

OUR ASTRONOMICAL COLUMN.

OTTO STRUVE'S DOUBLE-STAR MEASURES.—The most important addition to double-star astronomy during the last year is without doubt the work which we owe to Otto Struve, and which is entitled "Mesures Micrométriques des Étoiles Doubles" (Observations de Poulkova Tome IX. (avec un supplément) et Tome X.). The period which the observations cover is very large when one considers that it is for one observer, commencing as it does with the observations made in the year 1837, when Otto Struve was only seventeen years old. Readers who are unable to approach these volumes themselves will find that M. Bigourdan, in the October number of the *Bulletin Astronomique*, gives a general summary of the whole of the contents. As one would expect, the introductions to the volumes contain a mine of important information, both with regard to the measures and to the puzzling question of the "personal equation," a question on which even to-day astronomers hold different views. Otto Struve busied himself especially in this direction, making, in the years 1853-1876, a series of measures of artificial double stars. The expressions for the corrections which he obtained assumed considerable proportions, as will be seen below, the first being that for angles of position, and the second that for distance:—

Position angle

$$\text{Corr.} = + \frac{5'' \cdot 2}{1 + 0 \cdot 20g^2} + \frac{4'' \cdot 4 \sin(2\phi - 27^\circ 13')}{1 + 0 \cdot 14(3 \cdot 3 - g)^2} + \frac{5'' \cdot 6 \sin(4\phi - 25^\circ 0')}{1 + 0 \cdot 20g^2}$$

Distance

$$\text{Corr.} = + \frac{0'' \cdot 050(g - 2 \cdot 0)}{1 + 0 \cdot 09(4 \cdot 2 - g)^2} + \frac{0'' \cdot 15 \cos(2\phi - 28 \cdot 4)}{1 + 0 \cdot 06(5 \cdot 2 - g)^2}$$

when g represents "l'angle visuel du couple considéré expérimenté en prenant pour unité celui qui correspond au grossissement de 708 fois," and ϕ is the angle of the line between the two stars and the vertical.

Whether such corrections as these, made under non-observational conditions, should be applied to measures actually made in the sky is still open to much doubt. Otto Struve discusses also the observations made at Pulkova with those made at the same epoch by different observers; the comparison, to take an example, shows that Dawes's position angles in his early measures appear free from systematic error, while those made later require a correction of + 1''·8; his distances up to 8" seemed all to be desired. Dembowski's measurements of angles also required no correction, but his distances, especially about 6", demand a small positive correction (0''·22). In the second volume one finds the measures of W. Herschel's classes V. and VI., couples with large proper motion, including measures for the determination of parallaxes, and for the determination of the relation of the number of optical to physical binary stars discovered by M. Burnham and other astronomers, and a continuation of W. Struve's and O. Struve's measures. Double-star astronomy is already possessed of two fine monuments in the works of W. Struve's "Mensuræ Micrometricæ" and of Baron Dembowski's "Misure Micrometriche," and to-day we may, as M. Bigourdan adds, name a third in the "Mesures Micrométriques des Étoiles Doubles" of M. Otto Struve.

METHOD OF PIVOT TESTING.—By means of interference fringes, employed by M. Fizeau in his researches on crystals, M. Maurice Hamy describes a method of studying the form of pivots of a meridian instrument (*Comptes Rendus*, No. 20, Nov. 13th), which indicates errors not discernible by the ordinary course adopted. The great advantage to be gained by it is that the state of the pivots can be very easily, and with the expenditure of a very little time, ascertained. The arrangement consists in placing a metallic block astride a pivot, the block being supported further by a pointer fixed to a part of the telescope. The extremity of this pointer fits into the bottom of a horizontal groove, parallel to the meridian, in the pier. Contacts between the pivot and the pointer is thus ensured by the pressure of several weights, while displacements of the whole arrangement against slipping are totally eliminated. On the block rests, at one of its extremities above the centre of the pivot, a lever which is movable about an axis on the pillar on a vertical plane; this carries a small horizontal piece of glass, fixed in a certain manner. Between this mirror and the front of the lens of a fixed collimator are produced the interference fringes, the source of light (monochromatic) being placed at the focus of the lens. Turning the telescope on its

axis, the block remains still, but movements of a small nature in the vertical direction were observed which were sufficient to indicate the imperfectness of the pivot. To obtain at a glance the order of the magnitude of such errors, a plane mirror was fixed at some distance from the axis of the lever, so determined that the fringes were displaced by a row when the inclination of the telescope experienced a perturbation of 0'·015, by the action of one of the irregularities. The method of observation consists simply in counting the number of fringes which exceed a fixed limit when the telescope is turned, the number thus obtained expressing in hundredths of a second in time the order of the error. A trial of the above method shows that irregularities on the surface of pivots can be easily observed, and, moreover, the errors "ne sont pas complètement négligeable au point de vue des observations."

A BRIGHT METEOR.—The following are a few facts about a bright meteor which Prof. Schur, of Göttingen, has been good enough to send us:—The meteor was observed on Monday, November 27, at 5h. 54m. mean time, and the direction of its path lay between ζ Perseii and towards α Piscium. At first it appeared as bright as α Tauri, and then quickly excelled Jupiter in brilliancy, the light gradually fading away afterwards. The duration of the phenomenon was estimated at about ten seconds, and the trail was observed to be of a yellowish-red colour. Curiously enough, three minutes later a fainter meteor shot across the heavens from the zenith, its direction being nearly at right angles to that of the preceding one.

ASTRONOMICAL PHOTOGRAPHY.—Mr. H. C. Russell, F.R.S., President of the Astronomy, Mathematics, and Physics Section of the Australasian Association for the Advancement of Science, traced the history of astronomical photography in his presidential address at the recent Adelaide meeting. "In many departments of astronomy," he declared in the opening paragraph, "the observer must stand aside while photography takes his place and works with a power of which he is not capable, and I feel sure that in a very few years the observer will be displaced altogether, while his duty will be done by a new sensitive being—a being not subject to fatigue, to east winds, to temper, and to bias, but one above all these weaknesses, calm and unruffled; with all the world shut out, and living only to catch the fleeting rays of light, and tell their story."

"VIERTELJAHRSSCHRIFT DER ASTRONOMISCHEN GESELLSCHAFT."—The third part of this year's publication gives an account of the work done at the observatories usually included in this list, each director, as has been done in former numbers, summing up in a few words, and stating the work being, and about to be, accomplished. We must refer our readers to the publication itself for individual information.

GEOGRAPHICAL NOTES.

L'Afrique gives a brief account of the last exploring journey of the late M. Georges Muller in Madagascar. He had returned to Antananarivo from a successful visit to Antsirabe, where he went to collect bones of *epiornis*, and in June he set out for Lake Alaotra, which, in company with Father Roblet, he explored, adding a number of features to the maps of the district. Parting from his companion, Muller pushed on with the view of reaching Mojanga on the west coast, but near Mandritsara he was attacked and murdered by a party of Fahavalos, one of the independent tribes who still contend against the Hova supremacy of the island.

The *Madras Mail* says that the Indian Marine Survey vessel *Investigator* has proceeded to the Laccadives to continue the survey of those islands, which has been in course of preparation during the last two years. From the Laccadives the *Investigator* will go to Madras, and will be engaged for a few weeks in completing the East Coast Marine Survey from Pulicat Lake, where work was left off last year, to Madras Harbour. Finally in February the *Investigator* will proceed to Palk Straits, and a thorough survey of the dividing sea between India and Ceylon will be made, ostensibly with the object of testing the practicability of constructing a canal and a railway. The distance from the Indian mainland to Ceylon is sixty miles, of which twenty constitute Adam's Bridge proper. The bridge is said to consist of an irregular ridge formed of rock and sand partly dry at low water, but intersected by small intricate channels navigable only for native boats of very light draught. Average

spring tides rise only about two feet, so that the construction of the railway works and their future maintenance would be greatly facilitated. It is thought that the works required would consist of an iron and steel viaduct of considerable length, but in short spans, no large span being required except over the existing navigable channel, where a swing bridge would probably be necessary. Until a detailed survey of the strait has been made, however, it is impossible to speculate upon the details of the railway or the canal project with any degree of certainty; and the Government of India is determined to settle the question once for all by making a thorough survey of the coast and dividing sea.

FULL particulars have lately been received of the death by drowning, in September last, of Mr. H. M. Becher, while on his way to visit the mountain known as Gunong Tahan in the province of Trengganu in the Malay peninsula. He had come within sight of the mountain, which had never before been seen by a European, and roughly estimated its height at between 8,000 and 9,000 feet, when his camp on a low island in a river was submerged by a sudden flood, and the boat in which he attempted to reach the shore capsized. His companion, Mr. H. Quin, escaped, but did not continue the journey.

A LONG letter just received from Mr. Astor Chanler, who is travelling in East Africa, is published in the December number of the *Geographical Journal*. It contains the unfortunate tidings that his companion, Lieutenant von Höhnel, whose previous successful travels in East Africa are well known, had been seriously wounded by a rhinoceros, which rendered his immediate return to Europe necessary. Mr. Chanler, although he has suffered greatly from loss of men and animals, is determined to push on to the north in the hope of reaching Berbera or Zeila. At the time of writing, September 20, the party had returned to Daicho, near Mount Kenia, after a visit to the Rendile tribe, who live in the country to the north. These people appear to have strong Somali affinities, and were more intelligent than the Masai, but equally fierce and intractable. The loss of von Höhnel's services will detract from the geographical value of the expedition, as he is an accomplished surveyor.

IN our last issue we gave, without comment, an abstract of one of the rumours regarding the Nansen expedition, published by an evening newspaper. It is right to add, however, that the report of high land north of the New Siberian Islands is no new thing, and that Nansen has no thought of taking up winter quarters on any land, his intention being to get fast in the ice, and drift wherever it carries him. His only object in touching at the New Siberian Islands was to send letters home; but if the sea was as favourable as we believe it to have been, he would probably strike straight northward without calling anywhere.

ANTARCTIC EXPLORATION.

AT the meeting of the Royal Geographical Society on Monday evening Dr. John Murray, of the *Challenger* Expedition, read a paper on the renewal of Antarctic exploration. He sketched the history of voyages to the far south, and of the notions which prevailed as to the nature of the South Polar region from the earliest time down to the present day. He showed that while the huge southern continent believed in by the geographers of past ages had been vastly diminished by increased knowledge, the probability is that around the South Pole a land area of about 4,000,000 square miles actually exists. He indicated the present state of our knowledge of the region, which is extremely meagre, and then went on to show that until this knowledge was greatly increased many problems in science must remain unsolved. Until we had a complete and continued series of observations in the Antarctic area the meteorology of the globe could not be understood. Important problems in geology, in biology, in physics, in oceanography, demanded the renewal of research on an adequate scale in the South Polar area. Dr. Murray concluded as follows:—

Within the past few months I have been in communication with geographers and scientific men in many parts of the world, and there is complete unanimity as to the desirability, nay, necessity for South Polar exploration, and wonder is expressed that an expedition has not long since been fitted out to undertake investigations which, it is admitted on all sides, would be of the greatest value in the progress of so many branches of natural knowledge.

To determine the nature and extent of the Antarctic continent; to penetrate into the interior; to ascertain the depth and nature of the ice-cap; to observe the character of the underlying rocks and their fossils; to take magnetic and meteorological observations both at sea and on land; to observe the temperature of the ocean at all depths and seasons of the year; to take pendulum observations on land, and possibly also at great depths in the ocean; to bore through the deposits on the floor of the ocean at certain points to ascertain the condition of the deeper layers; to sound, trawl, and dredge, and study the character and distribution of marine organisms. All this should be the work of a modern Antarctic expedition. For the more definite determination of the distribution of land and water on our planet; for the solution of many problems concerning the Ice Age; for the better determination of the internal constitution and superficial form of the earth; for a more complete knowledge of the laws which govern the motions of the atmosphere and hydrosphere; for more trustworthy indications as to the origin of terrestrial and marine plants and animals, all these observations are earnestly demanded by the science of our day.

A dash at the South Pole is not what I now advocate, nor do I believe that is what British science, at the present time, desires. It demands rather a steady, continuous, laborious, and systematic exploration of the wholesouthern region with all the appliances of modern investigators.

This exploration should be undertaken by the Royal Navy. Two ships, not exceeding one thousand tons burthen, should, it seems to me, be fitted out for a whole commission, so as to extend over three summers and two winters. Early in the first season a wintering-party of about ten men should be landed somewhere to the south of Cape Horn, probably about Bismarck Strait at Graham's Land. The expedition should then proceed to Victoria Land, where a second similar party should winter, probably in Macmurdo Bay near Mount Erebus. The ships should not be frozen in, but should return to the North, conducting observations of various kinds towards the outer margins of the ice. After the needful rest and refit, the position of the ice and the temperature of the ocean should be observed in the early spring, and later the wintering parties should be communicated with, and, if necessary, reinforced with men and supplies for another winter. During the second winter the deep-sea observations should be continued to the north, and in the third season the wintering parties should be picked up and the expedition return to England. The wintering parties might largely be composed of civilians, and one or two civilians might be attached to each ship; this plan worked admirably during the *Challenger* expedition.

It may be confidently stated that the results of a well-organised expedition would be of capital importance to British science. We are often told how much more foreign governments do for science than our own. It is asserted that we are being outstripped by foreigners in the cultivation of almost all departments of scientific work. But in the practical study of all that concerns the ocean this is certainly not the case; we have to acknowledge no superiors nor equals in this branch of investigation, and if we be a wise and progressive people, British science will always lead the way in this direction. Twenty or thirty years ago we were in profound ignorance as to the condition of all the deeper parts of the great ocean basins; now we have a very accurate knowledge of the conditions which obtain over the three-fourths of the earth's surface covered by the waters of the ocean. This is the most splendid addition to earth-knowledge since the circumnavigation of the world, and is largely due to the work and exertions of the British navy in the *Challenger* and other deep-sea expeditions.

This country has frequently sent forth expeditions, the primary object of which was the acquisition of new knowledge—such were the expeditions of Cook, Ross, and the *Challenger*; and the nation as a whole has always approved such action, and has been proud of the results, although they yielded no immediate return. Shall it be said that there is to be no successor to these great expeditions?

A preliminary responsibility rests on the geographers and representatives of science in this country. It is necessary to show that we have clear ideas as to what is wanted, to show that a good workable scheme can be drawn up. When this has been done it should be presented to the Government with the unanimous voice of all our scientific corporations. Then, I have little doubt, that a Minister will be found sufficiently alive to the spirit of the times, and with sufficient courage to add a few