ART. XLIX.—*The Uranometria Argentina.*

IT is now nearly ten years since Dr. Gould arrived in Buenos Ayres on his way to Cordoba, under appointment by President Sarmiento to establish there a national observatory for the Argentine Confederation. It was more than two years after his arrival before he was able to mount his meridian circle and begin regular observations with it. This interval was not allowed to run to waste, and Dr. Gould began a series of observations with the purpose of doing for the southern stars what Argelander had done so well thirty years before, in the *Uranometria Nova*, for the stars of the northern sky.

Th results of this undertaking are now published in a quarto volume of 385 pages, and an atlas of 14 large maps of stars. The Uranometria Argentina will probably always be the standard of reference for the southern stars visible to the naked eye. Any information about it will therefore be acceptable to the readers of the Journal.

The quarto volume is printed in parallel columns of Spanish and English. It forms the first volume of the *Resultados del Observatorio Nacional Argentino.* It is beautifully printed by Coni at Buenos Ayres.

It consists of eight chapters. The first contains the history of the work. In the second, on *Standards of Magnitude*, Dr. Gould explains the several steps in forming standards for a symmetric and continuous series of gradations of brilliancy expressed in tenths of magnitudes, such that the round units themselves should coincide as nearly as possible with those of Argelander in his *Uranometria Nova.* A zone of stars 10° in breadth was selected, whose altitude was the same at Bonn and at Cordoba, in which 722 stars were selected as types. This series of standards was, in the end, minutely compared with the corresponding determinations of Argelander, and those of Heis in his *Atlas Coelestis Novus*, also with the magnitudes given in the *Durchmusterung* and in the zones of Lalande and Bessel. Some of the stars had been observed at Albany by Dr. Gould in 1858. A table of these type stars is given with their magnitudes as stated by these several authorities. For stars brighter than the sixth magnitude, the adopted scale ranges lower by an insignificant amount than that of the Uranometria Nova. Dr. Gould's comparisons of scales of magnitude in this chapter and in the fourth chapter are entirely independent of the like elaborate comparison by Professor C. S. Peirce in the ninth volume of the Annals of the Harvard Observatory.

The third chapter is devoted to the constellations and their

nomenclature. It opens with a history of what was done by Bayer, who first broke away from the traditional catalogue and figures of Ptolemy, by Lacaille, Bode, Sir John Herschel, Baily and others in their attempts to arrange the stars of the southern sky in constellations, and give the stars distinctive names in them. The principles which Dr. Gould has finally acted upon are expressed in six rules.

The first of these is that the constellations of Ptolemy and Hevelius, together with those adopted or introduced by Lacaille, are to be retained, and no others. *Argo* disappears *nominally*, being replaced by *Carina*, *Puppis* and *Vela*.

The other rules refer principally to the names of the stars and the constellations, except the third, which is perhaps the most important.

"The boundaries must be so arranged that the constellations shall include all stars denoted by Greek letters which were assigned to them by their authors (unless such arrangement has been superseded by later accepted authority), together with all others as bright as the sixth magnitude, which are referred to them by general usage. The boundary lines are to be formed, wherever possible, by meridians of right-ascension and parallels of declination for the mean equinox of 1875·0. When this is not feasible they should consist of regular curves as near as may be to great circles, and their positions be defined by points of intersection with meridians and parallels."

Dr. Gould has described boundaries for the several constellations up to the parallel of 10° of N. Declination, where the catalogue terminates. In approaching this limit he says that he has kept in mind the possibility of some future attempt to establish an analogous system in the northern hemisphere, and adds that this is clearly not to be thought of at present, but may at some not distant day be regarded as desirable.

The notation adopted for the stars in each constellation is given at length in the carefully prepared notes to the several constellations.

This fixing of the boundaries of the constellations, in the southern sky, is a subject of great importance. Would it not be well for the *Astronomische Gesellschaft*, or some other authority in astronomy, to consider Dr. Gould's boundaries, and, if they are approved, urge their acceptance by all astronomers?

The fourth chapter explains the determination of the magnitudes of the stars from those of the type belt, and gives a comparison of the magnitudes adopted with the magnitudes of Argelander, Heis, Lacaille, Behrmann, Lalande, Bessel and Herschel.

The fifth chapter contains the catalogue of the stars arranged by constellations. Only those stars are included that are

brighter than 7·1 magnitude, and are within 100° of the south pole, in all 7730 in number. The stars bear current numbers, in order of R. A., and the synonym in other catalogues, and the magnitude, together with the R. A. and declination are given for each star. Of the number mentioned, 6733 belong to the southern heavens, and 997 to the belt of 10° in width, north of the equator. They belong to 66 different constellations.

About 100 pages are occupied with the sixth chapter, which contains notes to the catalogue. Most of these are devoted to the magnitudes of stars, with special reference to their being possibly variable. This property of variability Dr. Gould believes to be much more frequent than has been hitherto supposed.

Chapter VII describes the atlas, which "consists of thirteen special charts, together with a fourteenth or general one, which presents at a single view the whole region included in our work, and serves as an index map both for the others and for the constellations."

These charts are drawn upon the stereographic projection, and correspond to a sphere having a radius of one meter. The stars are represented by circular black dots, having their areas proportional to their respective amounts of light; and upon the map there is given a scale to half magnitudes, but the actual drawing shows the separate stars to a nearer approximation.

"The names and distinguishing letters of the stars have been omitted, and the names of the constellations been placed in a compact form in those positions least likely to distract the attention of the observer" in order to have the real aspect of the sky as nearly reproduced as possible.

The practical inconvenience entailed by this condition of not having the stars' letters given in the first thirteen charts, is lessened by having the principal ones lettered in Chart XIV.

The charts themselves are sumptuously lithographed on heavy paper and in excellent style throughout. Perhaps nowhere is the artistic skill of the lithographer, Mr. Julius Bien, better shown than in the beautiful representation he has given of the Milky Way. Dr. Gould, after referring to the labor expended on the mapping of this part, goes on to say, "To astronomers dwelling near the level of the sea, or in the neighborhood of large cities, or where, for any other reason, the meteorological conditions are not especially favorable to transparency in the atmosphere, the brilliancy of the Milky Way as here depicted may seem excessive. But this is not so in any of those impressions which I have personally examined; none of them exaggerating in general its brightness as seen at Cordoba under favorable circumstances."

Chapter VIII, which is a dissertation on the distribution of the stars (occupying 35 pages), opens with a table showing "the number of stars, of each grade of brilliancy from $7^m{\cdot}0$ upward, which are to be found south of the parallel of ten degrees north declination." The results of this table are:—

Magnitude.	No. Stars South Declination.	No. Stars North Declination.
0·0 to 2·0	19	3
2·1 to 3·0	66	6
3·1 to 4·0	166	29
4·1 to 5·0	321	55
5·1 to 6·0	1238	174
6·1 to 7·0	4884	724

Putting Σ_m to represent the total number of stars contained in the catalogue to the mth magnitude inclusive, he finds

$$\Sigma_m = 0{\cdot}54896\ (3{\cdot}9111)^m$$

to be a near approximation to the number of stars of each magnitude contained within the limits. Then follows a careful and somewhat elaborate comparison between the numbers of stars assigned to the several magnitudes in the Durchmusterung, the Uranometria Nova and the Atlas Coelestis of Heis. Dr. Gould sums up the result of his extremely interesting investigation (p. 368) as follows:

"1. There is in the sky a girdle of bright stars, the medial line of which differs but little from a circle, inclined to the galactic circle by a little less than 20°.

2. The grouping of the fixed stars brighter than $4^m{\cdot}1$ is more systematic, relatively to that medial line, than to the galactic circle; and the abundance of bright stars in any region of the sky is greater as its distance therefrom is less.

3. The known tendency to aggregation of faint stars toward the Milky Way is according to a ratio which increases rapidly as their magnitudes decrease, and the law of which is such that the corresponding aggregation would be scarcely, if at all, perceptible for the bright stars.

4. These facts, together with others which have been stated, indicate the existence of a small cluster, within which our system is eccentrically situated, but which is itself not far from the middle plane of the galaxy. This cluster appears to be of a flattened shape, somewhat bifid, and to consist of somewhat more than 400 stars, of magnitudes from the first to the seventh, their average magnitude being about 3·6 or 3·7.

5. The general distribution of the fixed stars according to magnitude does not appear capable of being well represented by any simple algebraic expression. Yet by adopting the data of the preceding paragraph, and supposing the several magnitudes of the stars in the cluster to follow the law of Probabilities, we obtain for each class of magnitudes a number, which

being subtracted from the observed number in the sky, leaves a system of distribution which may be represented by the expression $\Sigma_m = ab^m$ within the limits of the errors of observation.

6. The accordance thus obtained holds good for the stars of both hemispheres down to the lowest limits of magnitude for which trustworthy enumerations exist; and this whether we employ the numbers of the Durchmusterung, of Argelander's and Heis's Uranometries, or of this present work.

7. The form of the expression $\Sigma_m = ab^m$ is that which corresponds to the hypothesis that in general the stars are distributed at approximately equal distances from one another, and are of approximately equal intrinsic brilliancy. It is, however, not requisite for its applicability that their distribution be equable in all directions, but only that their number be proportional to the volume of the spherical shell within which they are contained.

8. Each of the authorites, and each hemisphere, affords data from which results essentially the same value for the ratio b, the difference in the data being in every case, represented by differences in the coëfficient a. The value thus obtained for b, corresponds to the light ratio 0·4028 for descending, or 2·4827 for ascending, magnitudes."

Then follows a description of the parts of the Milky Way, with its rifts and ramifications, and the gradations and contrasts of light. With this is a careful determination of the medial points and the breadth of the stream, the position of the galactic circle, and the numbers of stars on the two sides of the circle.

"Inferences of some cosmological importance are deducible from the tables just given. It cannot escape notice that the part of the Milky Way which lies between 160° and 225° of galactic longitude, or from 6^h to 8^h of right-ascension, is much the broadest of all; this corresponding to the region of widest separation of the branch-circles in the undivided portion of the stream. Moreover the narrowest parts are from 3^h to $5\frac{1}{2}^h$ and from $10\frac{1}{2}^h$ to 12^h of right-ascension, or, roughly, in the galactic longitudes 105° to 150° and 255° to 270°. These regions, which are also of preëminent brilliancy, correspond approximately to the place where the circles of the branches intersect each other; in short, there are sundry indications that the whole phenomenon of the Milky Way may become simplified by treating it as the resultant of two or more superposed galaxies."

H. A. NEWTON.