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Contents:

(Illustrated articles are marked with an asterisk.)

ELEVATION OF THE ELASTIC LIMIT BY STRESS.

The SCIENTIFIC AMERICAN first published, on page 336, volume XXIX, the novel and unexpected discovery by Professor Thurston of the "Elevation of the Elastic Limit by Stress," as the discoverer has since called it, which was communicated to the American Society of Civil Engineers, in a note published in the transactions of the Society for November, 1873.

The *Journal of the Franklin Institute*, in the last month's issue, contains an interesting statement of the results of experiments made subsequently by Commander Beardslee, United States Navy, at the Washington navy yard, independently and by a different form of apparatus, which led to the re-discovery of the same important fact. The editor of the *Journal* presents the paper as furnishing "most conclusive confirmation of the discovery of Professor Thurston."

In these experiments of Commander Beardslee, the iron was generally of poor quality, the tests were made by tensile strain, and the results were recorded from observation instead of by automatic registry, all of which circumstances differ from those of the earlier researches, and the confirmation which is given of the phenomenon referred to is thus rendered the more conclusive. Samples were taken in pairs and subjected to a strain which exceeded the elastic limit. One was removed from the machine and laid aside; the companion specimen was left under the load in the testing machine. In the former case, four tests gave an average increase, in sixteen hours, of 10·00 per cent. The latter method, with six specimens, gave an average of 11·30 per cent, or, leaving out one exceptional result, 12·20 per cent. These specimens were of ½ square inch section. With smaller pieces of ¼ square inch section, the same treatment gave, by the two methods, 8·20 and 13·40 per cent, respectively.

The (at first sight) very singular fact, that an increase of resistance should be developed when the specimen is taken out of the machine after giving a set, is, we presume, readily explained by the fact that the set, produced by the refusal of some of the particles to return to their original positions, holds other groups of particles separated, and, as explained by the discoverer, allows a flow to take place, relieving internal strain, and permitting nearly all portions of the piece to act together in resisting external force. The set thus holds the piece under strain somewhat as does the machine.

The subject loses neither interest nor importance by investigation, and we shall hope to learn more of its practical bearings. We have already given much of our space to the discussion of these new facts relating to the strength of materials, and shall from time to time endeavor to present our readers with the latest results of research in this field. There is no subject which is of more direct importance to every mechanic and engineer than that of the strength of the materials upon which he is compelled to rely in all his constructions.

There are many facts still unknown to the public, or to the engineering profession even, and of which no knowledge can be gained by reference to books. For example, one of these is the resistance of iron to compression at different temperatures.

Many of our readers can undoubtedly furnish facts of interest and importance; and we hope that those who find themselves in possession of such facts, which have evidently escaped the observation of acknowledged authorities, will assist their brother workmen by sending them to us for publication.

THE GEOLOGICAL SURVEY OF JAPAN.

We have received from our countryman, Mr. B. S. Lyman, who was appointed, by the government of Japan, Director of the Survey, a preliminary report containing some of the results of the first season's work in Yesso.

It is a pamphlet of 46 pages, excellent in typography and appearance, published and printed in English by the *Kaitakushi* at Tokei. The work, according to the instructions of the Hon. K. Kuroda, Jikuwan of the Kaitakushi, was confined to the four southwesternmost provinces, Oshima, Shiribets, Iburi, and Ishcari, about one third of the island. A number of fossils were collected at several places, but they were too few to justify the employment, at least for the present, of a foreign palæontologist. Besides Mr. H. S. Munroe, an American, Professor Lyman was assisted by eleven natives. They are not only the first Japanese but the first Asiatics to undertake the study and practice of geology; and although the training of native geologists in India has been begun nearly at the same time, Professor Lyman trusts that the Japanese will continue to take the lead, and that Japan will become in a few years independent of foreign countries in this direction.

In determining the importance of the points to be more carefully surveyed, regard was had chiefly to their mining value, and many places were visited where valuable minerals had been supposed to exist, but where they proved to be deficient either in quantity or quality.

Along the principal and many of the smaller rivers are rich alluvial plains, which would be admirable farming sites, were it not for the lack of roads at the present time. The soil indeed seems to be very good, even on the uplands, and supports a rich growth of wild plants. The chief exception is in the neighborhood of Tarumai volcano, which so recently as the first of March, 1867, was in active eruption; and where for many miles around, even the low plains by the seashore have been so covered with pumice as very much to lessen their fertility. Yet even here a rich black soil, in some places six feet thick, exists at the depth of only about a foot below the surface of the ground. The volcanoes that still have active sulphur vapors seems to be mostly along the shores of Volcano Bay and the adjoining coast. Besides these, there are many more that seem to have long been quite extinct. The highest, most symmetrical, and beautiful of them all, is Shiribets Mountain, perhaps 6,000 feet high above the sea, and almost a regular cone. The useful minerals of chief importance in the field gone over are: Coal, iron sand, sulphur, limestone, gold, and rock tar and mineral springs; and traces of silver, lead, zinc, manganese, and copper.

The Kayanoma coal field covers about half a square mile, and has six workable coal beds from three to eight feet in thickness. The coal is what is strictly called brown coal, probably of tertiary age, though closely resembling bituminous coal in its appearance and in many of its qualities. Of iron, the whole amount of pure ore in the principal workable deposits is perhaps 125,500 tuns, containing 91,000 tuns of iron. Only 5,500 tuns of the ore (containing 4,000 tuns of iron) are of the easily smelted kind. The sulphur occurs mostly within the craters of now inactive volcanoes. Hot sulphur fumes rise through small crevices and deposit yellow sulphur on the cold surface of the ground, forming a crust more or less impure, with a mixture of partially decomposed rocks. The shape of such deposits is extremely irregular and often inaccessible in many parts; so that the precise extent can hardly be measured except very roughly. The whole quantity of sulphur to be got from the places thus far visited is possibly five hundred tuns. The gold occurs in the form of small grains and scales in alluvial gravel. No gold-bearing quartz has been discovered. The amount of gold in all the fields surveyed would seem to be less than two millions and a half of dollars, and in none of them to be abundant enough to give much encouragement to working. The oil is all black, and so very thick as to deserve better the name of tar; moreover it has not as yet been found in noteworthy amount. Mineral springs are abundant; and of the twenty-one which were examined, thirteen were sulphur springs with temperature from coldness up to boiling; six iron springs, from 27° to 91°; one cold spring, with copperas; and two nearly pure springs, 30° and 50° hot.

Though scanty, these details are sufficient to interest us in the future development of Japan, and it cannot be long before representatives of our commerce will follow where those who have represented our Science have already led the way.

A. R. L.

THE INCREASED USES OF THE MEMBERS.

We doubt if the human body has ever in any instance attained the acme of its possible development; and by this we mean that while certain sets of muscles or organs have, in individual cases, become subjected to the will so as to perform feats impossible save through education, we do not believe that the being ever lived who could control every member so as to cause it to operate to the extent of its capabilities. Whether in future ages such a condition will mark a higher stage in the development of the race: whether, as the human mind expands, or, as the saying is, the "world grows wiser," it is reserved for physical culture to keep pace with such mental growth: is a subject for speculation, which, in view of the doctrines of evolution and the constant approach of organic species toward more perfect individualism, is by no means devoid of present interest.

We have discussed at some length the question of the use of the left hand, and we have pointed out that, by a mistaken notion, children are taught to discard the use of the member, and hence to lose half the powers which Nature intended they should have when she formed the body as it is. We have also suggested that, so far from restraining the infant from using its left hand, its tendency to employ both members indiscriminately should be encouraged. Now, we propose to advance a step further, and to ask why should not a child be taught to utilize both hands at once, and at different occupations. The idea may seem somewhat chimerical at first, but it is not without the bounds of possibility. The reader has doubtless seen jugglers who, in performing their dexterous tricks, become so expert that, without any apparent difficulty, they can keep half a dozen knives or balls constantly in the air or in each hand. The falling and rising of these objects are not uniform, and hence to all intents the performer accomplishes a totally different result with each member. In similar manner great pianists—Rubinstein is a very striking example in point—use either hand upon the keys with equal dexterity and both together, in playing music of tremendous difficulty which requires a power of perception and a control of the muscles of each individual finger which is simply wonderful. Again, an organist, in performing upon a grand instrument, has several things to think of at once: both hands on the keyboard, both feet on the pedals, with stops on either side, couplers and the separate devices for *crescendo* and other accidental effects are to be looked after. Here are four members of the body acting different parts at the same time.

We could multiply instances of this kind with little trouble, all going to show that, even when advanced in life, it is possible to educate a certain set or even sets of muscles to perform hitherto unnatural work. Cases there are where men, on being disabled in the arms, have had recourse to their toes, and used those members for writing and even handling tools. We have visited the studio of quite a celebrated French artist whose exquisite paintings were entirely produced with brushes handled in the above manner. But while an individual member, or even the body, may be educated to perform feats apparently impossible, it requires a higher order of training to compel the members to perform different operations at once—a training, we think, only to be fully imparted in beginning at the earliest years, but still fully possible. With our dual brains, the right lobe is now the most developed, and with it the dexter side of the body. Let means be taken to develop the left side equally, and the body is symmetrical in its powers. Each side, governed by both brains, will be capable of work for which now, when controlled by, say, three quarters of the brain power, it is inadequate.

We need not point out the advantages to a person who can thus use both hands in connection with the brain. We have known an artist who could draw two different pictures at once; and in a former article, we alluded to a very eminent professor of natural history who, while watching a specimen through the microscope, sketches with one hand while writing with the other. Now, if a person advanced in life can become so educated, how much easier it would be to impress the same on the plastic mind of a child! Once taught, the person could write upon two different subjects at once, could make two copies at the same time, could write up two sets of books, could make stenographic notes and write them out in long hand simultaneously, and perform in brief a variety of operations productive of lucrative results. Moreover, he would do each understandingly, and not semi-automatically with one hand. Nine tenths of ordinary pianists who have to "learn a piece" play the treble with their brains and the bass with their muscles. The left hand learns certain fixed skips and jumps by practice, and performs them automatically at certain times, while the right hand carries the expression as well as the air of the composition, and is much more directly under the control of the performer.

We began by speaking of a possible future of the race. Is it then improbable that at some time man may have every faculty educated to its utmost, and thus become raised to a creature mentally and physically infinitely the superior of such as we now are, as much beyond us as we are beyond the monkey? Traits developed in the parent may be transmitted to the child and there intensified, and thus an approach to human perfection ultimately attained. But meanwhile, who is to begin? To whom among the scores of thousands who will peruse these lines—who may perchance give them a second thought—will it occur that the idea may be carried into practice with the very yellow-haired youngster, perhaps at this moment clambering upon his knee?

THE NEW THEORY OF QUANTIVALENCE.

The theory of quantivalence, by which the modern chemistry differs so radically from the science laid down in the old text books, thus far used and still taught in most of our scientific institutions, is based on close comparisons concerning the nature of divers chemical combinations; and these have taught that each elementary atom possesses a certain definite number of bonds, by which alone it can combine with other atoms.

There are two material conceptions by which we may assist our imagination to realize this abstract idea: One is to imagine the bonds as hooks attached to the atoms, by which