

THE MEASUREMENT OF DOUBLE-STARS
BY INTERFERENCE.

AN interesting form of micrometer is described by Herr Karl Schwarzschild in *Astronomischen Nachrichten*, No. 3335. The idea is gathered from the instrument which Michelson suggested and used for measuring small diameters and distances, an account of which appeared in the *Memoirs* of the National Academy of Science, Washington, 1891. Michelson, it may be remembered, placed before the object-glass of his refractor a disc in which were two parallel movable slits that set up interference phenomena; and an observation consisted in noting simply the disappearance and reappearance of the interference bands. Schwarzschild's disc, or more accurately oblong framework, on the other hand, contains several slits cut out at equal distances from one another, which cause several images to be visible at the eye-end of the telescope, forming a true multiple-image micrometer.

If one considers the case of the ordinary glass grating as used in spectroscopic work, it is well known that with a bright point as the source of light, we obtain a series of images, the angular distances of which from the unrefracted central image, for a certain wave-length, are given by the formula $\sin \alpha = \lambda \cdot n/d$, when λ is the wave-length, d the distance between the lines on the grating, and n their number. In the case of daylight the centre image becomes sharp and white, while the others become broader and broader, in fact small spectra. By exaggerating this idea of the grating, and cutting out of a card slits three millimetres broad and ten millimetres distant from one another, the angular distances of the images for wave-length $\lambda = 570 \mu\mu$ become very small, and can hardly be separated with the unaided eye. Such a grating as this placed before the object-glass of a telescope directed to a star would show, in the field of view, one colourless image accompanied on its right and left sides by several other images, the first of which would differ only slightly in sharpness and colour from the middle image. It is only to these three images that Schwarzschild pays attention. Of course it is necessary that some means should be at hand by which these images may be moved with respect to one another, and this he accomplishes very simply.

To the object-glass ring, and in a plane parallel to it, he fixes a framework capable of rotation in this plane. Two circular rods, at opposite ends of a diameter of the object-glass, and perpendicular to the framework, are rigidly fixed to the latter, and to these rods is connected the apex of two inclined smaller frameworks containing the slits, the other two extremities of which slide in the grooves of the large frame. Since the distance of this apex from the object-glass can, by means of a rack and pinion movement, be increased or decreased, and since also the distances of the different slits vary consequently in a simple known manner, the displacement of the images in the field of view can be easily calculated.

In bringing a double star into the field of view, two parallel series of images would thus be seen, one series from the primary, the other from the companion. The whole framework containing the grating was then rotated in position-angle until the two lines of images coincided; the position of this line was then determined by means of a micrometer eyepiece, and the position-angle read off. To measure the distance between the stars, the rack and pinion motion connected with the apex of the two frames containing the grating was then used, until the image of the companion appeared exactly between the two images of the primary. The position of the grating was then read off, and a brief calculation gave the distance required. From a series of observations of several binaries, the total mean gave as a probable error of the mean for each evening:

Distance	Probable error	
	in Distance	in Position angle
2".3	0".050	0".052

The numbers show, as Herr Schwarzschild points out, that greater accuracy can be obtained by this means than by the thread micrometer. He is not, however, very confident about the usefulness of the method, for when the distances to be measured exceed 5", the colour of the first images becomes very apparent, and thus destroys the accuracy in measuring. Further, the nature of the method stops it from being useful for measuring pairs dimmer than the 7th magnitude, because the aperture of the object-glass is cut down very considerably when the grating is much inclined and the light is distributed over several

images. The simplicity of the method has, however, much to recommend itself to many, more especially to those who possess large apertures, and can therefore afford to spare a little light. D.

FLORA OF ZERAFSHAN.

IN a communication to the St. Petersburg Society of Naturalist (*Proceedings*, 1895, i.), M. Komaroff thus sketches the flora of the Zerafshan region of Russian Turkestan. The Aral-Caspian flora covers the lowlands up to the 1000 to 1500 feet level. Next comes the prairie, or Steppe, zone, which spreads up to about 3500 feet of altitude. In its upper parts it is characterised by Steppe-bushes, of which the almond-tree (*Amygdalus spinosissimus*, Bunge) is the most characteristic representative. Higher up, from 3500 to 6000, or 6200 feet, comes the zone of deciduous trees, which may be subdivided into a lower sub-zone of Mediterranean trees (*Pistacia vera*, *Celtis australis*, *Amygdalus communis*, *Acer monspessulanum*, &c.), with a prevalence of fragrant Labiateæ, which attains approximately the 4500 feet level; and an upper sub-zone characterised by maple-trees (*Acer luctum*). The zone between 6000 feet and nearly 8500 feet is taken by the Juniperus-trees which correspond in Zerafshan to the coniferous trees of other regions. It is covered at its upper limits with rampant bushes of *Juniferus nana* and *pseudosabina*, *Comarum*, *Cotoneaster*, *Lonicera*, *Astragalus*, and so on. The Alpine zone attains the levels of 11,000 and 12,000 feet—the morainic plants, *Didymophysa fedtschenkoana*, *Corydalis fedtschenkoana*, *Cerastium lithospermifolium*, *Saxifraga axillaris* and *Allardia tomentosa* reaching the highest altitudes. On the Zerafshan glacier, at a spot where it was covered with some gravel, the author found specimens of *Saxifraga axillaris*, *Epilobium latifolium*, *Arabis tibetica*, *Poa karatavica*, and one *Carex*—a fact which shows how careful one must be in interpreting the real sense of plant-bearing strata imbedded amidst morainic deposits. It is also worthy of note, that the botanic zones of Zerafshan very much correspond to the zonal geological structure of the highlands. The Aral-Caspian flora covers the æolic deposits of the great desiccated inner sea of Central Asia; the Steppe flora covers the Loess girdle; the Mediterranean trees and shrubs occupy the limestones and the marls, while the Juniperus zone spreads over the crystalline slates and limestones, and the Alpine flora covers the higher granitic massives of the highlands. Man evidently alters to a great extent the character of the vegetation—pistachio-tree groves and the *Juniperus excelsa* trees being rapidly destroyed; while the hundreds of thousands of sheep which are brought every year to the Zerafshan mountains from the lowlands, entirely destroy the Alpine prairies—thickets of *Artemisia dracuncululus* taking the place of the grasses.

UNIVERSITY AND EDUCATIONAL
INTELLIGENCE.

OXFORD.—One of the arguments which are brought forward for granting the degree of B.A. to students from Newnham and Girton Colleges is that, when they apply for educational positions, they are at a disadvantage as compared with students from other universities which do grant the degree of B.A. Dr. W. H. Besant points out in a circular, which he had addressed to the members of the Senate, that this difficulty would be entirely removed if a charter were granted to Newnham and Girton Colleges, creating a Women's University, which should have the power of granting degrees. This need not interfere with the present arrangements for the teaching and for the examination of the students in the various subjects, the study of which they now undertake. Mr. J. L. Strachan-Davidson has suggested that Oxford, Cambridge, and Dublin—the three universities which have not as yet conferred degrees on women—should join in a petition to the Crown to grant a charter for a university whose sole function it shall be to give degrees to women. A scheme similar to that supported by Dr. Besant has been practically adopted by the University of Harvard.

THE members of the Skinners' Company visited Tonbridge on Saturday last, for the purpose of opening a new second-grade school which they have just built at a cost of upwards of £10,000

THE following are among recent appointments:—Dr. C. A. Strong to be lecturer on psychology in Columbia University; Mr. H. C. Warren to be assistant professor of experimental psychology in Princeton University; Herr H. Hinterberger to be professor of photography in the University of Vienna; Prof. James Holm, of University College, Nottingham, has arrived at Cape Town, to succeed Prof. Smith as professor of applied mathematics and physics in the South African College; Prof. G. F. Atkinson to be full professor and head of the department of botany in Cornell University; Mr. Arnold Philip to be professor of electrical engineering and applied physics in the Merchant Venturers' Technical College, Bristol, in place of Prof. W. Wilson, who will shortly vacate the chair in consequence of his appointment to the post of principal of the Salford Municipal Technical School.

THE plans and drawings of the Women's Medical Institute, the new Russian college for granting medical diplomas to women, are, says the *Lancet*, completed. The building operations will begin next month, and it is hoped that they may be finished in time to open the new institution in August of next year. It has been liberally subsidised by Government and by the municipality of St. Petersburg, and private subscriptions and donations have been neither few nor small. At present the whole capital amounts to about 600,000 roubles (nearly £64,000). But of this at least 450,000 or 475,000 roubles will be required for building and furnishing the institute. The late Prof. Tchudnofski, whose recent death has created a vacancy in the chair of General Therapeutics in the Army Medical Academy, has left to the Women's Medical Institute his entire medical library, containing over 4000 volumes. The number of students who will be admitted to the courses at first has been fixed at 125. Already over 100 applications have been received.

YALE UNIVERSITY is having a run of good fortune. The widow of Thomas G. Sloane will remarry soon after Easter, thereby forfeiting to Yale the sum of 200,000 dols. left by her first husband on condition of her remaining unmarried. She will let the money go without a contest. The will of the late George Bliss, of the great banking house of Morton, Bliss, and Co., was admitted to probate in New York on March 11. Among the bequests is one of 50,000 dols. to Yale, to be disposed of as the President of the University shall direct. A new dormitory is to be erected on the college *campus* this season, at a cost of nearly 100,000 dols. Ground was broken on March 9, at Washington, for the new American University, the Hall of History being the first building to be erected. This is a university of the Methodist Church, and Bishop Hurst of that Church presided. About 1,000,000 dols. has been secured towards the University fund. This should not be confounded with the proposed University of the United States. Nothing has yet been done regarding the latter, except the introduction of a Bill in Congress; and the fate of the measure is still problematical.

WHEN shall we be able to chronicle so many gifts from private persons to science and education in England as the following, which *Science* announces in a single number?—The will of the late Mr. Hart A. Massey, of Toronto, leaves about 650,000 dols. to educational and charitable institutions, including the following bequests: Victoria College, Toronto, 200,000 dols.; Wesley College, Winnipeg, Man., 100,000 dols.; Mount Allison College, Slackville, N.B., 100,000 dols.; Wesleyan Theological College, Montreal, 50,000 dols.; American University, Washington, D.C., 50,000 dols.—The Finance Committee of the Senate of the State of Virginia has presented a Bill appropriating 50,000 dols. annually, instead of 40,000 dols. as heretofore, to the University of Virginia.—The will of the late Mr. Charles L. Colby, of New York, bequeaths 20,000 dols. to Brown University.—Morris M. White and Francis T. White have given to Earlham College, a Quaker institution in Richmond, Ind., 25,000 dols., to be added to the endowment fund and to be known as the John T. White memorial fund, in honour of their father.—Mrs. Josiah Fiske, of New York City, has given 5000 dols. to Radcliffe College, in memory of her late husband. The College has also received 6568 dols., the balance of a bequest by the late Caroline B. Perkins.—Mr. T. E. Bondurant, of De Land, Ill., has offered to give 20,000 dols. to the endowment fund of Eureka College, Illinois, provided the Board of Trustees will secure 100,000 dols. additional by March 1, 1897. Mr. T. J. Underwood, of Sangamon County, Ill., has donated 10,000 dols. towards the fund.

A RETURN made to the Department of Science and Art, showing the extent to which, and the manner in which local authorities are applying funds to the purposes of technical education (including science, art, technical and manual instruction), has been published as a Parliamentary Paper. The return shows that the total expended on technical education during the year 1893-94 in England, Wales, Scotland, and Ireland was £647,632; and that the estimated total expenditure on technical education for the year 1894-95 was £737,421. These amounts are exclusive of the sums devoted to intermediate and technical education under the Welsh Intermediate Education Act. In England, 41 out of the 49 County Councils (excepting the County of Monmouth) are applying the whole of the residue received under the Local Taxation (Customs and Excise) Act to technical education, and 8 County Councils a part of it to the same purpose. Of the Councils of the 61 County Boroughs, 55 are devoting the whole of the residue to technical education, and 8 a part of it; while in one case only, the County Borough of Preston, the residue is not being applied to educational purposes, but to relief of rates. Further, the Councils of 11 County Boroughs, 51 Boroughs, and 86 urban districts are making grants out of the rates under the Technical Instruction Acts; and 8 local authorities are devoting funds to technical education out of the rate levied under the Public Libraries' Act. In Wales and Monmouth, the 13 County Councils and the Councils of the 3 County Boroughs are devoting practically the whole of the residue grant to intermediate and technical education, and several Councils are making grants out of the rates. As regards Scotland, 21 out of the 33 County Councils are applying the whole of the residue to technical education, and 9 a part of it, while 3 use it for the relief of rates. Of the 195 Burghs and Police Burghs, more than half (101) apply the whole of the grant to the relief of rates.

DESPITE Prussia's open secret of a Treasury exhausted for the Army vote, and the consequent amenities between the Ministers of Education and Finance, the necessity of maintaining the trade schools in some degree of efficiency is present to the German official mind. The want of funds applicable to educational purposes in Prussia, is among the causes making for the spread of social democracy, and this is particularly the case in the straitened salaries of the teachers of the *Volksschulen*. A review of the Technical Education item in the Prussian Budget for the last five years shows, however, a healthy growth. For altogether, apart from the continuation schools in West Prussia and Posen, for which special provision is made, the grant for 1895-96 was 1,947,257 marks (£97,362 17s.), which was an increase in the total State subvention of £22,304 14s., or nearly 30 per cent. of the entire grant. To take the trade schools (*Fachschulen*) alone, these were especially well treated. The State's expenditure on them rose from 896,993 marks (about £44,850) in 1891-92, to 1,263,157 marks (about £63,158) in 1895-96, or by more than 40 per cent., while their internal history shows an equally satisfactory development. In 1891-92 there were forty-four trade schools subsidised by the Treasury. Of these, four of the least significant have since been closed, while, on the other hand, no less than eight new ones have been started, involving a vote for the current year of more than £10,500. Three of these new schools are for building, two for weaving, one for pottery, one for engineering, and one for art industries. Similarly, the contribution to the continuation schools (*Fortbildungsschulen*) reveals an increase by more than 20 per cent., from £22,000 in 1891-92 to £26,500 in 1895-96. These figures are at least reassuring, and give hope that during the present year the Treasury will not look askance on the Education Office when it begs for money for the growth of its good work.

SCIENTIFIC SERIALS.

American Meteorological Journal, February.—The rainfall of the Malay Archipelago, by Dr. A. Woeikof. This article is chiefly based upon the observations which have been for fifteen years published in considerable detail by the Observatory of Batavia. It is generally considered that near the equator the rains are everywhere heavy and of nearly daily occurrence. Dr. Woeikof shows that in many localities, e.g. on the open sea, this is not the case. In the region in question, some of the wettest and some of the driest stations lie within 1½° N. and 1° S. of the equator. The most rain falls on the west coast of Sumatra; the more level Eastern Sumatra and Western Borneo