

I am free to admit, however, that no plan of operation or co-operation can be devised that will work to the complete satisfaction of everybody. We sometimes have men to deal with who are not amenable to either law or reason.

In his presidential address before the American Association at Cleveland, Professor Langley compared the advance made by scientific men in their search after truth to that of a pack of hounds following a trail. Permit me to carry this simile still further. Hounds understand that it is their business to follow the game, and, when left to their own instincts and wishes, they will follow it. Now imagine a bull dog seized with the ambition to become a hunter and joining the pack of hounds. Every one knows that the bull dog will, in spite of any thing that can be done, have a fight with half a dozen, or, more likely, with the whole pack of hounds, by the time the chase is well under way.

It is not a pleasing reflection to remember that the great search after truth, in which every genuine man of science is engaged, heart and soul, is often interrupted in this same fashion by the pugnacious disposition of some companion.

Let me recapitulate some of the benefits to be derived from voluntary and cordial co-operation between all geologists and all geologic organizations in this country:

1. Geologic research being under the nominal direction of the leading investigators, would be so conducted as to be of the greatest utility to the largest number.

2. When a piece of work was done by one it would be done for all, and duplication by State surveys and by individuals and the consequent waste of energy, time, and money would cease.

3. The functions and fields of official organizations being better defined, State and National surveys and individuals could so direct their efforts as to serve the purposes of others without neglecting their own immediate aims and without infringing upon each others' grounds.

4. National and State surveys would be strengthened, and local organizations and individual effort encouraged.

5. It would give us a better geologic literature, better instruction, better geologists, and more thorough specialists.

6. And finally, we trust, it would put a stop to those oracles of science who are so ready to prophesy in its name. This ideal state of affairs may never be brought about, but it is none the less desirable that we should aim at it. For the more nearly we approximate to it the more rapid will be the progress of science, and the progress of science is the progress of civilization.

To paraphrase a recent utterance of Bishop Potter, "It would be a monstrous conception of science if any one of us were to esteem it only as a selfish weapon with which he was to carve his way to personal fame and fortune." It has often been used for just that purpose. Higher ideals will give us nobler motives.

ON CERTAIN PHENOMENA OF GROWING OLD.¹

AFTER a few introductory remarks on the choice of a subject, Dr. Minot said that he had been guided in his selection by the idea of taking a subject which would be of general interest and indicate, if possible, the new directions in which biology is developing. For this reason he had chosen the subject as announced in the title of the address. He spoke first of the law of variations as connected with the age of the living organism. When variations occur which are due simply to chance, it is found that they are distributed according to a regular curve on either side of a maximum; but when we study the variations which occur in the living organism we find that there the curve is irregular, and that there is a certain point of maximum which occurs at a definite age, and that the ascent of that curve toward the maximum is steeper upon the young side than upon the older. The speaker presented a number of examples of this taken from the age at which Harvard students enter college, from the growth of children, from the age at which maturity is attained in the female sex, from the age of mothers and the number of children which they have had at each age, and giving other examples, without, however, presenting

them in statistical form. In all of these cases the same peculiarity of the curve being steep on the young side, and less steep upon the old side, recurs. But in all these cases the maximum occurs at a comparatively early period of life. In other cases, as, for instance, when we discuss the relation of suicide to age, we find that the maximum frequency occurs at a much more advanced period, and in this case the curve becomes steep upon the old side, so that there is here a large field of statistical inquiry which is to be worked out, and there is a large amount of material which might, if properly put into shape, yield valuable results. We might study from this point of view the relation of various diseases to age, the relation of the birth of the first child to the age of the parent, of the acquisition of fame, the age of second marriage, the age at which distinguished authors have published their first book, the age of entering the United States Senate, etc. All these and other similar data might be utilized for the purpose of the biologist to study the law of variation in connection with age. At the present time there is not sufficient work done in this direction to enable us to draw any more general conclusion than that which has been presented above.

The peculiarity of the curve of variation is unquestionably due to what may be called senescence, or growing old. This senescence shows itself in the fact that toward the younger period the same range of alteration takes place as toward the older period in more advanced age. This is particularly well illustrated by a series of elaborate experiments upon guinea pigs and their growth made by the speaker. These experiments, which were interrupted by an accident which destroyed the whole stock of animals, show that the loss of vital power commences with birth, and that in order to add a given percentage to the weight of an animal a much longer period is required when it is old than when it is young. This was illustrated by statistics and diagrams. The general result may best be expressed by saying that the older an organism is, the more time it requires to produce a given change, and this indicates that there is a progressive loss of vitality. The difference between this view and the current one is that, in the speaker's opinion, there is, scientifically speaking, no period of development, but only a steady decline from birth onwards.

The speaker then turned to the second part of his subject, and discussed how far anatomical peculiarities can be found to be correlated with this progressive line of vitality. He took up the various tissues of the body, considering them one after another in their order of development, and showed that in each one of the principal tissues and organs the cells composing them exhibit the same peculiarity; namely, that in their young condition they contain only a small amount of protoplasm, and in their adult condition a very much larger amount, so that the proportion of protoplasm to the nucleus increases with the age of the organism. This fact, which can be readily verified in the case of the higher animals, finds also certain support in the development of many of the lower forms, which were also briefly discussed. Hence the conclusion that the development of protoplasm is associated with the loss of vitality, and that instead of speaking of protoplasm as the physical basis of life, we might speak of it as the physical basis of advancing decrepitude; or, since the changes involved in growing old lead to death, we might designate it as the physical cause of death. These definitions of protoplasm are too dictionary-like, and might be misleading if taken strictly, but they can at least teach us that protoplasm is by no means a simple jelly which explains in a simple manner all the phenomena of life, but it is in reality an extremely complex substance, as complex as life itself. We see in this problem of age a series of phenomena which are not especially associated with any organ or any system of organs of the body, but something which involves all parts alike. Such a study as this goes, strictly speaking, in the direction of general biology. Hitherto we have had comparative anatomy and physiology, but of general biology extremely little. The speaker expressed his belief that the future of biology would lead in this direction, and that the study of the organism as a whole would supercede in the near future to a large extent the present study of the separate organs, both in their physiological and morphological aspects.

There is a great deal to be done, for it is only in the domain of

¹ Abstract of an address before the Section of Biology of the American Association for the Advancement of Science, at Indianapolis, Ind., Aug. 20, 1890, by Charles S. Minot, vice-president of the section.

general biology that we can seek the solution of the problems of reproduction, heredity, sex, growth, variation, death, the evolution of species, and the general economy of nature. All of this phenomena are common alike to the vegetable and the animal world, and for their thorough study it is necessary that the investigator should be strictly a general biologist and not merely a botanist or zoologist. These investigations are necessarily expensive in character, since they require that the animals and plants experimented upon be kept under specific conditions for long periods of time; but, it is to be believed that the results which may be obtained will amply justify both the labor and the expense. The speaker expressed the hope that some persons who felt generously inclined to aid in scientific work might give support for this line of work, and in concluding expressed the more general hope that those persons of wealth who wish to contribute to science may feel more and more inclined to endow research, for much can be accomplished in this way than in any other for the advancement of science.

Wherever we turn we see scientific work of the highest quality delayed and even stopped for the lack of means. Every one who can rescue these opportunities from being lost, even in part, will deserve well of mankind and the acknowledgments of the association.

AMONG THE PUBLISHERS.

—California topics occupy considerable space in the September *Century*. A paper of interest, practically illustrated, is Commander C. F. Goodrich's description of "Our New Naval Guns," detailing the process of manufacture and recounting their remarkable efficiency.

—Thomas Stevens (who went to meet Stanley when the latter was coming from the interior of Africa) speaks of his article on "African River and Lake Systems" in the September *Scribner's*, as suggested by several interesting discussions of the subject while

he was in Zanzibar and Cairo—notably one with Mason Bey, one of the best authorities on African affairs, who with Prout (a name familiar to readers of the magazine) explored the White Nile in 1877. Much of the information which he gained from Mason Bey appears in Mr. Stevens's article. Professor Shaler of Harvard, in his article on "Nature and Man in America," in the same number says: "It seems to me that it is rather to the physical conditions of North America than to any primal incapacity on the part of its indigenous peoples to take on civilization, that we must attribute the failure of indigenous man within its limits to advance beyond the lowest grades of barbarism. The Indian shows us in many ways that he is an able person. We may judge any folk by their greater men, and there can be no doubt that the ablest of our American savages rank high in the intellectual scale. It is, it seems to me, to the ceaseless disturbances of nascent civilization that we owe the failure of this folk to attain to a higher grade." Apropos of railway strikes, James S. Norton, a prominent Western lawyer, says, in the same issue, "If a corporation is held to strict performance of its duty as a public servant, should not its agents, who live upon its business, be held to some account—at least for combinations made to obstruct a public service as a means to satisfy the personal grudge of a few individuals?"

—The September number of *The Forum* will contain a political essay on "Money Interests in Political Affairs," by E. L. Godkin, editor of the New York *Evening Post*, in which Mr. Godkin traces to the growth of protection the enormous and alarming increase of the influence of money in politics, which he regards as the most important political fact of our time. In the same number Senator John T. Morgan of Alabama replies to Senator Chandler's recent article on "The Federal Control of Elections." Other articles in this number will be "The Training of Teachers," by President G. Stanley Hall of Clark University; "The Christianity of the Future," by Professor John S. Blackie of Edinburgh; "The Latest Astronomical News," by Professor Charles A. Young of Princeton;

Publications received at Editor's Office, Aug. 11-23.

- BALLOU, W. R. A Compend of Equine Anatomy and Physiology. Philadelphia, Blakiston. 205 p. 12°. \$1.
 BREWER, W. H. Warren's New Physical Geography. Philadelphia, Cowperthwait. 144 p. f°. \$1.
 CRITTENDEN, E. P. The Pleroma. A Poem of the Christ. New York, Putnam. 347 p. 8°. \$2.50.
 DAY, D. T. Mineral Resources of the United States, 1888. Washington, Government. 652 p. 8°. 50 cents.
 DENTAL MIRROR. Vol. I. No. 1. m. New York, Dental Publ. Co. 16 p. f°. \$1.
 DRAGON FLIES vs. Mosquitoes. Can the Mosquito Pest be Mitigated? (The Lamborn Essays, by Working Entomologists.) New York, Appleton. 202 p. 8°. \$1.50.
 LITCHFIELD, Mary E. The Nine Worlds: Stories from Norse Mythology. Boston, Ginn. 163 p. 12°. \$1.75.
 MARCON, J. B. Bibliography of North American Paleontology in the year 1886. Washington, Smithsonian Institution. 57 p. 8°. \$1.
 POULTON, E. B. The Colours of Animals, Their Meaning and Use, Especially Considered in the Case of Insects. New York, Appleton. 360 p. 12°. \$1.75.
 SCHOFIELD, A. Health at Home Tracts, 1-12. London, Rel. Tract Soc.; New York, Revell. 192 p. 12°. 60 cents.
 SMITH, E. F. Electro-Chemical Analysis. Philadelphia, Blakiston. 116 p. 12°. \$1.
 UNIFORMED RANK ARGUS. (Published in the interests of the Uniformed Rank, Knights of Honor.) Vol. I. No. 1. m. New Orleans, C. H. Ludwig. 4 p. f°. 50 cents.
 WALKER, F. Practical Dynamo-Building for Amateurs. (Science Series.) New York, Van Nostrand. 104 p. 16°. 50 cents.

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