

Moore continued to collect the birds of the islands where we anchored, and they have brought together a fairly typical collection of the avifauna of the South Sea Islands. Dr. Pryor collected the characteristic plants, and Dr. Mayer the insects and reptiles in addition to such pelagic work as could be done in port. Both Dr. Woodworth and Dr. Mayer took a large number of photographs, and we must have at least 900 views illustrating the coral reefs of the Pacific. Dr. Woodworth also collected incidentally such ethnological material as could readily be obtained during our short stay at different places.

We were everywhere received with the greatest cordiality and courtesy: by the Governor of the Paumotu, the King of Tonga, Sir George O'Brien (the High Commissioner of the Western Pacific at Suva), Mr. E. Brandeis (the Landes-Hauptman in charge of the Marshall Islands at Jaluit), and the Governor of the Carolines. The State Department at Washington having kindly asked through the French, English and German Embassies at Washington for the kind offices of the representatives of these nations in Oceania to the *Albatross* while in their respective precincts, thanks to these credentials nothing could exceed the interest shown everywhere in the success of our expedition.

I must also thank Capt. Moser and the officers of the *Albatross* for the untiring interest shown by them during the whole time of our expedition in the work of the ship, which was so foreign to the usual duties of a naval officer. A. AGASSIZ.

THE PRESENT STATE OF PROGRESS OF THE
NEW REDUCTION OF PIAZZI'S STAR
OBSERVATIONS.*

BETWEEN the years 1791 and 1814, Giuseppe Piazzi executed at Palermo, Sicily,

*Summary of a paper read before the Philosophical Society of Washington on March 31, 1900.

the series of observations which enabled him to publish in 1814 his *Præcipuarum Stellarum Inerrantium Positiones Medie ineunte Seculo XIX*. This was by far the most accurate and extensive catalogue of stars which had ever been published from original observations. But modern advances in this sphere of astronomical research have been fruitful in detecting many sources of error affecting the positions of stars as given in this catalogue. Methods for obviating these errors are known, however, provided there should be an entirely new reduction of all the observations—proceeding directly from each nightly record.

Several abortive attempts to supply this need of astronomy have been made during the last half-century. The impetus was given to the present undertaking by the writer in the summer of 1895, though the calculations were not actually begun until the fall of 1896.

Quotations from letters from such eminent astronomers as Professor Auwers, Dr. David Gill, Professor Schiaparelli, and others; and from the published works of Professor Simon Newcomb, Professor Lewis Boss, Dr. B. A. Gould and many others, show the imperative need of such a new reduction of Piazzi's observations.

In planning a work of this kind, after regard for general methods the first consideration becomes the quantity of work involved—as on that depends the financial outlay and the best disposition of energy. Some data on this point may be of interest.

The observations were made with two instruments: a transit instrument and a meridian circle. The catalogue records a few more than 147,600 observations with both telescopes. Of these Piazzi* himself estimated that 30,000 were made with the transit. The original observations are in

*Corrispondenza Astronomica fra Giuseppe Piazzi e Barnaba Oriani—letter of 26 May, 1815.

the *Storia Celeste** and it is safe to say that they will number 150,000. There are in the catalogue 7646 stars and in the *Storia Celeste* 216 more which had been discarded.

At the very beginning of the work the co-operation of Professor Porro of Turin was secured. Some years ago he had begun, while assistant to Professor Schiaparelli at Milan, an investigation of the independence of the observations on the transit instrument. By reason of his interest in that question and the work already done in connection therewith, he very readily consented to become responsible for the reduction of all the observations of the transit instrument while the writer assumed responsibility for all the observations on the Meridian Circle and the rest of the new reduction.

For the reduction of these latter 120,000 observations the work naturally is divided into parts depending on the process to be performed. The computation sheets for each process have been designated respectively as Form A, Form B, etc. The number of pages in each Form range from 386 to 8000 and are $8\frac{1}{2}$ by 11 inches in size. There are already printed and partly or wholly filled 22,500 such pages in the following Forms:

A. Journal of Notes, constants, methods, etc.	? %
B. Day-book and provisional reduction to 1800	10 %
C. Besselian Star-constants for 1800	100 %
D. Tabulated values of the star-constants	100 %
E. Interpolated values of the day-numbers	100 %
F. Reduction from Apparent to Mean place	40 %
H. Compilation of positions by other observers	
for deduction of proper motions	10 %
M. Miscellaneous tables and short computations	? %

The percentage at the end of each line shows approximately the amount which is already accomplished. By very careful methods of checking endeavor is made to avoid numerical incorrectness, and though the work is being pushed with all energy

* Nine volumes published by Littrow at Vienna, 1845-49.

possible, it is not being done in haste at the expense of accuracy.

It is a pleasure to record the zeal with which co-operation has been secured along several lines not strictly included in the direct operation of newly reducing Piazzi's observations, though vitally connected therewith. A re-observation of all Piazzi's stars for especial use in determining their proper motions has been undertaken (and is already far on its way towards completion) by Professor J. G. Porter of the Cincinnati Observatory and Professor R. H. Tucker of the Lick Observatory. Miss Flora E. Harpam and Professor Susan J. Cunningham are performing all the labor of compiling the star positions from other catalogues for deduction of proper motions. Others are doing other useful parts of the reductions and checkings.

So long ago as 1866, when writing the preface to his own reduction of D'Agelet's observations, Dr. B. A. Gould made the following statement:

"In addition to the motives already mentioned as having prompted me to undertake this reduction and catalogue, an especial incentive was found in the experience which it would afford and make available for a much more extended work which has long been a cherished project, a recomputation of Piazzi's observations and the formation from them of a new catalogue. This is an enterprise far too extensive for the powers of a private individual, but I look forward with much hopefulness to the possibility of obtaining the requisite means at some future time . . . No astronomical labor promises richer usefulness than this; and if the great work of reducing anew the observations of Bradley be carried out by a combination of the astronomers of Europe, as is now proposed, nothing seems more appropriate for the astronomers of the New World than to render a similar service by a new reduction of the *Storia Celeste*."

This statement is even more true now than when first written. Not alone have the observations of Bradley been newly reduced by Professor Arthur Auwers and published twelve years ago, but a new reduction of Mayer's catalogue was pub-

lished by the same eminent authority in 1894. A new reduction of Taylor's 11,015 stars is expected soon to appear from the Nautical Almanac Office of England. Thus the most important old catalogue which needs to be newly reduced is Piazzini's: and the object of my remarks has been to show that at the present moment a vast amount of the work incident thereto is *already accomplished*. Thanks to the generosity of Miss Catharine W. Bruce, of New York City, financial assistance was rendered for the employment of computers between June, 1898, and January, 1900, whereby much of this result was attained. But now the possibility of its completion rests not so much in the faithful persistence of those engaged in the computations as in the additional generosity of other patrons of astronomy, and in the continued encouragement which so many Observatories and individual astronomers have thus far seen fit to so kindly bestow.

HERMAN S. DAVIS.

WASHINGTON, D. C.

SCIENTIFIC BOOKS.

Scientific Papers. By JOHN WILLIAM STRUTT, Baron Rayleigh, D.Sc., F.R.S. Vol. I., 1869-1881. Cambridge at the University Press. 1899. Quarto, pp. i-xv., 1-562. New York, The Macmillan Co. Price \$5.00.

In endeavoring to review this first volume (1869-1881) of the researches of an author like Lord Rayleigh, who has contributed fundamentally to whatever he has undertaken, and who speaks authoritatively on almost every topic in physics; in whose work, in other words, both the quality and the quantity are in evidence, it would be rash to attempt to give more than an outline of the contents. The papers moreover, are in general too severely difficult to be read as a whole, and there are no figures or diagrams (or almost none) to assist the imagination, no italics to stimulate curiosity. Many of the papers are theorems in pure mathematics, but in few cases (contributions to the mathematical tripos examinations, for instance) is the mathe-

matical story left unadorned by the moral of an application. Lord Rayleigh is pre-eminently a physicist, and mathematics with him is good means to a better end.

The book opens (1869) with papers on the applications of dynamics to electro-magnetic phenomena, showing the influence of the inspiration of Maxwell and worked out along Maxwell's lines. Thus the analogy between the decomposition of water, produced or not produced according as the circuit of a Daniell's cell (alternately made through a shunt and broken through the electrolyte) contains a coil or not, and the action of an hydraulic ram, the analogy between the spark and the rupture of the pipe, etc., are all in the spirit of an accentuation of Maxwell's conception of electric inertia, long before Lodge had popularized that doctrine. The investigation leads to a consideration of circuits containing self induction and capacity, and is carried through two long papers largely experimental in character and similar to Henry's researches on the magnetization produced by oscillatory currents.

Then follow two papers on acoustics beginning a subject destined to culminate in 1877 in the well known work on sound, which like de St. Venant's elastics, has remained without a compeer. The shorter paper completes Sondhauss's theory on the influence of the size and the form of flasks on the sounds produced when a current of air is blown across their mouths, with the aid of Helmholtz's famous research on the vibration of open organ pipes. The longer is the great paper on the theory of resonance, published in three parts in the *Philosophical Transactions* of 1870. Rayleigh here also begins with Helmholtz's results for 'Hohlräume,' using a parallel but thoroughly different mathematical treatment. Part I. contains the general dynamics for resonators of small dimensions compared with wave length, and communicating with the air by any number of holes or necks, usually along an infinite plane, and a final application to the open organ pipe is sketched out. Part II. is devoted to the special problems relating to necks, etc., suggested in Part I. The neck is here considered relative to its 'resistance' to vibration, and the pertinent electrical analogy is used