(*Stercorarius crepidatus*) from Spitzbergen, presented by Mr. J. F. Studley; two Variegated Sheldrakes (*Tadorna variegata*) from New Zealand, presented by Sir Walter L. Buller, K.C.M.G.; two Streaky-headed Grosbeaks (*Poliospiza gularis*) from South Africa, presented by Miss Jessie Porter; an Oyster-catcher (*Himantopus ostralegus*), British, presented by Mr. R. Gurney; a Bordeaux Snake (*Coronella girondica*), a Common Snake (*Tropidonotus natrix*, var.) from France, presented by Mr. E. A. Minchin; a Squirrel Monkey (*Chrysothrix sciurea*) from Guiana, a Beccari's Cassowary (*Casuarius beccari*) from New Guinea, a Red Kangaroo (*Macropus rufus*, ♀) from Australia, deposited; two Otters (*Lutra vulgaris*) from Ireland, four Cayenne Lapwings (*Vanellus cayennensis*) from South America, purchased; a Chinese Mynah (*Acridotheres cristatellus*) from China, received in exchange; an African Wild Ass (*Equus tæniopus* ♀) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

DOUBLE STAR OBSERVATIONS.—In *Ast. Nach.*, No. 3370, Dr. Doberck, while discussing the elements of η Coronæ Borealis, takes the opportunity to determine the probable error that accompanies the observation of position angle and distance in the case of the better-known double star observers. Three stars have been selected for the discussion. η Coronæ, a close double, in which the probable errors are referred to a common distance of 0″·7; α Centauri, reduced to a mean distance of 10″, and, of course, including a different class of observers; and γ Virginis, with a mean distance of 2″·5. Dr. Doberck might with advantage have given the aperture of the telescope with which the observations have been made, but a glance at the list is sufficient to show that the greatest accuracy, as might have been anticipated, is on the side of the large telescopes. In the case of η Coronæ, Profs. Hall and Burnham are the only observers whose probable errors fall below 1° in position angle. In distance, their only competitor is M. Perrotin, who also has the advantage of large aperture. With γ Virginis, where the components are more widely separated, telescopes of moderate size are able to compete advantageously, and the measures of MM. Duner and Schiaparelli appear quite as trustworthy as those of Prof. Hall. The probable errors attached to observations made in the southern hemisphere are, on the whole, slightly larger than those derived from northern observers.

VARIABLE STARS.—Owing to the rapid accumulation of new material, which seems to be coming in on all sides, Dr. Chandler thinks that a new edition of his catalogue, incorporating everything up to date, is necessary. With this we entirely agree with him; for, although the system of supplements is a good one, they *can* accumulate, and when this happens the sooner they can be eliminated the better. Our readers are so familiar with these catalogues, that little need be said when it is stated that Dr. Chandler has entirely overhauled the work, and brought in all the new material. It is good, however, to hear, as he says, that the "degree of uniformity and completeness of the observation of the phenomena, and the consequent development of our knowledge with regard thereto, during the past few years is remarkable." He adds, however, further that the need for volunteers in the southern hemisphere is pressing (*Astronomical Journal*, No. 379).

VARIABLE STAR OBSERVATIONS.—Profs. Barnard and Chandler have both called attention to possible errors introduced into the observation of variable stars from physiological causes. The latter thinks that a systematic error arising from unequal sensitiveness of different portions of the retina, dependent upon different positions of the variable star with reference to those with which it is compared at different hour angles, can be traced in the case of the minimum phase of U Pegasi. Mr. A. W. Roberts, in the *Astronomical Journal*, No. 381, urges the employment of some mechanical means for the elimination of this source of error. He himself has been in the habit of using both a negative and a direct-vision eyepiece, and taking the mean of the two observations. In this way, it is asserted, the mean error of observation has fallen from 0·12 mag. to about 0·05 mag. The obvious suggestion of employing a prism mounted behind the eyepiece, and taking four observations in such a manner that the comparison star is rotated 90° about the variable, is not lost sight of; and when this arrangement is carried into effect, it is confidently anticipated that the mean error will not be greater than 0·03 mag. It is needless to point out that this implies a greater degree of accuracy than has been attained with any photometer. The probable error in the case of the Harvard photometer has been quoted as 0·075 mag., and Drs. Müller and Kempf, with the Zöllner photometer at Potsdam, have not been able to make their probable error much below 0·06 mag. Mr. Roberts' experiment will, therefore, be watched with considerable interest.

THE CAPE OBSERVATORY.—The Observatory Report for 1895 furnishes several items of general interest. The fine equatorial, presented by Mr. McClean, is in an advanced state, the only part not yet commenced being the line-of-sight spectroscope. Besides the cylindrical observatory and hemispherical dome, the donor has generously provided a rising floor of excellent design, and also an attached building containing entrance hall, study, developing room, and instrument store. The objective prism of 24 inches aperture has been completed by Sir Howard Grubb. The chief part of the year has been occupied in clearing off arrears of reduction and publication. The publications during the year included—"The Cape General Catalogue for 1885, with Appendices, &c."; "A Determination of the Solar Parallax and the Mass of the Moon from Heliometer Observations of the Minor Planets Iris, Victoria, Sappho"; the first volume of the "Cape Photographic Durchmusterung," containing the mean places of 152,000 stars for 1875, derived from Cape photographs between Declinations −19° and −37°; a complete account of the "Geodetic Survey of South Africa." Much actual observational work has been entirely suspended to allow of these publications being completed. It is also mentioned that an increase of staff will be required for the new astrophysical department created by the advent of the McLean telescope. With the transit instrument 2872 stars have been observed, the small number being due to the objects being chiefly slow-moving circumpolar stars. The work with the astro-photographic telescope has been satisfactory. 91 catalogue plates were taken, 55 of these being finally passed. 367 chart plates were exposed, 240 being passed. This leaves 15 catalogue and 253 chart plates yet to be done to complete the complement assigned to the Cape. A complete investigation of the réseau used here (Gautier No. 8), has been made, and will soon be published. The observations made with the zenith telescope in 1892, 1893 and 1894, for aberration and change of latitude, are completely reduced, and are being finally revised.

AN INVESTIGATION ON ABERRATION AND ATMOSPHERIC REFRACTION.—The latest volume of the publications of the Washburn Observatory of the University of Wisconsin (vol. ix.) contains an investigation, by Mr. George C. Comstock, on "Aberration and Atmospheric Refraction." It may be remembered that M. Lœwy pointed out the extended use of the equatorial telescope and its adaptation to new lines of research through the introduction of reflecting surfaces in front of the objective. The method adopted here, however, deviates widely from Lœwy's, for reasons given by the author in the introduction. Instead of the employment of a prism in front of the object-glass (the fundamental idea of the apparatus designed by M. Lœwy), the reflecting surfaces of which were the silvered faces of an equiangular glass prism, Mr. Comstock substituted for it three plane mirrors of rectangular cross-section. By this means he was able to overcome the great drawback, met with when using the prism, of the deformations of the prism arising from changes of temperature, and producing errors of focus which seemed to be insuperable with this type of apparatus. A detailed description of the mirrors and method of mounting, too long to be referred to here, is given. Mr. Comstock next enters on the determinations of the errors of the apparatus, and gives tables of the instrumental constants that follow, a description and investigation of the micrometer employed, and the effect of aberration and refraction upon the apparent distance between two stars respectively. Several other points are investigated, which he found were important after a preliminary trial of the method he adopted. From the discussion of 822 observations of the angular distances separating thirty-nine pairs of stars made by two observers, it appeared, as he says, "that the apparatus as employed is capable of furnishing a very considerable degree of precision, the probable error of a single observation made under normal conditions being ± 0″·30, *i.e.* less than a millionth part of the quantity measured." As mentioned before, the observations were made to determine, from the annual variations

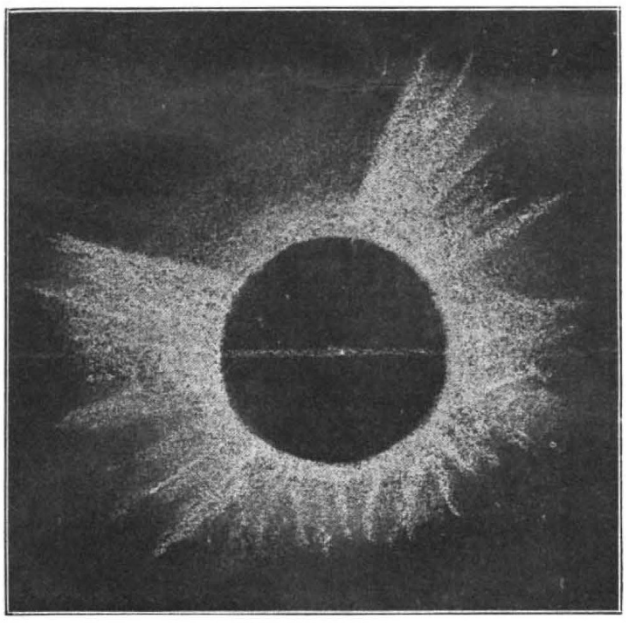
in the distance separating each pair of stars, a value of the constant of aberration, and a second part of the work was to make a comparison of the measured and computed distances, which would give the corrections to be applied to the refraction tables. A series of subsidiary investigations, the results of which are given on page 203, was also completed. The result of the whole investigation furnishes as a definite result: Constant of Aberration $= 20''\cdot443 \pm 0''\cdot010$, which differs only very slightly from the commonly accepted value obtained by Struve, and this within its own limit of probable error. The volume is accompanied by some excellent illustrations of the instrument and the novel dome which protects it. The second part of this volume contains the observations of the right ascensions of the stars observed with the prism apparatus made by Mr. Albert S. Flint.

NEW FEATURE ON MARS.—A telegram from Kiel announces the observation of a bright prominence on the terminator of the planet, by Messrs. Hussey and Holden, at the Lick Observatory on Wednesday last, August 27. The planet is well situated for observation at midnight, being at present some five or six degrees north of α Tauri.

THE ECLIPSE AT BODÖ AND NORTH FINLAND.

WE give this week a reproduction of the drawing of the corona made near Bodö, which accompanied Dr. Brester's letter in our last issue (p. 390).

Further particulars have been received concerning the doings of the Russian Expedition under Baron Kaulbars, which observed in Russian Finland. There was an unusually large development of the corona, the extensive and often oblique rays of which surrounded the dark disc of the moon. One of these rays reached a length double that of the sun's diameter. Some of the rays crossed each other, and Baron Kaulbars writes to the *St. Petersburger Zeitung* "that the remarkable proportions of the corona coincide with the opinion according to which this phenomenon is only very little developed with a *minimum* of sun-spots, for he had been able to see only very insignificant spots on the sun at rare moments during observations extending over several weeks."



Dr. Brester's drawing of the Corona.

Other expeditions to the Maritime Province of the Amur appear to have been very successful.

ON THE RÖNTGEN RAYS.[1]

WHO would have dreamt at the last annual meeting of the Victoria Institute, that before a year was out, we should be able to see on a screen, to receive on a photographic plate, which is afterwards developed, the skeleton, or a portion of the skeleton of a living man, or at least a living child? And as the modes of exciting these rays improve, we shall probably go on, step by step—indeed already, I believe, the whole body of a full grown man has been penetrated by these rays, the discovery of which we owe to Dr. Röntgen.

I feel some diffidence in bringing this subject before you, because I have never, myself, made experiments with the Röntgen rays. Nevertheless I have read a good deal about them, following what others have done, more especially where it connected itself with the subject of light, to which I have paid a good deal of attention. So I cannot but have a tolerably definite idea in my own mind as to the nature of these Röntgen rays which has been a matter in dispute and, I may say, is still in dispute, although I think opinions are generally coming round to that which I will bring before you in the end.

Now before I go to the Röntgen rays direct, I must touch on previous work which gradually led up to them.

For a very long time it has been known that an electric discharge passes more readily through tolerably rarefied air, than through air of greater density, and so with other gases. If we have a longish closed tube, provided with electrodes at the ends by means of platinum wires passing through the glass, if the air be tolerably exhausted from it, an electric discharge passes, comparatively speaking, freely through it, forming a beautiful skein of light, if I may so speak, and under certain circumstances that skein of light is divided into strata in a very remarkable manner. These strata fill the greater part of the tube from the positive electrode, or anode, as it is called, till we get nearly, but not quite, to the negative electrode, or kathode. There is a dark space separating the end of the positive discharge which, as I said, under suitable conditions and sufficiently high exhaustion, shows stratification, from a blue glow enveloping the negative electrode or part of it. The luminosity about the kathode is somewhat indefinitely bounded on the side of the stratification.

When, however, the exhaustion is carried still further, at the same time the strata become wider apart, and the luminosity recedes from the kathode and expands, forming a sort of glowing halo much more sharply defined on the inside than the outside; in that respect resembling the ordinary luminous halo—not the corona—occasionally seen round the moon. We have here, then, these two dark spaces, one outside the halo, where the luminosity gradually fades off, and another dark space on the inside, where the luminosity is more sharply defined, and which reaches to the negative electrode.

Now it is the phenomena in connection with this second dark space that I have more particularly to bring before you. As the exhaustion is rendered higher and higher, the inner dark space gets wider and wider until at a sufficiently high exhaustion it fills the whole tube or bulb. Mr. Crookes has worked more especially at this subject, and, indeed, the tubes which are now used for the production of the Röntgen rays, are generally called "Crookes tubes." I have seen in some of the foreign periodicals the word "Crookes" used to signify one of these tubes. Mr. Crookes' researches in very high vacua led him up to that most remarkable instrument, the radiometer, the nature of which led us to form clearer conceptions, than we had hitherto done, of the nature of the motion of molecules in gas; or rather, when the theory of the radiometer was made out, presented us, as I may say, with a visible exhibition of the thing in actual working.

Now these researches, which led Mr. Crookes to improve his vacuum, naturally led him to examine the electrical phenomena produced by excessively high vacua.

I have said that it was with the second or inner dark space that I had chiefly to do. When the exhaustion is sufficient, that fills the whole tube.

Now what takes place in this dark space? Suppose we interpose a screen, such as a plate of mica with a hole in it. A portion of the discharge from the negative electrode goes through that hole and continues onwards in a straight course until it reaches the wall of the tube. When it reaches the wall

[1] An extract from the Annual Address to the Victoria Institute, by Sir G. G. Stokes, F.R.S., the President.