

small horizontal paddle wheel almost exactly like a Crookes's radiometer. If the sound waves converge to one side of the wheel it will spin rapidly in the corresponding direction.

FROM the Volta Bureau of Washington we have received two reprints, one dealing with the so-called "visible speech" alphabet introduced into England by Dr. Alexander Melville Bell in 1865-7, and the other being an essay, by Dr. William Thornton, on teaching the deaf and dumb to speak, published in 1793. The reprints are illustrated by portraits of Drs. Bell and Thornton, and a biographical notice also accompanies Dr. Thornton's paper.

WE have received the report for 1903-4 of the Scientific Society of St. Paul (Brazil), and have been able to gather from it that the society was founded in June, 1903, the city already having a historical and geographical, a medical and an agricultural society. It numbered in April last fifty-six effective, four contributing, one corresponding member, and two "socios ouvintes," a total of sixty-three members, of whom twenty-eight were foundation members. The membership list now, however, shows thirteen corresponding members. There have been held two preliminary, one inaugural, fourteen ordinary, and four "economic" meetings, and from the account of these meetings the papers seem to have been interesting and varied. A desirable improvement would be the publication of the reports in one of the international languages.

THE question as to whether the trioxide of nitrogen, N_2O_3 , is capable of existence has frequently been discussed, but until recently has remained unanswered owing to the lack of experimental data. When the brown gas produced by the action of starch or of arsenious anhydride on nitric acid is passed through a freezing mixture, it condenses to a blue liquid, which does not solidify at -90° . But the determination of its vapour-density shows that the gas is completely dissociated, and Ramsay and Cundall showed in 1885 that no contraction takes place when the monoxide and dioxide are mixed. The blue solution might therefore be regarded merely as a solution of NO in N_2O_4 . The actual existence of the trioxide has recently been demonstrated by Wittorff (*Zeit. anorg. Chem.*, vii., 209), who has investigated the freezing point of mixtures of different composition. A liquid having the empirical composition N_2O_3 solidifies to a blue crystalline solid, which melts at $-103^\circ C.$, and is undoubtedly the pure trioxide. As the proportion of N_2O_4 is increased the freezing point at first falls to a eutectic temperature at $-112^\circ C.$, and then rises to the freezing point of the peroxide. In this way, by accurate work at low temperatures, it has been possible to solve one of the long-debated problems of inorganic chemistry.

It has long been suspected that in solution the dichromates might perhaps be dissociated into neutral chromates and free chromic acid, thus,



Purely chemical methods have given but little information as to the nature of the dissolved salt. As the result of an ingenious application of physicochemical methods, the problem has recently been solved by Abegg and Cox, and these authors have been able actually to determine the proportion of free chromic acid in dichromate solutions of different concentrations. The method, which is described in the *Zeitschrift für physikalische Chemie* (vol. xlvi. p. 725), depends on saturating a solution of a dichromate with neutral and basic mercuric chromates, $HgCrO_4$ and

$HgCrO_4.HgO$. In presence of these two salts the concentration of free chromic acid in the solution is maintained constant at 0.706 mol. per litre at 50° and 0.456 mol. at 25° , and any excess of chromic acid must be combined either as chromate or as dichromate. It is calculated that in the case of potassium dichromate complete dissociation occurs at a dilution of 1000 litres, whilst at 100 litres 99 per cent. of the salt is dissociated, at 10 litres 91 per cent., and at a dilution of 1 litre 62 per cent. Even in the strongest solutions, therefore, the greater part of the dichromate is dissociated into chromic acid and normal chromate.

MESSRS. WHITTAKER AND Co. will shortly publish a new book entitled "The Insulation of Electric Machines," by Mr. H. W. Turner and Mr. H. M. Hobart.

MESSRS. GEORGE BELL AND SONS have published parts i. and ii. of "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne, in one volume at 4s. 6d. The book may be had with or without answers.

THE twenty-fourth volume of the *Geographical Journal* has now been published. It contains the monthly numbers from July to December, 1904. As usual, the volume is richly illustrated by means of blocks and a profusion of well executed maps. The volume should be added to the library of every geographer and teacher of geography.

MESSRS. NEWTON AND Co.'s new supplementary list of lantern slides includes several sets which should prove very valuable to science teachers and lecturers. Among these instructive slides we notice photographs by Mr. W. M. Martin illustrating the embryology of a chicken; British birds and nests photographed by Mr. R. B. Lodge; photographs of insects and other small forms of animal life; photomicrographs of rock sections; and photographs of diseases of the bone, by Dr. C. T. Holland.

A REVISED and enlarged edition of Dr. Arthur Keith's "Human Embryology and Morphology" has been published by Mr. Edward Arnold. This edition differs from the last in several particulars. The chapters dealing with the early development of the human embryo and the formation of the placenta and membranes have been re-written. Much of the chapter dealing with the urogenital system has been amended, and numerous additions have been made in other sections of the book.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF COMETS 1904 *d* AND 1904 *e*.—The results of several observations of comets 1904 *d* and 1904 *e*, respectively, are published in a supplement to the *Astronomische Nachrichten*, No. 3987.

The latter object was observed at Bamberg by Prof. Hartwig on January 1 and 2, and was seen as a circular patch about 2' in diameter, having a nucleus which was not symmetrical. The magnitude of this comet has been variously estimated. In the above observation Prof. Hartwig recorded it as 11.0, but Prof. Nijland, observing at Utrecht on January 1, estimated it as 9.5, whilst Prof. Ambronn, observing at Göttingen on January 2, found it to be 10. The brightness at the time of discovery, as given by M. Borrelly, was equal to the tenth magnitude.

The following is an extract from the daily ephemeris of comet 1904 *d* published by Herr M. Ebell:—

1905	12h. (M.T. Berlin).			log r	log Δ	Bright- ness
	α (true) h. m. s.	δ (true)				
Jan. 20 ...	17 57 38 ...	+44 57 ...	0.3253 ...	0.3437 ...	0.98	
" 24 ...	18 13 1 ...	+47 5 ...	0.3299 ...	0.3446 ...	0.95	
" 28 ...	18 29 11 ...	+49 10 ...	0.3346 ...	0.3465 ...	0.93	
Feb. 1 ...	18 46 10 ...	+51 9 ...	0.3394 ...	0.3495 ...	0.89	
" 5 ...	19 3 58 ...	+53 3 ...	0.3443 ...	0.3535 ...	0.86	

Brightness at time of discovery = 1.

EPIHEMERIS FOR COMET TEMPEL, 1904 c.—In No. 3986 of the *Astronomische Nachrichten* M. J. Coniel gives a daily ephemeris for Tempel's second comet extending from January 3 to March 2, which is a continuation of the ephemeris published by him in No. 3971 of the same journal. Although the southern declination of the comet is decreasing, its R.A. is so near to that of the sun, and the object itself is so faint, that observations will be difficult, and only possible immediately after sunset.

The comet's position on January 21 will be

R.A. = 22h. 37m. 47s., dec. = $-16^{\circ} 19'$.

SEASONAL DEVELOPMENT OF MARTIAN CANALS.—A further contribution of observed phenomena, in support of his theory concerning the causes which produce the seasonal development of the canals on Mars, is published by Mr. Lowell in the January number of *Popular Astronomy*. The particular canal therein discussed is Brontes, which is 2440 miles in length and connects along a great circle, in nearly a north and south direction, the two important points Linus Titanum and the Propontis.

From a study of ninety drawings made during the period January-July, 1903, six of which are reproduced on the plate accompanying the paper, it was seen that the visibility of the canal increased after the summer solstice in the northern hemisphere, and, further, on dividing the canal into five nearly equal sections from north to south, the section nearest the north polar cap became strengthened first, and the others followed in order of their north polar distance. This is plainly shown on the visibility "cartouches" given by Mr. Lowell, who considers the phenomena as a further proof of his theory that the visibility of a canal is due to vegetation, quickened by the water loosened at the melting of the polar snows and flowing towards the equator. The extension south of the equator is considered as a probable proof of intelligent artificial interference in the propulsion of the water.

VARIABLE STARS AND NEBULOUS AREAS IN SCORPIO.—An examination of thirty-three plates exposed on the large nebulous regions mentioned in previous *Circulars* has led Miss H. S. Leavitt to the discovery of 105 new variable stars in the constellation Scorpio.

The positions of these, for 1900, their greatest and least observed magnitudes, and their magnitude ranges are given in No. 90 of the Harvard College Observatory *Circulars*.

The most striking result of this research has been the revelation of vast areas of diffused nebulous matter, so faint as to be beyond visual observation. One of these areas extends over a number of square degrees in the constellations Ophiuchus and Scorpio, and, like the Orion nebula, it attaches itself to individual stars, the principal condensation being about the quadruple star ρ Ophiuchi. The region is marked by an absence of faint stars, and dark lines may be traced beyond the confines of the nebulosity as yet seen on the plates.

REPORT OF THE NATAL OBSERVATORY.—The report of Mr. E. Nevill, Government astronomer of Natal, for the year 1903, gives a brief *résumé* of the work accomplished at the Durban Observatory during the period with which the report deals, and contains a mass of information respecting the meteorology of the colony.

The time signals have been sent out as in former years, and Borrelly's comet was observed regularly during its appearance, the orbit deduced from the observations agreeing with those obtained at other observatories.

It is proposed to utilise the tide observations made during the years 1884-8 in order to provide the port authorities with tide-tables, but, owing to the constructional changes in the harbour during the last few years, it will be necessary to reduce the more recent observations and this will require additional computing assistance.

In former years it has been customary to issue the meteorological data compiled from the returns of the subsidiary stations once each month, but in future the returns will be published daily. Among the numerous tables given in the report there occurs, for the first time, a summary of the meteorological observations made at the Botanical Gardens, Durban, during the period 1873-1883

inclusive, before the institution of the Government observatory.

THE JESUIT OBSERVATORY AT BELEN, HAVANA.—An interesting illustrated account of the observatory attached to the Jesuit College at Belen, Havana, has been written, in Spanish, by Father Mariano Gutiérrez, S.J., the sub-director, and contains a history of the installation of the institution in 1857, and its proceedings since that date.

The meteorological section was first founded under the direction of Father Antonio Cabré, S.J., in the year named, but its position was not secured until the installation of Father Vines as director, in 1870, to the memory of whom the author of the history pays a high tribute, and laments his death in 1893 as an irreparable loss.

The equipment of the observatory is fairly complete, and includes meteorological, seismological, magnetic, and astronomical instruments, most of which, including the 6-inch Cooke equatorial, are illustrated in the present volume.

THE DISCOVERY OF JUPITER'S SIXTH SATELLITE.

THE addition of a sixth satellite to the system of Jupiter marks another triumph in Prof. Perrine's employment of the modified Crossley reflector. As mentioned in a note published in "Our Astronomical Column" last week, Prof. Perrine first suspected the existence of the newly discovered body from observations made during December, 1904, but it was not until January 4 that a further observation confirmed his suspicion, and enabled him to open the new year with the announcement of this important discovery.

The new satellite, so far as one may gather from the meagre news yet to hand, is situated at a much greater distance from its primary than any of the five previously known. The telegram announcing the discovery gave this distance, on January 4, as $45'$, whilst that of the outermost of the four satellites discovered by Galileo never exceeds $10' \cdot 5$, and the fifth, the innermost of all, is not quite half the distance from Jupiter that the moon is from the earth.

Assuming, for the moment, that the above distance is the outward limit of the satellite's orbit, it should make one revolution about its primary in about half a year, whereas the time occupied by the fourth satellite is only 16.7 days; thus we see there is an immense gap between the two bodies which, according to precedent, may contain other satellites as yet undiscovered.

The recent discovery raises the number of satellites in the solar system, discovered during the past thirty years, to five, and it is worthy of note that the discovery of a satellite has usually occurred at times when a new instrument has been installed or old instruments or methods have been improved. This fact calls to mind, although beyond our thirty years' limit but still dealing with the Jovian system, that Jupiter's four moons, Io, Europa, Ganymede, and Callisto, or i., ii., iii., and iv. as they are usually designated, were the first members of the solar system to be discovered, resulting, as they did, from Galileo's first use of the telescope in January, 1610.

After these, and within the past thirty years, came Deimos and Phobos, the lilliputian attendants to Mars, which were discovered by Prof. Asaph Hall at Washington in August, 1877, and were the first fruits of the then recently mounted 26-inch refractor of the U.S. Naval Observatory.

The fifth satellite of Jupiter was discovered by Prof. Barnard on September 9, 1892, with the nearly new giant refractor of the Lick Observatory. It is, comparatively, a minute object and can only be seen with the largest telescopes under the most favourable conditions. Its diameter can scarcely be greater than 100 miles, whilst the diameters of the other four, in order of their distance from the planet, are 2400, between 2000 and 2200 (about the size of our own moon), 3000, and 3600 miles respectively. This object revolves between