river period was determined by Lesquereux from specimens of vegetation, now extinct, collected in the survey of the ancient rivers: specimens indicating a flora of the pliocene age, retaining some characteristic miocene forms

After the volcanic period, the land rose again, the time of emergence embracing the glacial period and the new eroding period in the sierra, during which the slates, and the hard metamorphic greenstones, and the granites were slashed with cañons three thousand feet deep by the action of ice and running water. Taking the rates of continental movement determined by Lyell, our geologist calculates that the time required for the changes thus outlined could not have been less than eighteen hundred centuries. For a period so long preceding the glacial epoch as the time when ancient Cherokee was buried by the waters of the advancing sea, his estimate is certainly not extravagant, though it does transcend so enormously the time men have been accustomed to allow for man's residence on earth.

APPARITIONS.

From time to time, as there was occasion, we have referred to the so-called revelations of modern spiritualism, to the discovery of gross imposture in connection with the same, and to the strange hallucinations, in regard to this subject, which have overtaken even men who have no mean pretentions to the name of scientists. We have just seen a *resumé* of the history and theories of supernatural appearances and influences, in the second volume of the new edition of the *Encyclopedia Britannica*, a work which is generally regarded as an unusually high authority. The article to which we refer traces the origin of and reasons for superstitious beliefs, considers the evidence for the reputed appearance of ghosts, and concludes with the principal arguments for and against the creed of the spiritualists. The writer of the article evidently considers the strength of the argument, in favor of spiritualism, to consist in the character of a few of its supporters, men like Mr. Wallace and Mr. Crookes in England, and Robert Dale Owen in this country. Reference is made to the experience of Mr. Crookes, who not only saw a spirit, but clasped it in his arms, and thus demonstrated its substantial existence; and the conclusion to the whole matter is that spiritualism, even if its principles are not fully proven, is still a fair subject for scientific investigation, with a reasonable presumption in its favor.

We have referred to this article in the *Encyclopedia Britannica* because an opinion, such as that cited above, in a publication of such high standing, is worthy of more than passing notice. No matter how wonderful the events that are related by the fanatics who generally make up the congregation of spiritualists, their revelations have little effect on any one outside the circle of their immediate followers; but let a man of some scientific attainments, and, moreover, a member of the Royal Society, add his testimony to the truth of these events, and we see that he may deceive even the very elect. It was generally understood, when the last edition of the *Encyclopedia Britannica* was announced, that it was to be scientific in the best sense of the term, and, while giving due weight to popular beliefs and superstitions, that it would endeavor to sift away the chaff with which many of them are enveloped, and reveal their real character. We are to understand, then, from the article under consideration, that such investigations as have been made by some of the more distinguished converts to spiritualism can properly be classed under the head of scientific experiments, which, while not perhaps absolutely conclusive, leave the matter *sub judice*. When we remember the character of the evidence on which all the modern miracles depends, the difficulty if not impossibility of making a thorough investigation with the facilities afforded at a *séance*, and the complete exposure of all the notorious cases of spiritual visions, our readers will probably venture to doubt whether the treatise on "Apparitions" in the *Encyclopedia Britannica* either gives a clear understanding of the actual facts connected with spiritualism, or represents in any sense the views of scientists generally in regard to the matter. No mention is made, for instance, of the exposure of the Katie King fraud in this country, while the vision of this airy being, produced in England under the auspices of the same mediums, is given as one of the strong arguments for allowing spiritualism to have a standing among scientific men. For our part, we can say that we have never heard of any event at a spiritualistic *séance* that at all approached the movements of the wonderful Psycho, in London, whose *rationale* escaped detection for months, with exhibitions in open day, and with apparently every facility for investigation that could be desired.

PROSPECTS OF SCIENCE ON THE PACIFIC SLOPE.

The conditions for the advancement of Science beyond the Rocky Mountains are peculiarly favorable. The country itself presents an exhaustless field of research in every department of the physical and vital history of the world. Its records of continental upheaval and subsidence, of ancient rivers and vanished seas, of vast volcanic outpourings and vaster scenes of erosion, are wonderfully full and legible. In the beds of its tertiary lakes are the remains of multitudes of the progenitors of recent forms of animal and vegetable life—inexhaustible mines of material for the solution of the great problems of evolution. On the shores of those lakes and rivers dwelt the most ancient races of men that geology has furnished glimpses of. Already abundant traces of them have been discovered in and beneath the later tertiary strata, and it is not unreasonable to hope that future observation may connect them with the post-glacial founders of the civilizations which grew up along the valley of the Colorado, before that strange river had sunk its channel a mile below the surface of the plain it once watered, probably before the Nile spread its first layer of fertile soil over the foundation sands of ancient Egypt. Chemical geology has already been immensely furthered by the knowledge gained through the mining operations of the interior and the investigations they have inspired; while the demands for men of scientific training, incident to a country so largely given to mining, have secured to the Pacific Slope a proportion of scientific observers unequaled in any other country.

In older communities, Science and scientific thinking have to contend with the conservatism of custom and the traditions of scholastic culture; in the far west, where scientific training has been at a premium from the first, where public prosperity rests so largely on scientific operations, Science is likely to get more than its fair share of encouragement, rather than less.

In proof of this, it is necessary only to contrast the financial condition of the California Academy of Sciences with that of our eastern societies of like character. It is true that something more than money is needed for productive investigation: the natural and social conditions must be favorable, and there must be no lack of men of proper zeal and training to undertake the work. In this respect, as already noted, the Pacific Slope is as greatly favored as in its abundance of wealth; and only the grossest mismanagement of their means and opportunities can prevent the richest harvest of scientific achievement by the Pacific scientists, whether independent or connected with the California Academy.

The magnificent scope and execution of Mr. Bancroft's research, in connection with the native races of the Pacific coast, afford at once an illustration of the western way of working, and a model of thorough scientific investigation. We shall be greatly disappointed if Mr. Bancroft's work does not prove to be the first of a long series of correspondingly valuable researches in other departments of knowledge, undertaken by the scientific workers of the west. Hitherto their work has of necessity been chiefly of a practical, money-making sort. It has given them the best possible training for the conduct of investigations of broader scope and remoter profit. The work lies ready at hand; and it is safe to predict its prosecution with true western vigor and thoroughness.

DANGERS OF CHLORAL DRINKING.

Blessed be the man that invented sleep, said the immortal Sancho Panza. When the primary physiological effect of chloral was first made known, thousands called down equal blessings on the man who discovered that simple and seemingly harmless sleep compeller. No matter what cares made life a burden, no matter what excitements or excesses made a stranger of "tired Nature's sweet restorer," here was a painless key to the soothing realm of Morpheus, with no apparent penalties to pay for the invasion. It is not surprising, therefore, that chloral soon came to be employed, without medical direction, to a greater extent than had ever been the case with any other sedative.

But experience has not justified the implicit confidence reposed in it. Its apparent harmlessness only made the insidious effects of its daily use the more dangerous. Though it might not kill directly, it too frequently enabled death to take place from causes that would not have been immediately fatal without the sedative influence of the drug on processes needful for life; and not infrequently the machinery of life came to a stand under its influence when no other disturbing cause could be detected: more frequently, perhaps, the *Lancet* avers, than with the use of any other sedative except chloroform, with which it has many chemical and a few physiological relations. The danger of premature death, however, is not the gravest consequence of chloral drinking: and the *Lancet* editorially predicts that some day, when the punishment for the misuse of the drug falls upon some sensitive temperament and gifted intellect, we shall have the "Confessions of a Chloral Drinker," to take its place beside De Quincy's "Confessions of an Opium Eater."

There seem to be two sources of danger attending the habitual use of chloral. The most obvious arises from the fact that the sleeplessness which it is employed to remove is the result of improper living. The proper cure for the distressing symptom is a return to right living, which will never be done so long as the penalty is masked. Instead of curing the disease, chloral simply hauls down the danger signal and permits the wrong doer to hurry on to complete destruction. It is thus a delusion and a snare.

But this is not the worst. Chloral is itself a serious disturber of the vital economy, though its action is very slow. Healthy life is the attendant, if not the effect, of a properly balanced and correctly working organism. Any tampering with our physiological machinery, more especially if habitual, is of necessity mischievous; and the practice of chloral drinking is such an interference. We see its immediate effect in the phenomena of sleep; and there is an analogy, as the *Lancet* points out, between the temporary effect of a single dose, and the permanent effect of its habitual use.

"In sleep, the sensory recipient and lower motor centers are separated from those of consciousness and will with which, during the waking state, they are in close connection. This separation can take place only under certain conditions, which vary much in different individuals. Chloral introduces an artificial influence, and separates forcibly those functions of the nervous system which would otherwise have been linked together. It stills unpleasant emotion—removes disagreeable sensation—paralyzes the will. This can hardly occur repeatedly without some permanent effect. Each region of its influence presents an example of perverted action. The will becomes weakened, emotional manifestations are in the chloral drinker more easily produced; the evidence of the senses is perverted, and their action is no longer under the same control of associated impressions. All influences of a depressing character are felt more keenly. The sufferer becomes more 'nervous,' emotional, hysterical. Neuralgia and other sensory disturbances become frequent, and with them various paretic phenomena depending chiefly on defective will Ultimately still graver consequences may result. Delirium, imbecility, and paralysis of the pharynx and œsophagus are among the symptoms which have occurred in recorded cases, and which have ceased when the habitual dose was discontinued. All the time the supposed need for sedatives increases, the craving therefor may become as intolerable as for opium—the patient moaning for chloral which he can hardly swallow—while sleep gradually becomes impossible, except under artificial influence."

This is a serious showing for a drug popularly believed to be absolutely safe and harmless. And when we add, to its direct injuries to the nervous system, its indirect influence in perpetuating the unsanitary conditions and habits which lead to a resort to it, the need of caution in its use and the propriety of abstaining from its use except under medical advice must be apparent to the dullest.

COLLEGIATE RACES.

Now that the excitement of the intercollegiate regatta has waned, there will, we think, occur to many some sober second thoughts, regarding that and all similar competitions, which deserve more than a passing consideration. Physical pluck and endurance will always command admiration; but whether such qualities are to be considered superior to others which involve the higher attributes of the mind, so as to warrant their cultivation in lieu of or to the detriment of the latter, is a question which quickly suggests itself in view of the relative importance popularly accorded to the recent display of physical strength and to the several college commencements which lately have occurred. If the columns of the daily press are to be taken as an index, the meager space allowed to the reports of the latter exercises, and the almost unlimited enterprise exhibited in securing the most trivial particulars relative to the boat race and its participants, show plainly on which side popular interest is enlisted. Are we then to infer that superiority at the oar, or on the race course, is by the friends of education, as well as by the people generally, ranked higher than superiority in mental attainments? We hope not—we believe not—but then, are we not tacitly at least encouraging such a conclusion in the minds of the young men who fill our colleges?

There can be no gainsaying the fact that a certain amount of physical culture is a necessary concomitant to good health. A well balanced and healthy brain is rarely found in a weak and decrepit body. *Mens sana in corpore sano* is a wretchedly trite proverb, but none the less true; and certainly there is no class to whom its precept is more important than to those who in youth undertake a four years' course of study. But physical culture carried to excess is as bad as no culture at all, or even worse, since it may leave behind it, after severe exertion, injuries which are ineradicable: or Nature, strained beyond endurance, may give way in the hour of trial, and, as in the case of Renforth the oarsman, death may triumph in the midst of the contest. Every account of the recent regatta and the subsequent foot races agrees in stating that, in very many cases, the marks of over training were apparent, facts abundantly proved by the fainting of some of the most muscular rowers, and by the pitiable condition in which, it is reported, several of apparently the strongest of the pedestrians concluded their efforts.

While it cannot be expected that young men will fail to be carried away by their own and by the intense popular enthusiam manifested in these competitions, and thus rush to extremes both in the matter of physical exercise and in neglect of other duties, it is not to be supposed that the older and wiser heads of college authorities and of parents will countenance proceedings fraught with bad results. To the former, especially, the public looks for a wise guidance of those under their charge; and it is certainly as much their duty to impress upon their students the laws which govern health and correct living as those which underlie any department of knowledge. It certainly is their office to point out how far physical culture is beneficial as it is to show that its neglect is hurtful—to check it in one case as to encourage it in the other.

We are very much disposed to question the expediency of such contests as those now ended, and from another and different standpoint from that above taken. Their only advantages are an increase of *esprit de corps* among the students and the bringing of our educational institutions prominently to public notice. These, however, are more than compensated for by the highly demoralizing effect which they possess, in common with all races or chance occurrences upon which gambling can be based. It certainly is demoralizing for any body of men to be reduced to the level of the race horse or the dice box; and the fact that betting is not only indulged in freely by the students themselves, but freely countenanced by the alumni, is not at all calculated to improve the moral tone of the institutions in which young men are supposed to obtain the foundations for their subsequent careers.

The New York Dock Department.

George S. Greene, Jr., C. E., has recently been appointed Chief Engineer of the Dock Department of the city of New York, General Charles K. Graham having resigned. Mr. Greene, although comparatively young, is an indefatigable worker, a thoroughly practical, experienced engineer, and a man of spotless character. The appointment reflects credit upon the Commissioners by whom the selection was made The administration of the Dock Department devolves upon a board of three Commissioners, namely, Salem H. Wales, formerly of the SCIENTIFIC AMERICAN, President, Jacob A. Westervelt, and Henry F. Dimock, all of whom are leading and influential citizens