Gyroscope,' in course if which were given some interesting experimental details observed from experiments carried out by Dr. Warring. These experiments are to be performed before the academy, at a future meeting. S. A. Mitchell.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

April 24.—In reference to some original work Dr. Julien reviewed a paper by August Rosiwal, 'Ueber geometrische Gesteinsanalysen,' from the Verhandlungen der Kaiserlich-Königlichen Geolog. Reichsanstalt for 1898.

May 1.—Mr. H. C. Magnus reviewed Bulletin 56 of the New York State Museum. The Bulletin gives many interesting data concerning the 1901 state geologic map. It also gives an excellent review of the geologic surveys of the state, with a table at the end correlating the terms used by the different surveys. Professor Kemp reviewed from the *American Journal of Science,* April, 1903, 'The Mechanics of Igneous Intrusions,' by R. A. Daly.

May 8.—Dr. A. F. Rogers reviewed 'A Three-circle Goniometer,' by G. F. Herbert Smith; Mineralogical Society of London, vol. 12, 1900. Miss Florence Henry reviewed 'The Animal Ecology of the Cold Spring Sand Spit,' by C. B. Davenport. Dr. Geo. I. Finlay reviewed Bulletin 182, U. S. G. S. This bulletin, by F. L. Ransome, treats of the 'Economic Geology of Silverton Quadrangle, Colorado.' Professor Kemp called attention to the 'Geology of the Celebes,' by Professor Bücking, and to Bulletin 213, U. S. G. S., on the economic geology for 1902. This contains the abstracts of some papers not yet issued by the survey. H. W. Shimer.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 345th regular meeting was held April 14. Professor Friedrich Hirth, of Columbia University, occupied the evening, reading a paper entitled, 'The Early Development of Chinese Civilization.' Professor Hirth exhibited examples of early Chinese art and explained the symbolism and the hieroglyphic characters that are found on ancient works of art and their relation to modern characters. The inception of Chinese culture Professor Hirth places at the second millennium B. C., noting the unreliability of Chinese written accounts as to the early times. About 120 B. C., Bactrian Greek art influence found its way into China, of which examples were shown consisting of designs on the backs of metal mirrors and of rock carvings. The developments of architecture, writing and printing were traced. Professor Hirth affirms that in art Japan stands entirely on the shoulders of China. The paper was discussed by Messrs. Flint, Spofford and McGee. A vote of thanks of the society was tendered Professor Hirth for his instructive paper.

Walter Hough,
Secretary.

DISCUSSION AND CORRESPONDENCE.

A TROPICAL MARINE LABORATORY FOR RESEARCH.

To the Editor of Science: The subject which Dr. A. G. Mayer has so ably introduced for discussion under the above title is of such importance as to call for careful consideration from biologists. It is also beset with difficulties of a peculiar character, the recognition of which will largely determine its success or otherwise. Of the desirability for such a permanent laboratory and of the great results to biology which would accrue from its establishment there can scarcely be any divergence of opinion. Granted the means for its support the primary discussion will center around the best means for attracting the greatest number of able workers, involved in which is the important question of the most suitable site.

The suggestion for the establishment of a biological laboratory in the tropical Atlantic is by no means new. Ten or more years ago the subject received the public support and encouragement of the late Professor Huxley and Professor Ray Lankester, and was discussed in the English *Times* and various scientific journals, while the Institute of Jamaica has at times made recommendations of a like character.

Three or four years ago a committee of American botanists, composed of Professors D. H. Campbell and D. F. MacDougal, visited

various islands of the West Indies with a view to the selection of a suitable spot for a tropical station. In the end Jamaica was practically determined upon, when the sad death of an American botanist and zoologist in the island resulted in a suspension of the efforts. Within the past two years the Commissioner of the Imperial Agricultural Department for the West Indies, Dr. D. Morris, C.M.G., has endeavored to secure assistance from the Imperial and local governments for the establishment of a marine section to his department, at which biological research could be conducted, but as yet without much encouragement, owing to the depressed financial condition of the islands.

As in so many instances one turns for a ray of hope to the trustees of the Carnegie Institution. But before this beneficent organization can be approached it is manifest that the scheme should be thoroughly discussed and some consensus of opinion reached by biologists as to the most desirable spot. From his personal experience Dr. A. G. Mayer is prepared to support the claims of Tortugas, Florida. A residence for several years in Jamaica is my excuse for the presentation of what I conceive to be the superior advantages of this island, in which I am supported by two of Dr. Mayer's correspondents, Professors E. G. Conklin and T. H. Morgan.

First with regard to the comparative richness of marine life in the different regions of the West Indies. Investigations of the various groups so far conducted (fishes, crustacea, echinoderms, corals, actinians) reveal a great similarity throughout, as would be expected from the uniformity of temperature and the insular conditions of all the likely places. Hence, as regards abundance of life, any area otherwise suitable would be almost equally desirable, except for specific purposes, for the needs of the marine zoologist alone.

A tropical laboratory is much more likely to be a success if from its position it appeals to the worker on land and fresh-water forms as well as marine, to the botanist as well as to the zoologist. And there is no reason why the center chosen should not be as desirable for the one purpose as the other. It is in this respect, however, that the various islands differ greatly, and where the advantages are altogether in favor of Jamaica. Nowhere in the West Indies is there readily available such a diversity of terrestrial faunal and floral conditions, a fact already recognized by Professors Campbell and MacDougal after an investigation of other islands, and supported by the many American botanists and zoologists visiting there from year to year. The presence of a well-equipped and long-established government botanical department, with all its collecting traditions, is not one of the least of its attractions, as well as known localities for such interesting forms as *Peripatus*. The student concerned with the results of the introduction of new animals and agricultural pests will have his ardor more than satisfied by the mongoose, toad and tick.

In the matter of health the tropics are generally viewed with suspicion. This is well founded as regards investigators who desire to carry on work, involving exposure, in the same manner as in temperate parts, but is of little moment to the resident or experienced visitor aware of the precautions called for under the totally new environment. To select any locality of which the general healthiness or climatic conditions are uncertain, or where proper medical advice and attention are not available, would undoubtedly sooner or later result in a sad collapse.

A central, readily accessible spot, where the general social life and the character of the people will add something to the experience of visitors, is also matter for consideration. The Naples Zoological Station undoubtedly owes some of its success to its geographical position and historic surroundings. A comparatively unknown isolated spot, with no associations beyond those of the laboratory, is not likely to offer sufficient attractions to make a long sea voyage, especially to European colleagues, nor can possibly give that status which a center of activity already recognized can confer. The general social conditions of Jamaica, the hospitality offered from the governor downwards, the experience of English

official, naval and military life are features which have always constituted a charm and attractiveness to the many American biologists who have already experienced them.

Another consideration very important to my mind is the educational value to young biologists—prospective investigators—to be obtained from such an establishment. The broadened conception of the possibilities of the animal and plant world which even a short experience within the tropics affords is very desirable. To wander amid the beauty and luxuriance of life on a coral reef, or pass amongst the intricacies and remarkable adaptations within a tropical forest, gives an inspiration not to be experienced in temperate regions. For this purpose a station having the greatest variety of both land and marine conditions is obviously most desirable. I conceive that many professors will think it worth while to take or send their most promising students, the idea of a general acquaintance with a tropical fauna and flora predominating over that of discovering material for research. For many years such has been the custom of Professor Brooks with regard to his students, and the conditions found in Jamaica have most nearly approached the ideal.

J. E. Duerden.

University of North Carolina.

SHORTER ARTICLES.

THE PHYSICAL BASIS OF COLOR.

At the present time no one, I think, questions the validity of the wave-theory of light. We may hold various views as to the nature, or even the existence, of that omnipresent medium, the ether; and the physicist, though unable to get along without it, is continually changing his conceptions of its manner of action; but the broad general principles upon which the theory is built remain unshaken.

The backbone of the theory is *periodicity*. Innumerable measurements of extreme accuracy have been made whilst experimenting in the various domains of optics, all of which agree in the conclusion that light, in its very essential nature, is *periodic;* and the simplest image one can form in his mind of such a phenomenon is a wave-motion, while the simplest method of representing it mathematically is by the circular functions of the sine and cosine.

The three quantities which determine a wave-motion are its amplitude, its wave-length (and, therefore, its frequency or period), and the form or contour of the waves. The mechanical measure of the intensity is proportional to the square of the first of these, while the sensation of color is in some way indissolubly connected with the second—possibly, also, with the third, though I do not know of any direct evidence on the question.

It has been usual to assert that color is purely a function of the wave-length, just as pitch is a function of wave-length in acoustics. Light of one wave-length would excite one color, light of another wave-length, a different color, etc. In an article on 'Color Saturation,' which appeared in the *American Journal of Psychology* (Vol. VII., No. 3, April, 1896), my friend and colleague, Professor A. Kirschmann, expresses dissent from the view generally accepted (by physicists, at any rate), and it is the question raised by him that I wish to briefly consider.

Dr. Kirschmann remarks: 'It is claimed that light of one certain wave-length causes the impression of red, another that of green, etc.; but this is mere hypothesis, for *nobody has ever seen light of one wave-length.*' Perhaps it would be fairer to state the proposition as I have done in the preceding paragraph. The physicist surely does not claim that he has ever worked with light of absolutely a single wave-length, though we shall see how near he has been able to approach to it. If a writer on the wave-theory should indulge in such superficial dogmatic statements, he must not be taken too literally, and the true value of the theory must not be judged therefrom.

Dr. Kirschmann supposes a 'pure' spectrum, a meter in length, to be produced on a screen, and discusses the nature of a narrow band of this image 1/100 of a millimeter in width. Taking the number of vibrations per second, corresponding to extreme red and extreme violet, to be 412 million million and 790 million million, respectively, we see that