

the rose, and benefited humanity by the diffusion of the material products of the earth. Should you ask me how it is in the future to use its influence for the benefit of humanity at large, I would say, look at the work now going on in these precincts, and study its spirit. Here are the agencies which will make 'the voice of law the harmony of the world.' Here is the love of country blended with the love of the race. Here the love of knowledge is as unconfined as your commercial enterprise. Let not your youth come hither merely to learn the forms of vertebrates and the properties of oxides, but rather to imbibe that Catholic spirit which, animating their ever-growing energies, shall make their power an agent of beneficence to all mankind.

S. NEWCOMB.

WASHINGTON, D. C.

THE YERKES OBSERVATORY.

THE opening of the Yerkes Observatory has been an important event in the progress of science. The last masterpiece of Alvan G. Clark, the forty-inch refractor, has been appropriately established. A great institution for all branches of research in the related fields of astronomy and astrophysics has begun its activity. The University of Chicago has made an important addition to its already large equipment for the discovery and teaching of scientific truth.

A series of conferences, attended by a representative gathering of some sixty of the astronomers and astrophysicists of the country, occupied the three days preceding the formal exercises of dedication on October 21st and 22d. The program, as printed in the recent number of this JOURNAL (No. 147, October 22d) was carried out with but minor changes.

Stimulating discussions followed the presentation of many of the papers, in which a delightful feature was the participation of

Professor Carl Runge, of Hannover. Unfortunately, a necessary postponement of the date of the exercises had made it impossible for Professor Schuster, of Manchester, Eng., and M. Deslandres, of Paris, to remain for the conferences.

The demonstrations, in the various laboratories of the Observatory, of new and interesting phenomena formed an important part of the program. The weather was not sufficiently favorable to permit the exhibition, with the great telescope, of many of the celestial objects as planned, but all present on the first two days had the opportunity of testing the light-grasp of the instrument on double stars and nebulae, and in connection with the solar spectroscope.

The generous hospitality of the University provided for its scientific guests during the week unique entertainment in the spacious rooms of the Observatory itself, and the arrangements for this rather serious undertaking were admirably carried out, with the effective cooperation of a well-known Chicago caterer. To the full extent of their capacity the homes of the resident astronomers were also thrown open to their friends.

The location of the Observatory, selected after long deliberation and full examination of the available situations, commends itself at once, aside from its natural beauty, by reason of its isolation from traffic and manufacturing, a favorable condition which is likely to continue into an indefinite future. The center of motion of the great refractor is about 80 meters above the level of Lake Geneva, which is about 600 meters distant, the elevation above sea-level being about 400 meters. The railway station and post office are over a kilometer distant, at Williams Bay, Wisconsin, on the Chicago and Northwestern Railway, at a distance of 120 kilometers, or two and one-half hours, from Chicago.

The Observatory building, of brown Ro-

man brick, with terra cotta trimmings, is in the form of a Latin cross, having a longer axis of one hundred meters, with the great tower and dome at its western end, and with two smaller (ten-meter) domes at the northern and southern extremities of the shorter axis. A meridian room, with double sheet-iron walls, is at the eastern end of the building. The space of thirty-two meters in the attic between the small towers serves as a heliostat room. The main floor of the building contains offices, computing rooms, spectroscopic laboratories, an instrument and a photographic room, a chemical laboratory, a lecture room, library and reception room. The lower story, or basement, contains a concave grating room, an emulsion, an enlarging and a photographic dark room, and a constant temperature room. Very important features of this floor are the optical and the instrument shops, well supplied with machines and tools. Here large instruments are being constructed, and a sixty-inch glass reflector is now being ground by the optician.

The great dome, twenty-seven meters in diameter and eighteen meters in height, is provided with a rising floor having a vertical range of seven meters and operated by electric motors. This floor is a very essential feature in working with a telescope of sixty-two feet focal length and successfully overcomes what would otherwise be almost insurmountable (acrobatic) difficulties in observing. The massive iron and steel mounting of the forty-inch telescope (constructed, as were the dome and rising floor, by Warner and Swazey), is operated by electric motors regulated at the eye-end. The driving clock controls the motion of a mass of twenty tons.

The tests of the optical efficiency of the telescope have been thoroughly satisfactory. It has also been already demonstrated that the 'seeing' by day is excellent at Williams

Bay, a fortunate condition in view of the disturbed day atmosphere at the Lick Observatory, but it is not to be expected that the night seeing can equal that at Mt. Hamilton.

The northeastern dome, nine meters in diameter, shelters the telescope formerly at the Kenwood Observatory, having two 12-inch objectives, visual and photographic. The southeast tower will for the present be occupied by a reflecting telescope. The equipment of the Yerkes Observatory in solar and stellar spectroscopes, gratings and kindred apparatus is already large. The gifts of Mr. Yerkes have included: For the objective, \$66,000; for the equatorial mounting, \$55,000; for the dome and rising floor, \$45,000; for the building and smaller domes, stellar spectrograph, steam heating plant and power house, engine, dynamo and motors, over \$145,000. The fifty-five acres of land, valued at \$50,000, was given by Mr. John Johnston, Jr.; the instruments of the Kenwood Observatory by Mr. W. E. Hale; and \$7,000 for a 10-inch photographic telescope, with building and dome, by Miss Catherine Bruce, of New York, to whose liberality astronomy owes much.

The address at the formal exercises of dedication was delivered in the ninety-foot dome, before a company of six hundred of the officers and guests of the University, by Professor J. E. Keeler on 'The Importance of Astrophysical research and the relation of Astrophysics to other physical sciences.' In a few well chosen words Mr. Charles T. Yerkes presented the deed of the institution to the President of the Trustees of the University, who responded in their behalf, as did President Harper for the Faculty. After a luncheon and inspection of the Observatory a special train conveyed the visitors to Chicago.

On the following day, October 22d, striking demonstrations were given, at the Ryerson Physical Laboratory by Professors Michel-

son and Stratton, of the applications of the interference refractometer and of the effect of a magnet upon radiation recently discovered by Zeeman. Professor Michelson also exhibited a harmonic analyzer, which may, perhaps, find application to certain pending problems of astronomy. The visiting scientists were entertained at luncheon by the President of the University and Mrs. Harper, and at 3 p. m. an address on 'Aspects of American Astronomy' was delivered by Professor Simon Newcomb. Finally the liberal hospitality of Mr. Yerkes provided a banquet in the evening for the visiting scientists.

The work of the Yerkes Observatory has thus been formally inaugurated. The aims of the institution as expressed by the President cannot fail to meet the approval of all friends of science:

"It is proper that a word should be said on behalf of the Faculty with respect to the policy which shall control the University in the use it shall make of the Observatory. The founder has indicated his desire in definite form that the Observatory shall not be used for popular purposes. Situated as it is, in close proximity to a village of large size, and within a short distance of so great a city as Chicago, it would be comparatively easy for the astronomers to occupy their entire time in exhibiting the instruments to the public. For the present it is the desire of the donor and the decision of the Trustees that the Observatory shall not be open to the public.

"In every department of science there is opportunity to-day for the development of what might be called the sensational. In no subject is this possibility greater than in that of astronomy. The work of not a few observatories and of not a few astronomers has been seriously injured by the desire to do and say that which will attract public attention. The Yerkes Observatory will strenuously oppose every tendency of this

character, and will make every effort to represent only that kind of work which is of solid and substantial character.

"So much for the negative side. As to the positive policy of the Observatory, I quote from a statement of the Director: 'The policy of the Yerkes Observatory will be: (1) To derive the greatest possible return from the use of the large telescope it is evident that special attention should be given to (a) micrometrical observations of stars, satellites, comets, nebulae, etc.; (b) solar investigations, both visual and photographic; and (c) spectroscopic researches on the chemical composition of the stars and their motion toward or from the earth. The present staff is sufficient to permit much of this work to be taken up to advantage. Another astronomer will be needed to develop the spectroscopic work, which is, probably, the most important work the Observatory can undertake, on account of its great light-gathering power.

"(2) To provide for the investigation of any phase of an astronomical or related physical problem. Most American observatories are unprovided with the instruments and laboratories necessary for the interpretation of the phenomena constantly encountered in spectroscopic observations of the heavenly bodies. Spectroscopic laboratories, on the other hand, are not equipped to carry their investigations beyond the artificial boundaries of physics into the realm of astronomy. It is hoped that the Yerkes Observatory may ultimately be in a position to represent both the astronomical and the physical sides of astrophysical work, and at the same time provide the best facilities for research work in astronomy of position."

The present staff of the Observatory consists of Professor George E. Hale, Director; Professors S. W. Burnham, E. E. Barnard, F. L. O. Wadsworth; Mr. F. Ellerman, Assistant; Mr. G. W. Ritchey, Optician.

It would appear an urgent need that adequate endowment should be supplied for the maintenance of this splendid institution at the high degree of efficiency of which it is so capable.

EDWIN B. FROST.

THE ALUMNI BIOLOGICAL EXPEDITION OF
NEW YORK UNIVERSITY TO THE
BERMUDAS.

THE archipelago of the Bermudas was chosen as the ground for the first expedition of the Biological Department of the University for several reasons, among them the following: the means of communication, by the steamships of the Quebec S. S. Co., was easy; they seemed to afford a tropical marine fauna in abundance for study; they were free from the malarious diseases of the West Indies, the fatality of which was so sadly proved this summer in the expedition to Jamaica, and it seemed worth while to investigate the conditions under which a station might be established for permanent research.

Thanks to a number of alumni who made liberal contributions to the enterprise, the party left New York for Hamilton on June 3d. The party consisted of Dr. C. L. Bristol, in charge; Mr. Warren H. Everett, instructor, and Messrs. Brush, Carpenter, Brown, Rosenthal and Grose, of the University; Dr. Walter M. Rankin, of Princeton University, and Dr. Tarleton H. Bean, late of the U. S. Fish Commission and now Director of the Aquarium in New York City. The party was joined later by Mr. Ernest Haycock, of Harvard University. The last of the party arrived in New York on August 8th. Headquarters were established at the Harrington House, about six miles from Hamilton and situated on the narrow strip of land separating Harrington Sound from Castle Harbor. A vacant house near the shore of Castle Harbor was transformed into a comfortable laboratory, and from this

as a center trips were made in various directions.

The most attention was given to a search for the various forms and a careful survey of the general conditions subtending their abundance and collection, so that, taken as a whole, the work might prove a reconnaissance and furnish knowledge for future investigations. In this the expedition was fairly successful and would have been much more so but for a long spell of southwest wind which prevented off-shore work, excepting for a few days. One instance of this may be given. Captain Meyers, of St. Georges, very kindly put his large ocean-going tug and a diver at our disposal to go to North Rock, and for a whole week we waited before a favorable morning came, but on that day, just as we arrived at the collecting ground, a heavy wind prevented any serious work. Our work was confined mainly to the lee shores and here we were greatly rewarded. Of corals the genera *Diploria*, *Meandrina*, *Astrea*, *Siderastrea*, *Porites*, *Isophyllia*, *Oculina* and *Mycedium* were found; of gorgonians, *Rhipidogorgia* and *Gorgonia*. The Actinaria are very abundant and our collections are numerous. We found but few hydroids and a mille-spore coral. The Medusæ and Hydro-Medusæ are very abundant in the still waters of Harrington Sound. The Echinoderms are exceedingly interesting and abundant. The Holothuria are represented by the genera *Holothuria*, *Semperia*, *Stichopus*, the last being very abundant. The Asteroidea are few and are represented by one species of *Asterias* and one of a new genus not yet determined; the Ophiuroidea by several genera. The Echinoidea are represented by *Cidaris*, *Diadema*, *Hipponæ*, *Echinometra*, *Toxopneustes*, *Mellita* and one new genus. The Crustacea are numerous and exceedingly interesting. Our collections will be studied by Dr. Rankin, who will report on them later.