OUR ASTRONOMICAL COLUMN

THE ELLIPTICITY OF URANUS.—It may be remembered that Sir William Herschel, who was at first under the impression that the disk of Uranus presented a perfectly circular outline, was afterwards convinced that there was an appreciable elongation in the direction of the major-axis of the orbits of the satellites, though he has not recorded any measures to test this conclusion. On October 13, 1782, about eighteen months after the discovery of the planet, he writes: "I perceived no flattening of the polar regions." On March 5, 1792, he used "a newly polished mirror of an excellent figure: it showed the planet very well defined and without any suspicion of a ring." With powers 240–2400, all which his speculum bore with great distinctness, he formed a different opinion, and remarked, "I am pretty well convinced that the disk is flattened." On February 26, 1794, he has an observation thus recorded, "20-feet reflector, power 480. The planet seems to be a little lengthened out in the direction of the longer axis of the satellites' orbits." Further, in a paper communicated to the Royal Society in December, 1797, wherein he announces his supposed discovery of four additional satellites of Uranus, he says: "The flattening of the poles of the planet seems to be sufficiently ascertained by many observations. The 7-foot, 10-foot, and the 20-foot instruments equally confirm it, and the direction pointed out February 26, 1794, seems to be conformable to the analogies that may be drawn from the situation of the equator of Saturn and of Jupiter." This ellipticity being admitted, he inferred that Uranus had a rapid axial rotation.

In September, 1842, Mädler, remarking that notwithstanding the statement made by Sir W. Herschel no measures of the planet existed which would confirm it or otherwise, instituted a series with the filar-micrometer of the Dorpat refractor. The measures were made on five nights, and the diameter of the planet was determined at every 15° of the circumference, the mean of each set being made to fall nearly at the time of meridian passage. The nights (September 16, 17, 19, 20, and 21) were of exceptional clearness, and permitted of a power of 1000 being used. Mädler found the greater diameter of Uranus 4″·249 at the planet's mean distance, and the compression $\frac{1}{10{\cdot}85}$; the angle of the greater axis was 160° 40′ counted from north towards east. At this time Uranus was less than 11° from the descending node of the orbits of the satellites, as determined by Prof. Newcomb.

Between August 24 and October 20, 1843, Mädler repeated his measures on seven nights: his results from this year's series were—

Greater axis of projected ellipse ...	4″·3274
Lesser axis ,, ,, ...	3·8910
Compression	$\frac{1}{9{\cdot}92}$
Angle of greater axis with declination circle	15° 26′·1

This ellipse is for September 28, 1843, when the distance of Uranus was 19·079. The greater axis for the mean distance of Uranus would be 4″·304.

An ellipticity comparable with that of the planet Saturn might have been expected to strike the generality of observers provided with the large instruments which have been available since the epoch of Mädler's measures; yet neither with the Pulkowa refractor, with the late Mr. Lassell's 4-foot reflector, employed by him and Mr. Marth in measures of Uranus at Malta in 1864–5, nor with the Washington 26-inch refractor, or many other instruments of adequate power, do we find that there has been any confirmation of the great inequality of diameters found by Mädler, up to 1877.

It now appears from a communication made by Prof. Safarik of Prague to the *Astronomische Nachrichten* in April last, that on March 12, 1877, he found Uranus "certainly elliptical, the greater axis in the parallel," and this impression he received on various occasions up to the date of his letter. On April 2 in the present year he records of the appearance of the planet: "Stets stark länglich; in den besten Momenten schätze ich die Elliptität stärker als jene Saturns"; the greater axis was at 190°. The instruments used were of very moderate capacity, being an achromatic of 11 cm. and a silver-on-glass speculum of 16 cm.

In consequence of a representation from Prof. Safarik, who laid stress upon the actual proximity of the planet to the ascending node of the orbits of the satellites, Prof. Schiaparelli has made, this year, an extensive series of measures of the diameter of Uranus, the results of which have appeared in No. 2526 of the above-named periodical. The measures are discussed on two methods giving for the ellipticity of the planet in the one case $\frac{1}{10{\cdot}98 \pm 0{\cdot}93}$, and in the other (perhaps the more preferable value), $\frac{1}{10{\cdot}94 \pm 0{\cdot}67}$. In addition to actual measures, Prof. Schiaparelli drew the outline of the planet, as it appeared to the eye, on thirteen nights, the drawings giving by measurement an ellipticity of $\frac{1}{11{\cdot}07}$. An assistant in the same way found $\frac{1}{10{\cdot}9}$. The Milan measures with the filar-micrometer were made between April 12 and June 7. For the equatorial diameter at the mean distance Prof. Schiaparelli found 3″·911.

PHYSICAL NOTES

IN the current number of *Wiedemann's Annalen*, Prof. C. Christiansen of Copenhagen resumes his researches on the indices of refraction of coloured liquids. The methods adopted consisted in the examination of the liquid in hollow prisms of very small refracting angle; a few drops of the liquid being placed between two small pieces of glass touching each other at one side, but separated about half a degree. Another method consisted in inclosing the liquid between a piece of very thin glass and a biprism made of a glass the index of refraction of which was known, the index of the liquid being calculated by taking the refraction as the difference of the two separate refractions of the glass and the liquid. Prof. Christiansen gives tables of results for water, alcohol, turpentine, and nitrobenzol, and also for solutions of permanganate of potash of various degrees of concentration. For the latter substance the results agree with the determinations of Kundt, but are probably more exact.

PROF. G. M. MINCHIN has greatly improved the form of the absolute sine electrometer invented by him some months ago. The first of the new instruments constructed by Mr. Groves of Bolsover Street is now complete, and is to be sent out to Prof. Anthony of the enterprising and wealthy Cornell University. We hope shortly to illustrate and describe this beautiful instrument.

PROF. EWING of Tokio prints in the *Proceedings of the Seismological Society of Japan* three valuable seismological notes. The first of these describes a duplex pendulum seismometer the principle of which is the following:—A common pendulum having its centre of gravity below the centre of suspension is stable; an inverted pendulum with pivoted supporting rod is unstable. By placing an inverted pendulum below a common one, and connecting the bobs so that any horizontal displacement must be common to both, the equilibrium of the jointed system may be made neutral or as nearly stable as is desired. A very sensitive seismograph is thus obtained. The instrument has not yet been put to the test of an actual earthquake.

PROF. QUINCKE has contributed to the *Proceedings of the Royal Prussian Academy of Sciences* an important memoir on the changes produced by hydrostatic pressure in the volume and refractive index of transparent liquids. The ratio of these changes exhibits, it appears, a definite relation. The compressibility in volume was measured by subjecting the liquids to pressure in glass vessels furnished with capillary tubes. The indices of refraction were measured by observing the number of interference bands in homogeneous light in an interferential refractometer. One of the most important results of this research is the light it throws on the disputed formula called the *constant of refraction*. According to Dale and Gladstone the name of *constant of refraction*, or *specific refractive power*, should be assigned to the quantity $\frac{\mu - 1}{s}$, where μ is the index of refraction and s the specific gravity of the substance. According, however, to Laplace the quantity $\frac{\mu^2 - 1}{s}$ is the true constant of refraction; whilst, according to Professors H. A. and L. Lorenz, that name should be given to the more complicated function $\frac{\mu^2 - 1}{(\mu^2 + 2)s}$. Now since with liquids that are subjected to pres-

sure the density varies proportionally with the pressure within certain limits, the true constant of refraction should be that function of the index of refraction and of the density which is independent of pressure. In point of fact Prof. Quincke's experiments confirm the formula of Dale and Gladstone, since $\frac{\mu - 1}{s} = \frac{\mu_1 - 1}{s_1}$, where s_1 is the density under any given pressure, and μ_1 the observed refractive index under the same pressure. To put the matter in simple phrase, *the decimals of the refractive index increase proportionately with the density.*

In a further paper in *Wiedemann's Annalen*, Prof. Quincke has given some details concerning the experimental methods pursued in his investigations, together with figures of the apparatus and tables of results for a large number of liquids under different conditions.

M. Bleekrode has lately described in the *Journal de Physique* a very convenient form of apparatus for projecting galvanic experiments on a screen. It consists of a glass bath (6 cm. long, 5 cm. high, 1 cm. broad), at either end of which is a metallic support which not only makes contact with the two plates that are immersed in the bath, but also are attached to a flat galvanometer which is placed on the top of the bath. The galvanometer consists of a light ebonite framework the same size as the top of the bath and 1 cm. thick, upon which is wound two or three layers of insulated copper wire ·3 mm. thick. A single needle is used, supported on a pivot in the centre of the coil. The whole apparatus is of such a size as to be easily used in any lantern.

In a recent number of *Carl's Repertorium*, Th. Edelmann describes a very simple means of determining the specific weight of a gas. His method consists in taking a column of gas which presses on a membrane, then observing the displacement of the membrane. This is a somewhat analogous action to the aneroid barometer. The absolute arrangement being to have the membrane strained on a metallic box about 30 cm. diameter, this box is in direct communication with a tube 2 m. long filled with gas. Upon the membrane rests a light lever which carries a mirror at its point of suspension; thus by raising a scale at a considerable distance the slightest movements can be observed and therefore the density taken with the greatest accuracy.

M. Morin has lately brought out a new electric candle, one great advantage in it being that the light may be extinguished or relighted at any time. This is obtained by the attraction of a piece of soft iron by a flattened solenoid; fixed on the same axis as the soft iron is a cam, upon whose position the proximity of the carbon depends. This motion is easier and not so noisy as the electromagnet as used by Wilde and others.

M. Tommasi has brought out a new regulator in which he uses selenium, whose resistance varies considerably with variations in the intensity of light. At present it has only been adapted to regulating the position of the light of a Jablochkoff candle.

The latest idea brought out for making incandescent lamps is by Messrs. Boulton, Soward, and Probert. They electrolyse a carbonaceous gas between platinum electrodes, in a globe; as soon as an arch of carbon is formed the globe is exhausted and the lamp ready for use.

Messrs. J. Elster and H. Geitel have found that a Zamboni pile can be made to work as an accumulator by charging it from a Holtz machine. After ten minutes they obtained a spark with the poles 1 mm. apart. Peroxide of lead does not work so well when used ready formed.

M. Reynier has published some figures concerning the work done by a Leclanché battery when used on a telephonic exchange. Two batteries of three cells each were used for thirty days of seven hours' duration. The loss of weight of zinc during that time was 64·5 grms., which represents 63,235 coulombs. This is equal to a current of 0·084 ampere during the month. Taking the E.M.F. of a Leclanché cell at 1 volt, the total work done is 189,705 watts, which is equivalent to 1 h.p. every 52 minutes.

GEOGRAPHICAL NOTES

The new number (No. 1 of vol. iv.) of the German African Society's *Mittheilungen* gives a table of magnetic observations and temperature made at different points of his route from Kakoma to Karema by Dr. E. Kaiser, who unhappily died last November on the bank of the Rikwa lake. A copious list follows of Dr. Kaiser's altitudes between Zanzibar and Kakoma. On the basis of English maps of the Niger and the Binuë, Dr. Kiepert traces Herr Ed. Robert Flegel's route from Eggan to Bida in September, 1881, and thence by way of Keffi to Loko in November and December of the same year. Summing up Herr Flegel's topographies, Herr Stück determines the latitude of Loko at 7° 58′ 16″ ± 7″ N., and of Keffi at 8° 49′ 22″ ± 3″ N. In an interesting letter from Ngaundere amid the sources of the Logone, dated August 22, 1882, Herr Flegel claims to have discovered the source of the Binuë, or at least an important part of the territory from which this river takes its source. On July 31 last Herr Flegel proceeded from Jola to the watershed between the tributaries of the Faro and the Binuë, and on August 17 reached the first fountain-brook of the Binuë, passing it and two further heads of the river on the 18th. Ascending a steep mountain chain, the watershed between the Binuë, Faro, Logone, and Old Calabar system, he beheld the last stream, by the inhabitants unanimously named the Binuë in contradistinction to the Guzun-Binuë (beginning of the Binuë) he had first passed. From the back of the mountains close by their encampment on the first *rimchi* (farm) of Ngaundere, the source of the Binuë was pointed out by the natives. If not *the* source, it was undoubtedly one of the main sources. After a stay of four months at Ngaundere Herr Flegel returned to Lokoja, whence, in a letter of February 21 last, he projects an early exploration of the lands yet unknown to the south of the Benuë and of the watershed crossed by him the previous year. He also contemplates opening up the territories where the Tsad and the Niger have their sources, and investigating the relations between these two water-systems, examining Barth's hypothesis of a direct water communication between the Tsad and the Niger by means of the Mao Kebbi and the Jubori swamps. He will further make inquiry into the political and ethnographical relations between the Tsad and Niger territories. Astronomical topographies are given of places visited by Lieut. Wissmann between Malange and Kimbundu. There are two interesting and instructive reports by Dr. Pogge and Lieut. Wissmann on their expedition through the south-east of the Congo basin, between Kimbundu and Nge Njangwe, from July 31, 1881, to April 17, 1882. The Kioque, inhabiting the country along the Luelle and the Chikapa, among whom the two travellers journeyed for a month and a half, are described as an intelligent and enterprising people, expert smiths, hunters, and far-travelling merchants. Carrying on a large trade in gum, and soon exhausting a district of its gum produce by their inconsiderate method of going to work, they are in a state of perpetual movement towards the north. Almost all the ivory which reaches Loanda is forwarded thither by the Kioque from the Tuschilange country. The Tuschilange (sing. Kaschilange) or Baschilange (sing. Muschalange) are a mixed people, composed of the aborigines and the Baluba, who have entered the country from the south. Of the three divisions of them the central is the *Bena Riamba, i.e.* sons of wild hemp, so called from their excessive addiction to smoking that herb, which is smoked more or less in almost the whole of Africa, and produces an intoxicating effect combined with coughing. The *Bena Riemba* are forbidden to keep goats or swine, and the travellers during their stay among them suffered from the want of animal food. Crossing the splendid river of Lubi, the travellers passed from the land of the Baschilange to that of the Bassonge, who, according to Lieut. Wissmann, occupy the highest industrial position he had ever seen negroes hold. Artistic working in iron and copper, weaving, basket-making, carving, and pottery are all highly advanced among them. Living in fair villages with large clean houses, under the shade of palms and bananas, the men cultivate their trim fields, and leave only the lighter work to their wives—a relation in marked contrast to that existing among the peoples they had hitherto visited.

The July number of Hartleben's *Rundschau für Geographie und Statistik* contains, among numerous others, the following original papers:—Researches concerning Madagascar, by J. Audebert.—On the Bedouins of Palestine, by R. Ranipendahl.—On the three first German "Geographentage," by Dr. Sigm. Günther.—On the United States of Columbia; these are remarks accompanying a good map of the States in question.

The commander of the *Willem Barents*, now on her fifth North Polar expedition, has sent news to Amsterdam from