

ART. XXXVIII.—*Letter of Dr. B. A. GOULD, Director of the Cordoba Observatory, to the Editors, dated Cordoba, Aug. 5, 1873.*

MY last letter to you was written in the beginning of Sept., 1872, at which time I gave you some account of the progress of the Uranometry, and of the preparations which were then going on for the commencement of the long deferred work of the zone observations.

Since that date I have been so overwhelmed with labors of various sorts, that I have scarcely been able to secure the needful hours for physical repose, while various superadded cares,—almost inseparable, I suppose, from an undertaking of such magnitude,—have scarcely left me the quiet for ordinary affairs of routine, and have rendered letter-writing altogether out of the question. Yet I have greatly desired to send you some brief account of the progress of the work, and now avail myself of the earliest good opportunity.

Work at the Cordoba Observatory.

The observations for the Uranometry were essentially completed early in the present year, nothing remaining to be done except the examination of discordances and the scrutiny of doubtful cases. The observations for these purposes have been carried on by Mr. Thome, in such intervals as the absorbing duties of the zone-observations permitted, and nothing now remains to be accomplished except the reductions of the star-places to the mean equinox of 1875·0, the actual preparation of the charts, and the careful delineation of the Milky Way. These represent a large amount of labor, although small in comparison with the work of observation and identification already accomplished.

Mr. Davis nearly completed the drawings of the Milky Way, upon his first series of maps, before he left us in March last; and I hope that before long the remainder may be disposed of. The preliminary tests of the observations show all the accordance that could reasonably be expected between the results obtained by the different observers; and one of the earliest processes yet to be undertaken will be the thorough and systematic comparison of the results of the four observers, and the determination for each one of his probable error for a single estimate. I am confidently hoping that a few weeks will enable us to begin the preparation of the Uranometry for publication. The rule has been to determine the magnitude of all stars down to the 7·3 magnitude, partly in order to make sure of omitting none as bright as the 7·0, and partly for other reasons. The magnitudes thus determined for stars not to be included in the Uranometry will be available for the catalogue, which I hope to construct from the zone-observations.

On the 9th of September, the observations of the zones were commenced in earnest, after a considerable amount of preliminary practice and a good deal of trouble in bringing the various apparatus into order. Whenever the weather permits we take three zones nightly, the length varying according to circumstances, but averaging somewhat less than 100 minutes. Each zone is preceded and followed by the observation of four stars, well adapted for the determination of the instrumental corrections, and by the measurement of the nadir in both coördinates; so that the entire series of observations occupies at least eight hours.

During the intervals between the zones I give rest to my eyes—the assistant who has read the microscope for the first zone taking the observations for instrumental determinations; and being himself relieved at the microscopes by a colleague, who also officiates during the second zone, while the former enjoys a period of rest. Thus the routine gives alternately to each recorder at the microscopes one night with one zone, one with two zones, and one of repose. This arrangement, which is the most convenient, was interrupted in April, by the reduction of our force to two assistants. The weather, which had for four or five months been indescribably bad, so much so indeed that from the solstice to the March equinox there had been but 5 nights free from clouds, had just become settled and favorable; during an entire month there were but two cloudy nights, and until the middle of May we enjoyed magnificent opportunities for observing. During all this time, Messrs. Thome and Bachmann continued the work without interruption or diminution, so that we observed one-half as many stars during this period of six weeks as during the whole six months preceding. This unremitting alternation they continued without the respite of a single night, provided the sky was clear, until within a few days, when the new assistant, Mr. Latzina, had acquired sufficient dexterity to relieve them in a measure by permitting the resumption of the old routine.

Thus, notwithstanding the very unfavorable weather, which has essentially delayed the completion of these series of observations, that will now require the greater part of another year. I have the satisfaction of informing you, that we have secured no less than 379 zones, containing about 50,000 stars, of which less than one-fifth are duplicates. For the width of the zones I took two degrees as far as 46° Decl., and thence gradually increased it southward, until the last belt comprises the five degrees from 75° to 80° . In the Milky Way this width is halved, and in the magnificent galactic region near η Argus and the Cross, it became necessary to subdivide yet again. Thus my original estimate of the amount of work to be done fell short

of the truth, and my present means of judging lead me to expect somewhat more than 500 zones between the parallels of 23° and 80° South Declination. These should contain about 65,000 stars, so that you will see how large a share of the work of observation has already been accomplished. I am now considering the advisableness of repeating the observation of the 10 degrees farthest north, and am inclined to believe that I shall decide to do this, in so far as it can be accomplished, without delaying the conclusion of the undertaking,—for which the greater part of another year will be needed to fill up the various regions which have been and are “being lost.” Naturally, in the intensity of all this labor, no time has been available for the reduction of these observations, nor indeed has comparatively more than a small part been even read off from the chronograph-sheets.

The Southern Circumpolar list of 54 stars, which as I once wrote you was prepared during the first year and has been worked up in the same manner as the analogous lists for the Northern Circumpolars, which I prepared for the Coast Survey some fifteen years since, and has been adopted by the American Ephemeris, affords us an ample series of well-determined stars for determining the azimuth at any desired time, and obviates the necessity of too long an interval for the observation of determining stars between the zones.

The intervals between the transits of the fundamental stars are turned to account for the determination of the positions of other stars, and in this way the materials for a small catalogue of carefully determined star-places are gradually accumulating. Among these are many of the stars used for comparison with the comet observed in January and February, 1872, but I find that I had unfortunately over-estimated the optical power of the meridian circle, which had at that time not been mounted. Thus there are several of the comparison stars which prove too faint for determination with the circle,—in which instrument I have been obliged to sacrifice the illumination of the threads upon a dark field, for the sake of obtaining a better illumination of the field itself. The continued cloudiness of the early months of this year cost me the determination of some of these comparison-stars, so that I have not even yet taken up the reduction of the observations.

In this catalogue I am endeavoring to include as many as possible of those of Lacaille's stars which have not been well observed since his time, and those stars whose places are not accordant in the different catalogues.

Mr. Davis left us early in March, as I have already mentioned, and as he desired to return home by the way of Chile, I availed myself of the opportunity to obtain data for determining the longitude of some places through which his route would pass.

His observations were made with much precision, and afford admirable determinations of the longitude of the cities of Rio Cuarto and Mendoza. Similar observations made at San Luis prove to be affected by errors of record, which preclude satisfactory results; but any future observations capable of giving results of sufficient approximation to indicate the errors which exist, will make these data available also. I had hoped to have obtained before this time the means of determining the longitudes of several other provincial capitals and prominent points, but the number and character of the impediments which are continually presenting themselves would be almost incredible to those not familiar with these regions. Still I hope before many months to carry out this plan.

The longitudes thus far determined are:—In connection with Sr. Moneta, Chief of the National Engineers, by transit observations and exchange of signals on several nights—

Rosario, E. $0^h 14^m 14^s.48 \pm 0^s.02$ (latitude, $32^\circ 56' 41''.7$)
 Buenos Aires, E. $0 23 18.88 \pm 0.03$ “ $34 36 21.4$

By solar observations made by Mr. Davis with reflecting circle—

Rio Cuarto, W. $0^m 36^s.4$ (lat. $33^\circ 7' 19''$).
 Mendoza, W. $0^h 18^m 30^s.6$ (lat. $32^\circ 53' 6''$).

The photographic work went on with all the success that we had any right to expect with the broken lens. Dr. Sellack succeeded in obtaining impressions of some twenty Southern clusters, among them one of the η *Argus* cluster with 57 stars, and one of the magnificent cluster near χ Carina with 122 stars. But the fracture seems to have been fatal in one respect, for none of the stars on these plates give a trail, so that the zero of position is not determined with the sharpness desirable. Finally, I decided to bespeak another object-glass of Mr. Fitz on my own account, and in October sent him the order. The National Government, with the liberality which it has never failed to manifest on every fitting occasion, soon afterward authorized the purchase of the lens for the Observatory, and gave to Dr. Sellack an appointment from the beginning of the year, as professor in the scientific faculty now organizing in this University, with instructions to continue the photographic work at the Observatory for the present. The new lens has now arrived in perfect order. Mr. Fitz gives very encouraging accounts of its performance, and a very few days ought to see the work resumed anew under better auspices for success. Before long I hope to be able to give you good accounts of the results obtained.

Cordoba Meteorological Bureau.

The meteorological bureau, of which I wrote, was established by the National Congress soon afterward, and is already organized. A liberal sum was placed at my disposition for the pur-

chase of meteorological instruments, to be distributed to such competent persons, in different parts of the country, as may be willing to undertake the necessary observations. Although I lost no time in ordering some instruments, as preliminary specimens, from various countries, only a few have as yet arrived; and these are already distributed. Meanwhile I am doing my best to secure the co-operation of educated men in various parts of the country, that their observations may commence as soon as the requisite instruments are at their disposal. And in the interval I am endeavoring to obtain whatever meteorological observations may have been heretofore made, within the Argentine territory, in the hope of publishing the results as a sort of basis for the study of the climatic and atmospheric relations of the country. I have had the gratification of finding that two gentlemen have carried on uninterrupted series of observations for some dozen years past, the one in Buenos Aires, the other in Bahia Blanca, near the Patagonian frontier. Others have likewise made series of observations of greater or less extent, in other places, all which I hope soon to have collected. Unfortunately, the difficulty of obtaining and transporting mercurial barometers has led almost all the observers to make use of aneroids which have been inadequately or not at all compared, and even now the transportation of a barometer is a matter of serious difficulty; since the interior traffic is chiefly carried on by troops of mules, and even where the roads permit of carriage in wagons, the peril to a fragile instrument is not much less. One gentleman recently informed me that he had had six Fortin barometers successfully forwarded him, and with every precaution which his ingenuity could suggest,—but none had ever reached him in safety. The post-office has recently introduced a lighter class of vehicles for easier and quicker transmission of the mails; and as the government is providing for the construction of roads between all the principal towns, I hope for better success in the distribution of the instruments,—since every existing facility is afforded with the utmost cordiality and liberality by the administrative officers.

Thus far the new meteorological office has secured the co-operation of about fifteen correspondents, of whom ten are already provided with the necessary instruments, and I have small doubt of finding as many more willing to undertake the gratuitous and arduous labor of three daily observations,—a matter requiring far more effort and care in this country than at home. It has seemed the far wiser policy to aim first simply at securing a few elementary data, than by asking for many and varied observations to imperil the accuracy and systematic character of the whole, and incur danger of deterring observers from an undertaking which might appear to them

too laborious. Hence the programmes issued ask only for the readings of the barometer, thermometers with wet and dry bulbs, direction and estimated force of wind and amount and form of the clouds, and quantity of rain. These taken at 7 A. M. and 2 and 9 P. M., are quite enough for persons not devoted to scientific pursuits. I have prepared a little pamphlet giving the necessary instructions and precautions, and blank forms, modeled essentially upon those of the Smithsonian institution, for the registry of the observations,—both of which have been already freely distributed. Some of the officers of the national army had commenced regular observations at frontier stations, when the present insurrectionary movement of Lopez Jordan, the assassin of Gen. Urquiza, in Entre Rios, interrupted the undertaking by requiring a concentration of the national troops in that unfortunate province, now for the second time in three years devastated by the semi-savage hordes, whom the hope of plunder, and the excitement of a mode of life more attractive to the gaucho than the pastoral pursuits of peace, have served to gather round this chief.

Earthquake of October, 1871.

You may remember hearing of the calamity to the Argentine city of Oran, which was destroyed by an earthquake on the 25th October, 1871. This was the most northerly town in the republic, situated about $4^{\text{h}} 14^{\text{m}}$ W. from Greenwich, and $23^{\circ} 10'$ S. lat., and contained about 4500 inhabitants, of whom perhaps a thirtieth part perished in the ruins. The houses in these regions are usually built, as you know, with but one story: the better class consisting of single rooms arranged round one or more open court-yards; the poorer, of a single apartment like an Irish cabin; and all constructed principally of adobe or sun-dried bricks,—so that the loss of life on such occasions is far less than would be the case were the building material harder, or the structures more elevated. This unfortunate town, having just been rebuilt from its ruins, has now suffered the same fate for the second time.

On the 7th July, I received from Major Host, a Prussian engineer officer with whom I had just concluded arrangements for determining the longitude of the city of Salta (latitude $24^{\circ} 15'$, longitude about $4^{\text{h}} 23^{\text{m}}$ from Greenwich), a telegraphic message informing me that on the day preceeding, at $3^{\text{h}} 54^{\text{m}}$ P. M., Salta had been visited by a violent earthquake, which lasted for 28 seconds, and consisted of about five severe shocks at intervals of 5 or 6 seconds,—the motion being from N.E. to S.W., followed by a series of slight vibrations which continued until about 10 P. M.

Later accounts brought information that the city of Jujuy,

north of Salta, had suffered much injury, the church tower having been thrown down, the principal public buildings much injured, and many private houses destroyed ; and we have now the tidings of the new destruction of Oran. Meantime, through the courtesy of Mr. Voglino, Superintendent of the Transandine telegraph, and the kindness of correspondents, I have learned of several shocks in the cities of San Juan, Santiago and Valparaiso on that evening and the following night, which for a time impressed me with the suspicion that the earthquake which destroyed Oran and shook the cities of Salta and Jujuy must have been the same which was felt on the Pacific Coast ten hours later. This belief appears to be generally entertained, and statements to this effect have been made in the principal journals. Nevertheless, the intrinsic improbability of such a phenomenon seemed so great, that I have made very careful inquiries, through those regions of this republic and of Chile which suffered on those dates, and have convinced myself that the first impression was incorrect.

The shocks which destroyed Oran at about 3½ P. M., July 6, are stated to have been felt at Jujuy and Salta, at from 6 to 8 minutes before 4, and at Tucuman (approx. lat. 26° 50', long. 4^h 15^m) at about 4^h 35' to 4^h 40^m. But it must be remembered that in all these places most of the people are unaccustomed to any exact determination of time, and that even the few who carry good watches have no correct standard of local time. The lines of telegraph which the National Government has been rapidly extending in various directions throughout the country, and which are now provided with the correct Cordoba and Buenos Aires time, are beginning to remedy the deficiency, but this is comparatively a slow process. Therefore it is unsafe to found any careful estimate of the velocity of the wave from the data given. The managers of the National Telegraph and of the Transandine line uniformly afford every possible facility for scientific investigations, and Mr. David, the Chief of the Cordoba office, has gathered from the various offices to the northward, as has Mr. Voglino from those to the westward, all the data which could be obtained. It is now clear to me that there were two distinct shocks at an interval of some ten or more hours ; one on the borders of Brazil and Bolivia on the afternoon of the 6th, and the other on the Pacific Coast at a little after 2 A. M. of the 7th. Both shocks appear to have been felt in Rioja, San Juan and Mendoza, along the eastern slope of the Andes ; but the data relative to the precise time of the shocks are so vague, that I do not venture to draw any inferences as to the rapidity with which the wave traveled. In Valparaiso there were eleven distinct shocks, so severe as to break all the telegraph wires between that city and Santiago.

Meteoric Iron of Grau Chaco.

The government of the Argentine province of Santiago del Estero has offered a liberal premium for the discovery of the mass of meteoric iron so often cited as existing within that province in the uninhabited region known as the Grau Chaco. This mass of iron, cited in almost all the books, was described in 1788 by two engineers, Celis and Cervino, who had been sent by the viceroy of Buenos Aires to examine into the truth of the reports given by the Indians on the subject. They reported that near the middle of a great plain called *Otumpa*, about sixty leagues to the eastward of the city of *Santiago del Estero*, they found the mass of iron in question, in form approximately a parallelopiped, of dimensions not much less than $9\frac{1}{2}$ feet by 6, and $4\frac{1}{2}$ thick, and whose weight they estimated at about 90,000 lbs. During the War of Independence, while the port of Buenos Aires was closed by the Spanish blockade, an expedition was sent to the Grau Chaco to obtain iron from this source for the manufacture of fire-arms.

The expedition was successful, and returned with a considerable quantity: a piece weighing about 1,500 lbs. was given to Sir Woodbine Parish, the English Consul, who described it in his well known work on the La Plata, and sent it to the British Museum. The English chemists found it to contain about ten per cent of nickel. A brace of pistols manufactured from the same material was sent to the President of the United States. Similar but smaller pieces of iron are said by the Indians to exist in abundance in the same region, and it is to be hoped that under the stimulus of the large pecuniary reward now offered, the long lost site may be discovered anew.