gulation, or resort to comparatively inaccurate star-places, such as those obtained with meridian instruments. Proper motion, also, which necessitates new heliometric triangulations made very near the date of the photographic observations, is altogether eliminated in the use of this method.

It is merely necessary to arrange the telescope so that it can be rotated around its optical axis, or some other axis parallel to its optical axis. Suppose two photographs of a group of stars have been made with such a telescope, rotated 90° between the two exposures. If, then, the object glass possesses the peculiarity of making all the Y-coordinates too large in the first exposure, the same peculiarity will show itself in the second exposure by making all the X-coordinates correspondingly too large. Thus it is sufficient to make a series of negatives of the same star-group, rotating the instrument through various angles between the exposures, when a simple comparison will surely bring to light any form of optical distortion depending on the direction of measurement upon the plate.

The process is a purely differential one, and requires only a roughly approximate knowledge of the absolute star-positions, sufficient for the computation of refraction corrections, etc. It can be applied to an equatorial telescope of the ordinary form if we photograph the region immediately surrounding the pole of the heavens. In that case, the polar axis of the equatorial becomes a suitable axis for rotating the telescope, since the polar axis is parallel to the optical axis, when the tube is pointed at the pole. It is obvious that a trial of this method will furnish not only a determination of optical distortion, but will yield also, as a sort of by-product, a photographic catalogue of the close polar stars. For this reason it seemed desirable to include in the work a set of plates of the south pole as well as the north. In this way we should obtain very precise catalogues of both sets of close polar stars, all reduced and computed according to a uniform method.

In 1895 the writer was visting at the Cape of Good Hope Observatory, and discussed the matter with Sir David Gill. The plan met with his approval, and he consented gladly to make the necessary south polar plates. With equal readiness, Dr. Anders Donner, of the Helsingfors Observatory, offered to make the north polar plates. These latter negatives were measured at Columbia University by Mrs. Herman S. Davis and Mrs. Annie Maclear Jacoby; the measures were reduced at Vassar College by Miss C. E. Furness; and they were published by the Vassar College Observatory. The south polar plates were similarly measured and reduced at Columbia by Misses F. E. Harpham, Mary Tarbox, Eudora Magill and H. L. Davis, and the results will soon be published by the Observatory of Columbia University. The researches for both poles agree in showing that the optical distortion depending on direction of measurement is too small to be detected with certainty even by the delicate differential method here described.

W. S. Eichelberger,
*For the Council.*

*(To be concluded.)*

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*THE U. S. COAST AND GEODETIC SURVEY.*

The last annual report* of the Superintendent of the United States Coast and Geodetic Survey to Congress is fully illustrated with maps and diagrams and presents in detail the work accomplished by this bureau for the fiscal year ending June 30, 1901.

Throughout the report there is frequent evidence of the increased scope of the Survey's operations within the last few years, as well as proof of the flexibility of the

* Now in the hands of the printer.

organization, which appears to have readily adapted its methods to the diverse conditions of our widely distributed possessions.

Appendix 4 in a manner indicates the continuous growth of the area to be charted by the Survey, which has followed upon the territorial expansion of our country. It consists of tables used in the computation of geographical positions. The first publication of this character was limited to the United States, between 23° and 50° of latitude. Two extensions carried the tables to the Arctic Ocean and the present one extends them to the equator.

The physical and social conditions of Alaska and of the Philippines make a strong contrast, and the methods employed in charting the two regions must on that account, to a certain extent, differ. But it appears from the report that there are other conditions common to both which require similar treatment. It is the general belief that both Alaska and the Philippine Islands are on the threshold of a commercial awakening. The rich mineral resources of the former promise steady development, while the many valuable products of the latter only await organized effort to be the source of a boundless traffic. For the safety of the vessels and cargoes engaged in this commerce accurate charts are most important. Those of a large portion of the coast of Alaska and adjacent waters are still constructed from the information obtained by early explorers and navigators, whose facilities for obtaining accurate locations were meager. In the Philippines the charts are truly oriental in their untruthfulness.

It is the policy of the Survey to first attack those portions most urgently needed and the doubtful areas in Alaska are being gradually reduced in size. Thus during the year surveys were extended along the coast of Seward Peninsula where Nome, the focus of the latest and most promising gold fields, is situated. It faces the open sea and at present the transfer of persons and property to and from the vessels is subject to the risks of sudden storms and heavy surf. In the future development of this region a harbor for ocean-going vessels will be a necessity, and with this in view the two nearest, Port Clarence to the north and Golofnin Bay to the east, were included in the Survey. Later in the year the principal passes through the Aleutian Islands into Bering Sea, as well as Icy Straits and Cross Sound, were taken up with every prospect of completion.

In the Philippines, Manila, as the seat of the government, is the central point from which the telegraph lines diverge in all directions. A suboffice and astronomical station were established there, and from the latter as the initial point the longitudes of 14 stations were determined by telegraph and also at the same time latitude and azimuth observations were made. Three charts and notices to mariners were issued and six additional charts were ready for publication on July 1. A steamer was purchased by the Philippine Commission for the use of the Coast and Geodetic Survey, and money was appropriated by the Commission to repair and equip this vessel.

In Porto Rico, hydrographic work was continued in the harbors and bays and offshore. The triangulation around the island and topographic surveys of the shore line were continued. The topographic survey of Vieques Island was completed.

Our home interests were not neglected as may be seen from the fact that hydrographic and topographic surveys were made in localities in 19 States for the purpose of bringing the charts up to date in consequence of natural or artificial changes which have occurred since the original surveys.

Speed trial courses for the use of ships and torpedo boats were established in Dela-

ware and Chesapeake bays, and the Santa Barbara channel course was extended.

In addition to other field and office work, continuous tidal stations were maintained in this country at 6 stations and at 1 in the Philippines, and tide tables for 1902 were published, giving predictions for 70 principal and about 3,000 subordinate stations throughout the world.

During the year the Coast Pilot relating to southeast Alaska was thoroughly revised in the field and prepared for the printer. The field revision of the Coast Pilot between San Diego and San Francisco was completed and new editions of sections relating to the Atlantic coast were published, and the revision and issue of other numbers are in progress.

Strict business methods are not often associated with the measurement of the bases of a great trigonometrical survey. From the literature on the subject it appears that in the endeavor to attain a high degree of accuracy financial considerations have been subordinated to the scientific and experimental. The conduct of the measure of the nine bases along the ninety-eighth meridian was an exception to this rule, and Appendix No. 3, which describes the methods and results has an added interest of novelty. This was the first campaign of a party organized solely for the measurement of bases. A great gain in economy and time was accomplished by taking advantage of the skill acquired by the party by the frequent repetition of the same operations. After a thorough study of former measures a standard of accuracy was determined upon, and the operations so planned, by strengthening some points in the methods, that the number of measures could be reduced and certain refinements omitted. These bases form part of the chain of triangulation which it is proposed to extend along the ninety-eighth meridian, in both a north and south direction from the transcontinental chain, to the boundaries of the United States. It will include an arc of 23°, and together with the transcontinental triangulation as the backbone will form one of the ribs of the main framework for the control of all the triangulation in the United States. The Mexican Government has already in progress a system along the same meridian which, it is expected, will extend the arc 9° in latitude, and it is also possible for the Canadian Government to extend the arc far to the northward. Appendix No. 6 treats of the completed portion of the work in Kansas and Nebraska.

In connection with the general magnetic survey which supplies the data for constructing the compass diagrams on the charts, and furnishes the land surveyor the information for correctly running his traverse lines, observations were made at 374 stations in 30 States and Territories, including Alaska, Porto Rico, Hawaii and the Philippine Islands. In southeastern Alaska places have been examined where local magnetic disturbances affect the compasses of passing ships to such an extent as to endanger navigation.

A magnetic observatory has been established in Maryland, and sites for others have been selected in Alaska and Hawaii. In addition to their regular work, these will cooperate, at the formal request of the German Government, with the international magnetic work to be carried out during the time of the various antarctic expeditions which have been sent out from Germany and Great Britain.

Another piece of work of international interest was executed by the Survey in 1900. Observations were then made with the half second pendulum apparatus, devised by the Survey, at several of the more important European base stations, for the purpose of connecting Washington, which is used as the base for the American pendu-

lum observations. Appendix No. 5 gives the details of the results secured.

A special report on 'The Eastern Oblique Arc of the United States was completed and is being printed as a special publication. It is an important contribution to the subject of geodesy.

Satisfactory results have been obtained at the astronomical observatories maintained under the direction of the Survey at international expense, at Gaithersburg, Md., and Ukiah, Cal., for the purpose of determining the variation of latitude.

The Survey has been represented by its officers on commissions charged with the marking of one international and two state boundaries.

The report refers to the reorganization of the Office of Standard Weights and Measures and its establishment as the National Bureau of Standards by act of Congress March 3, 1901. The principal reasons for the change in order to meet the present requirements of scientific and commercial interests are summarized, and a description of the functions of the new bureau and the proposed buildings and accessories is given in detail.

## SCIENTIFIC BOOKS.

*A Treatise on Zoology.* Edited by E. RAY LANKESTER. Part IV. *The Platyhelmia, Mesozoa, and Nemertini.* By W. BLAXLAND BENHAM, D.Sc., M.A. London, Adam and Charles Black, Publishers; New York, Macmillan & Company. Pp. 204. 114 figs. in text. Price $5.25.

Volume IV. of Lankester's valuable series well maintains the standard set by the parts previously issued, and the lower divisions of the old group 'Vermes' are here treated in a broad and suggestive manner by a well-known helminthologist. The author deserves the gratitude of all zoologists for bringing together in a concise but comprehensive form the many facts that have been accumulated in connection with these lower forms of Invertebrata.

From the nature of the subjects treated the text is necessarily disconnected, but each division is accurately set forth in respect of the structural modifications and types, and each is complete in itself. The divisions which are thus separately treated are: Turbellaria, Temnocephaloidea, Trematoda, Cestoidea, Nemertini, and appendices to the Platyhelmia, including Rhombozoa (*Dicyema*, etc.), Orthonectida, Trichoplax, Salinella, etc. The author adopts Lang's classification of the Turbellaria into Rhabdocœlida, Tricladida and Polycladida; Monticelli's orders of the Trematoda, and Bürger's divisions of the Nemertini. The greatest changes are to be found in the Cestoidea. Here Lang's 'orders' *Cestoda monozoa* and *Cestoda polyzoa* are changed to the 'grades' *Cestoda monozoa* and *Cestoda merozoa*, while each is further divided into sections and orders. Among the *monozoa* we find the orders *Amphilinacea, Gyrodactylacea* and *Caryophyllacea* based upon the characters of the genera similarly named. The *merozoa* are further subdivided into sections *Dibothridiata* and *Tetrabothridiata* according to the number of sucking cups or 'bothria.' In the former there is one order, *Pseudophyllidia* of van Beneden, while in the latter the number of orders is raised to four: *Tetraphyllidia, Diphyllidia, Tetrarhyncha* of van Beneden and *Tetracotylea* of Diesing. (Tæniidæ auct.)

We are particularly pleased with the substitution of the term 'merozoa' for Polyzoa in the classification of Cestoidea and it should do away with the confusion of terms among English-speaking zoologists who adhere to Thompson's term Polyzoa for an order of the Molluscoida. The use of the term 'Mesozoa' in the title of the book is less satisfactory for it perpetuates the probable error of regarding a small group of parasitic and degenerate forms of Platyhelmia (?) as 'intermediate' or primitive types, notwithstanding that this view is strongly attacked in the text, where the word appears only in an historical sense.

An innovation of great value is the introduction of a concise historical statement, in which are given the names and dates of the men who have added to our knowledge of each of the classes considered; and still another