being R.A. 12h. 21m. N. declination 12° 55′. The comet has also been observed at Hamburg, October 17, 17h. 5·8m. Hamburg mean time. R.A. 12h. 22m. 42·9s. Declination + 13° 25′ 24″. It has a tail, and is about as bright as a star of the ninth magnitude.

DETERMINATION OF GEOGRAPHICAL LONGITUDE.—In part 15 (August 1) of the *Zeitschrift für Vermessungswesen*, Herr C. Runge, of the Technical Hochschule, Hannover, gives a very interesting account of his results in determining geographical longitude with an ordinary camera. The negative from which the results were obtained, was taken on June 17, the camera being pointed to the new moon. Eight exposures were made one after the other, with intervals of about two minutes. Without moving the camera, and after an interval of about thirty minutes, another series of pictures was taken (on the same plate), the objects this time being some stars in Leo, which were allowed to record their trails on the plate for the period of about an hour and a quarter with regular intermittent breaks of five seconds. The times of exposure were noted with an ordinary watch, and the measuring of the plates made with an accurate micrometer. Dealing here only with the accuracy of the method, we may say that the declination of the moon can be determined to 20″, and in some cases with greater accuracy; in the example given the differences between the measured and calculated values were + 11″, − 19″, + 15″, − 6′. In the measuring of the moon-distance Herr Runge says that although this was the first trial, and the star-images were not all that could be desired, yet the accuracy was surprising, and can perhaps be still increased, even without the help of any "mechanische Hülpmittel." Since the above example was made he has obtained the geographical latitude and local time by this photographic means, and with excellent results. The instrument employed consisted of a simple camera with a so-called "gruppenantiplanet" objective, by Steinheil in München, with a focal length of 24 cm. The stop used for the above plate had a diameter of 17 mm.

ASTRONOMY AND ASTRO-PHYSICS AT CHICAGO.—A few of the many papers on astronomy which were read at the series of meetings that commenced at Chicago on August 22 appear in this month's *Astronomy and Astro-Physics*, and as they are too long for individual description, we give simply the titles of the papers and their authors: "Great Telescopes of the Future," by Alvan G. Clark. This deals with the subject completely from the object-glass point of view.—"A Field for Woman's Work in Astronomy," by Mrs. M. Fleming; "Engineering Problems in the Construction of Large Refracting Telescopes," by Worcester R. Warner. This is accompanied by a photograph taken by Mr. Burnham of the 40 inch Yerkes instrument, as exhibited at the Columbian Exposition.—"The Two Magnetic Fields surrounding the Sun," by Prof. Frank H. Bigelow; "The Constitution of the Stars," by Prof. Edward C. Pickering. This paper concludes as follows: "With few exceptions all the stars may be arranged in a sequence beginning with the planetary nebulæ, passing through the bright line stars to the Orion stars, thence to the first type stars, and by insensible changes to the second and third type stars"; "Concerning the Nature of Nova Aurigæ's Spectrum," by Prof. W. W. Campbell; "Preliminary Note on the Corona of April 16, 1893," by Prof. J. M. Schæberle, being a discussion of the facts gathered from the numerous photographs taken; "The Wave-lengths of the Two Brightest Lines in the Spectrum of the Nebulæ," by Prof. James E. Keeler; and lastly, "Contributions on the Subject of Solar Physics," by Prof. E. R. von Oppolzer.

A NEW ASTRONOMICAL OBSERVATORY AT MANILA.—Manila already possesses a Government meteorological and seismographic observatory, and an important astronomical observatory will soon be established there. The chief instruments will be a novel photographic meridian instrument and a large Merz refractor (19·2 inches), the latter being provided with a photographic correcting lens. Father Algue seems to be taking the work in hand, and he proposes to institute a series of latitude observations in connection with a similar series to be carried on at the Georgetown Observatory, for the determination of the variation of latitude. The instrument at Manila will consist, according to *Astronomy and Astro-Physics* for October, of two telescopes in the same tube; or at least there will be two object glasses, one at each end of the tube, their foci coinciding. These will be of the same diameter, 6 inches, and focus 3 feet, the tube being equal to the sum of the focal lengths of the object-glasses. The photographic plate is placed in the focus of the two objectives, *i.e.* in the centre of the tube. The method adopted is that of Talcott, and during the observation of both stars the instrument is not moved. The upper objective throws the image of the first star on the upper side of the sensitive film, while by the help of a basin of mercury below, and the lower objective, the trail of the second star is recorded on the under side of the same film. Besides visual work the Merz refractor will be used for photographic observations of double stars, spectrographic work, photographic parallax, &c.

THE VISIBILITY OF VENUS TO THE NAKED EYE.—Principal A. Cameron, at Yarmouth, Nova Scotia, and M. Bruguiere, at Marseilles, have made a series of observations with a view of determining for how long a period the planet Venus can be seen in the day time without optical aid (*Trans. Nova Scotia Institute of Science*, vol. i. part 2. 2nd series). Beginning with the superior conjunction of February 18, 1890, Mr. Cameron saw Venus with his naked eye 26½ days after that date, and M. Bruguiere, in the same latitude, detected the planet 4½ days before the inferior conjunction of December 4, 1890; so that altogether she was visible to the unaided eye during 259 days. The elongation of the planet when first picked up by Mr. Cameron was 6½°, and when M. Bruguiere saw her last in November, 1890, the elongation was nearly 9°, but the brilliancy was only 6½ per cent. of the mean greatest brilliancy.

MEYER'S CONVERSATIONAL LEXICON.—The popularity of this series of volumes can only be accounted for by the very judicious way in which the publishers have dealt with every branch of science, treating it fully, accurately, and in such language that it can be understood by the most general reader. Under the heading "Astronomy" is given an excellent and concise account of the early history and development of the science. This lexicon has reached its fifth edition.

GEOGRAPHICAL NOTES.

A CABLE has recently been laid between the seaport of Bundaberg, in Queensland, and New Caledonia. This line of 910 miles, although not very important in itself, is of some interest as possibly the commencement of a great Pacific cable which may ultimately unite Australia and Canada. Should this scheme be carried into effect the probable route of the cable would be from New Caledonia to Fiji, thence to Samoa, and by Honululu and the Fanning islands to Vancouver.

THE last number of the *Bulletin* of the Paris Geographical Society publishes the list of awards of the society's medals, the bestowal of which was noticed in this column (vol. xlviii. p. 40), together with the reports of the awards, which were too lengthy to be read at the meeting in April. A notable fact connected with these prizes is the custom of recognising the value of original maps and books of geographical research, historical or critical, as well as the work of explorers.

AN amusing instance of the danger of commenting on geographical news without referring to a full report occurs in the last number of the *Revue Française*, a journal which is valued for its full and usually accurate record of recent and projected travels. In mentioning the fact of the discovery of Active Strait, near Erebus and Terror Gulf, by the Dundee sealers this spring, the editor adds parenthetically, "volcanoes of Victoria Land to the south of New Zealand"—a pardonable mistake, as the names of Ross's ships were perhaps too freely scattered over the Antarctic regions. But in this instance it happens, somewhat oddly, Erebus and Terror Gulf is in land named after a French and not a British monarch, being in Terre Louis Phillippe, south of the Falkland Islands.

THE full programme of the Royal Geographical Society's Evening Meetings for the Session 1893–94 has been published. In addition to the subjects intimated in this column last week, we note that papers are expected by Prof. Lapworth, F.R.S., on the ups and downs of the earth's surface; by Dr. J. W. Gregory, on his expedition to Mount Kenia; Mr. R. D. Oldham, of the Indian Geological Survey, on the geographical development of India; Mr. K. Grossmann, on a journey in Iceland; Mr. T. J. Alldridge, on journeys in the interior of Sierra Leone; Dr. H. R. Mill, on the survey of the English lakes; Mr. H. Warington Smyth, on journeys on the Upper

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Mekong; Mr. W. H. Cozens-Hardy, on surveys and research in Montenegro; and Mr. E. J. L. Berkeley, on British East Africa. It is also hoped that the Prince of Monaco, Sir Archibald Geikie, and Mr. J. Y. Buchanan may contribute papers. If Mr. and Mrs. Bent return in time from their projected exploring journey in Hadramant, an account of their work will be looked forward to before the close of the session.

A NUMBER of the *Journal* of the Manchester Geographical Society just issued (January to June, 1893) contains a paper on the Yoruba country, Abeokuta, and Lagos, by the Rev. J. T. F. Halligey, which gives some vivid descriptions of native life and manners.

DR. GERHARD SCHOTT'S physical observations on a voyage in a sailing ship from Hamburg to the China coast and back are published as an Ergänzungsheft of *Petermanns Mitteilungen*. In the discussion of his work Dr. Schott takes account of previous researches on the parts of the ocean he traversed, and his paper is an interesting addition to our knowledge of oceanography. The memoir is divided into two parts: hydrography, including a discussion of surface temperature as affected by diurnal range, rainfall, and wind, the specific gravity of surface water, surface currents and drifts, and observations on waves; and meteorology, dealing with the instruments employed, the record of air-temperature, humidity, and cloudiness. The memoir is, of course, well illustrated by maps and diagrams.

THE THICKNESS AND ELECTRICAL CONDUCTIVITY OF THIN LIQUID FILMS.

IN August, 1883, an article was published in NATURE (vol. xxviii. p. 389), signed by Prof. Rücker and myself, giving an account up to date of our researches on liquid films. Since that time our work has from time to time as opportunity offered been continued and further results have been obtained, a brief account summarise the results to which attention was drawn in 1883. of which I now propose to give. It may be useful first to briefly

A cylindrical soap film when allowed to thin under the action of gravity shows in succession the tints of the various orders of Newton's Colours, and finally becomes black. The thickness of any part of the film may be determined (supposing the refractive index to be known) from the colour it exhibits when light is reflected from it at a definite angle. The mean thickness of a horizontal ring of the cylindrical film may also be determined by measuring the electrical resistance of the ring, and by assuming the specific conductivity of the film to be the same as that of the liquid in mass. In the case of a liquid consisting of a mixture of soap solution and glycerine with a little potassium nitrate added to increase the conductivity, we proved by comparing the thickness of a film obtained by the optical method with the thickness deduced from its electrical resistance, that down to a thickness of 374 $\mu\mu$ (micromillimetres)—corresponding to colours of the second order of Newton's scale—the specific conductivity of the liquid remains unaltered. When the film becomes thinner than 374$\mu\mu$, and exhibits the colours of the first order, estimates of its thickness derived from colour observations are less trustworthy, and when these colours are replaced by black, we only know from the colour that the thickness of the film has less than a certain maximum value. Assuming, however, the specific resistance to be unchanged when the film became black we showed that the thickness of such a black film does not differ much from 12$\mu\mu$.

Experiments were then carried out by the electrical method on a solution of oleate of soda (hard soap) containing 3 per cent. of KNO_3 but no glycerine. Black films made of this solution were found to have a mean thickness of 11·7$\mu\mu$, showing that the thickness of the black is practically the same whether the solution does or does not contain glycerine. As this result, however, depends upon the validity of the assumption that the specific resistance of a black film is the same as that of a large quantity of the liquid, it was desirable if possible to measure the thickness in question by a method free from the assumption involved in the electrical method. For this purpose an optical method depending upon interference phenomena (Phil. Trans. 1883, p. 652) was employed. Two glass tubes about 16 inches long and $\frac{3}{4}$ inch in diameter were placed horizontally side by side and were traversed by two interfering beams of light, the interference bands being produced by thick glass plates. The tubes were filled with plane soap films, each tube containing from 40 to 60 films and having its ends closed by pieces of plate-glass. After an hour or more, when the films had thinned sufficiently to appear black, the position of the central interference band in the field was noted, and its displacement when the films were broken, first in one tube and then in the other, carefully measured. From these measurements the average thickness of a black film could be easily deduced, the only assumption made being that the refractive index of the liquid is unaltered by the tenuity of the film. The average thickness of about 900 films was found to be 12·1$\mu\mu$. This result justified the assumption made in the electrical method with regard to the constancy of the specific conductivity of the liquid.

The results established before the recent work was begun were therefore as follows:—(*a*) The thickness of a black soap film formed of a solution containing one part of oleate of soda dissolved in 40 of water with 3 per cent. of KNO_3 added is about twelve micromillimetres. (*b*) It is practically the same when to the soap solution is added two-thirds of its volume of glycerine. (*c*) From this it follows that the specific conductivity of such a solution is the same whether the liquid be considered in large quantity or in the form of a minutely thin film. (*d*) The thickness of the black, though often varying from film to film, is always the same in the same film—*i.e.*, is independent of area and age. With regard to these results it may be said at once that they have all been repeatedly and completely confirmed by subsequent investigation.

We now come to the more recent work. Since in the earlier experiments the solutions were always of the same strength as regards soap, and always contained not less than 3 per cent. of KNO, it was important to determine whether the thickness of a black film is or is not dependent upon the proportion of soap or salt in the solution. The optical method was first employed. The strength of the soap solution being kept constant, viz. 2 grammes of hard soap to 100 cc. of water, the proportion of salt was diminished from 3 per cent. to zero. Under these circumstances, the mean thickness of a black film was found to steadily increase from 12 $\mu\mu$ to about 24 $\mu\mu$. A similar large increase in the thickness was found when the solution contained glycerine, or was made of soft instead of hard soap. When no metallic salt is present, and the strength of the soap solution varies, the thickness of the black increases as the solution becomes more dilute. Thus for a hard soap solution, when the percentage of soap was 3·3, the thickness was found to be 21·6 $\mu\mu$ and rose to 29·3 $\mu\mu$ as the percentage of soap diminished to 1·25. If, on the other hand, the solution contains as much as 3 per cent. of KNO_3, variation in the proportion of soap has little or no influence on the thickness of the black. This is shown by the following table:—

Hard Soap Solution, containing 3 per cent. of KNO_3.

Percentage of soap in the solution	2·5	2·0	1·66	1.14
Mean thickness of the black in $\mu\mu$	13·1	12·1	11·6	12·1

The results above given have been deduced from the optical method of measurement, and the question arises whether the large increase in the thickness of black films formed from an unsalted solution is real, or whether it is due to some incorrect assumption. The only point where error is possible is in the hypothesis that the refractive index is the same as that of the liquid in mass. The thickness of a film varies inversely as $\mu - 1$ (μ being the refractive index), and as the refractive index of the soap solution is 1·34, it would have to be reduced to 1·17 in order that the calculated thickness might be doubled. It appears therefore *à priori* extremely improbable that the mere addition of 3 per cent. of KNO_3 should so completely change the optical properties of the liquid that whereas if the salt be added the refractive index is practically the same in the thin films and in the liquid in mass, yet without the salt the refractive index should be as much as 13 per cent. less than that of the liquid in mass. It may further be mentioned that Drude (*Wied. Ann.* xliii. p. 169, 1891), by an optical method quite different from that employed by us, has compared the refractive indices of black and coloured films, of which the latter may unquestionably be taken as nearly if not quite identical with that of the liquid in mass, and has shown that they do not differ by more than 1 part in 140. Such a variation would not affect the apparent thickness of the films as measured by the optical method by more than 3 per cent., whereas, as we have seen, the presence or absence of the salt alters the apparent thickness by 100 per cent. On the whole, then, the evidence is very strong that the differences of thickness indicated by the optical method

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