in which the first half was ruled at the rate of 1000 to the inch, and the second half at the rate of 1001 to the inch, the one half would evidently do the same thing for one soda line as the other half of the grating was doing for the other soda line, and the two lines would be mixed together and confused. In order, therefore, to do anything like good work, it is necessary, not only to have a very great number of lines, but to have them spaced with most extraordinary precision; and it is wonderful what success has been reached by the beautiful dividing machines of Rutherfurd and Rowland. I have seen Rowland's machine at Baltimore, and have heard him speak of the great precautions required to get good results. The whole operation of the machine is automatic; the ruling goes on continuously day and night, and it is necessary to pay the most careful regard to uniformity of temperature, for the slightest expansion or contraction due to change of temperature of the different parts of the machine would bring utter confusion into the grating and its resulting spectrum.

In printing, the contact has to be pretty close, and the finer the grating the closer must the contact be. I experimented upon that point by preparing a photographic film upon a slightly convex surface, and using that for the print; then, where the contact was closest, the original of course was very well impressed, and round that, one got different degrees of increasingly imperfect contact, and one could trace in the result what the effect of imperfect contact is. I found that, both with gratings of 3000 and 6000 lines to the inch, good enough contact was obtained with ordinary flat glass; but when you come to gratings of 17,000 or 20,000 lines to the inch the contact requires to be extremely close, and in order to get a good copy of a grating with 20,000 lines per inch it is necessary that there should nowhere be one ten-thousandth of an inch between the original and the printing surface—a degree of closeness not easily secured over the entire area. It is rather singular that though I published full accounts of this work a long time ago, and distributed a large number of copies, the process of reproducing gratings by photography did not become universally known, and was re-discovered in France, by Isarn, only two or three years since.

One reason why photographic reproduction is not practised to a very great extent is, that the modern gratings—such as Rowland's—are ruled almost universally upon speculum metal. A grating upon speculum metal is very excellent for use, but does not well lend itself to the process of photographic copying, although I have succeeded to a certain extent in copying a grating ruled upon speculum metal. For this purpose the light had to pass first through the photographic film, then be reflected from the speculum metal, and so pass back again through the film. Gratings such as could easily be made by copying from a glass original are not readily produced from one on speculum metal, and I think that is the reason why the process has not come into more regular use. Glass is much more trying than speculum metal to the diamond, and that accounts for the latter being generally preferred for gratings; indeed, the principal difficulty consists in getting a good diamond point, and maintaining it in a shape suitable for making the very fine cut which is required.

I may now allude to another method of photographic reproduction which I tried only last summer. It happened that I then went with Prof. Meldola over Waterlow's large photo-mechanical printing establishment, and I was very much interested, among many other very interesting things, in the use of the old bitumen process—the first photographic process known. It is used for the reproduction of cuts in black and white. A carefully cleansed zinc plate is coated with varnish of bitumen dissolved in benzole, and exposed to sunlight for about two hours under a negative, giving great contrast. Where the light penetrates the negative the bitumen becomes comparatively insoluble, and where it has been protected from the action of light it retains its original degree of solubility. When the exposed plate is treated with a solvent, turpentine or some solvent milder than benzole, the protected parts are dissolved away, leaving the bare metal; whereas the parts that have received the sunlight, being rendered insoluble, remain upon the metal and protect it in the subsequent etching process. I did not propose to etch metal, and, therefore, I simply used the bitumen varnish spread upon glass plates, and exposed the plates so prepared to sunshine for about two hours in contact with the grating. They are then developed, if one may use the phrase, with turpentine; and this is the part of the process which is the most difficult to manage. If you stop development early you get a grating which gives fair spectra, but it may be deficient in intensity and brightness; if you push development, the brightness increases up to a point at which the film disintegrates altogether. In this way one is tempted to pursue the process to the very last point, and, although one may succeed so far as to have a film which is quite intact so long as the turpentine is upon it, I have not succeeded in finding any method of getting rid of the turpentine without leading to the disintegration of the film. In the commercial application of the process the bitumen is treated somewhat brutally—the turpentine is rinsed off with a jet of water; I have tried that, and many of my results have been very good. I have also tried to sling off the turpentine by putting the plate into a kind of centrifugal machine; but by either plan the film in which the development has been too far pushed, is liable not to survive the treatment required for getting rid of the turpentine. If the solvent is allowed to remain we are in another difficulty, because then the developing action is continued and the result is lost. But if the process is properly managed, and development stopped at the right point, and if the film be of the right degree of thickness, you get an excellent copy. I have one here, 6000 lines to the inch, which I think is about the very best copy I have ever made. The method gives results somewhat superior to the best that can be got with gelatine; but I would not recommend it in preference to the latter, because it is very much more difficult to work unless some one can hit upon an improved manipulation.

I will not enlarge upon the importance of gratings; those acquainted with optics know how very important is the part played by diffraction gratings in optical research, and how the most delicate work upon spectra, requiring the highest degree of optical power, is made by means of gratings, ruled on speculum metal by Rowland. I suppose the reason why no professional photographer has taken up the production of photographic gratings, is the difficulty of getting the glass originals; they are very expensive, and I do not know where they are now to be obtained. It seems a pity that photographic copies should not be more generally available. I have given a great many away myself; but educational establishments are increasing all over the country, and for the purpose of instructing students it is desirable that reasonably good gratings should be placed in their hands, to make them familiar with the measurements by which the wave-length of light is determined.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. STANLEY DUNKERLEY has been appointed to the University Demonstratorship of Mechanism and Applied Mechanics at Cambridge, made vacant by the election of Mr. Dalby to the Professorship of Mechanical Engineering at Finsbury College.

AMONG the recipients of honorary degrees, conferred at the close of the summer session of the University of Edinburgh on Saturday, were Prof. Francis A. Walker, President of the Massachusetts Institute of Technology, and Sir Dietrich Brandis, K.C.I.E., F.R.S., late Inspector-General of Forests in India.

DR. J. B. PORTER, of Columbia College, New York, has been appointed to the newly-founded Macdonald chair of Mining and Metallurgy in the M'Gill University, Montreal. Mr. Herbert W. Umney, of Bath, has been appointed Assistant-Professor of Civil Engineering.

THE Council of the Hartley Institution, Southampton, have just made the following appointments:—Lecturer in Mathematics, Dr. Cuthbert E. Cullis, Assistant Lecturer to Prof. Karl Pearson, University College, London. Lecturer in Chemistry, Dr. D. R. Boyd, Demonstrator and Assistant Lecturer in Chemistry, Mason College, Birmingham. Lecturer in Biology and Geology, Mr. E. T. Mellor, Assistant Demonstrator in Biology, Owens College, Manchester.

HER MAJESTY'S Commissioners for the Exhibition of 1851 have made the following appointments to Science Research Scholarships, for the year 1896, on the recommendation of the authorities of the respective Universities and Colleges. The scholarships are of the value of £150 a year, and are ordinarily tenable for two years (subject to a satisfactory report at the end of the first year) in any University at home and abroad, or in some other institution approved of by the Commissioners. The scholars are to devote themselves exclusively to study and research in some branch of science, the extension of which is important to the industries of the country. The nominating institutions and the scholars are as follows:—University of Glasgow, W. C. Henderson; University of Aberdeen, A. Ogg; Mason College, Birmingham, T. S. Price; University College, Bristol, E. C. Fortey; Yorkshire College, Leeds, H. M. Dawson; University College, Liverpool, H. E. Annett; University College, London, J. E. Petavel; Owens College, Manchester, J. L. Heinke; Durham College of Science, Newcastle-on-Tyne, J. A. Smythe; University College, Nottingham, G. B. Bryan; University College of Wales, Aberystwyth, S. W. Richardson; University College of North Wales, Bangor, D. Williams (conditional appointment); Queen's College, Galway, J. Henry; University of Toronto, A. M. Scott; Dalhousie University, Halifax, Nova Scotia, D. McIntosh; University of New Zealand, J. A. Erskine.

The following scholarships granted in 1895 have been continued for a second year on receipt of a satisfactory report of work done during the first year:—

Nominating institution.	Scholar.	Places of study.
University of Glasgow.	W. Stewart.	Universities of Glasgow and Berlin.
University of St. Andrews.	H. C. Williamson.	Marine Laboratories, Naples and Kiel.
University College, Dundee.	J. Henderson.	Polytechnicum, Munich.
University College, Liverpool.	J. T. Farmer.	MacDonald Engineering Laboratories, Montreal.
University College, London.	E. Aston.	University College, London, and University of Geneva.
Durham College of Science, Newcastle-upon-Tyne.	A. L. Mellanby.	MacDonald Engineering Laboratories, Montreal, and Durham College of Science.
University College, Nottingham.	M. E. Feilmann.	Polytechnicum, Zürich.
Queen's College, Belfast.	W. Hanna.	Laboratory of Royal College of Physicians and Surgeons, London, and Bacteriological Institute, Prague.
McGill University, Montreal.	R. O. King.	MacDonald Engineering Laboratories, Montreal. (To change for second year.)
Queen's University, Kingston, Canada.	T. L. Walker.	University of Leipzig.
University of Sydney.	J. A. Watt.	Royal College of Science, South Kensington.
University of New Zealand.	E. Rutherford.	Cavendish Laboratory, University of Cambridge.

A limited number of the scholarships are renewed for a third year when it appears that the renewal is likely to result directly in work of scientific importance. The following scholarships granted in 1894 have been renewed for a third year:—

Nomina g institution.	Scholar.	Places of study.
Universi of Edinburgh.	J. C. Beattie.	Universities of Vienna and Berlin.
University of Aberdeen.	W. B. Davidson	Universities of Würzburg and Leipzig.
University College, Liverpool.	Dr. A. J. Ewart	University of Leipzig and Botanical Institute, Java.
University of Toronto.	Dr. F. B. Kenrick.	University of Leipzig.

GENEROUS gifts to educational institutions in America have often been noted in these columns. The New York *Critic* has collected some valuable information concerning the total amounts of such gifts and legacies received from various benefactors. Perhaps the following summary of these encouragements will create a spirit of emulation in the wealthy men of the British Isles before whom it may come. George Peabody, various, £1,035,000. Stephen Girard, Girard College, present value about £3,000,000. John D. Rockefeller, University of Chicago, £1,485,200; Vassar College, £20,000; Barnard College, £5000. Miss Helen Culver, University of Chicago, £205,000. Leland Stanford, Leland Stanford Junior University, from £3,000,000 to £4,000,000. Johns Hopkins, Johns Hopkins University, over £600,000. John C. Green, Princeton College and Lawrenceville School, £600,000. Anthony J. Drexel, Drexel Institute, £600,000. Asa Packer, Lehigh University, 115 acres of land and £500,000. Charles Pratt, Pratt Institute, £540,000; Charles M. Pratt, £8000. Leonard Case, Case School of Applied Science, £400,000. Henry W. Sage, Cornell University, £234,000. Cornelius Vanderbilt (deceased), Vanderbilt University, £200,000; William H. Vanderbilt, £92,000; Cornelius Vanderbilt, £8000. Peter Cooper and his family, Cooper Union, £330,189. Paul Tulane, Tulane University, £210,000. Seth Low, Columbia University, £200,000; Barnard College, £2000. Washington C. De Pauw, De Pauw University, £200,000. James Lick, University of California, £150,000. Isaac Rich, Boston University, £140,000. Ezra Cornell, Cornell University, £134,000. J. Pierpont Morgan, New York Trade School, £100,000. Colonel and Mrs. Richard T. Auchmuty, New York Trade School, £82,000. The total of this list, which is probably not complete, amounts to £15,080,389.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, July.—The "International Cloud Atlas." Mr. Symons takes the opportunity offered by the publication of this work (of which only a very few copies have yet been distributed) to make a brief reference to the principal works on clouds which have recently preceded the present one, including M. Weilbach's "Nordeuropas Skyformer" (Copenhagen, 1881), the "Wolken-Atlas" of MM. Hildebrandsson, Köppen, and Neumayer (Hamburg, 1890), M. Singer's "Wolkentafeln" (Munich, 1892), "Classificazione delle nubi" by the Specola Vaticana, containing some excellent reproductions of M. Mannucci's photographs (Rome, 1893), and the Rev. W. Clement Ley's "Cloudland" (London, 1894). The "International Cloud Atlas" (Paris, 1896) has been prepared under the superintendence of the International Meteorological Committee, and contains twenty-eight coloured reproductions of clouds. Although none of them is from an English photograph, Mr. Symons thinks our countrymen may be well content to see how largely the international system of 1896 is based upon the work of Luke Howard, and that the classification adopted is practically that of the joint work of Dr. Hildebrandsson and the Hon. Ralph Abercromby.—The spring drought of 1896. Mr. Symons selected twenty-eight stations distributed over the United Kingdom; these show that the rainfall for the first half of the year at eight out of sixteen English and Welsh stations, the total fell below two-thirds of the average, the lowest values being 48 per cent. at Haverfordwest; while for the Scotch and Irish stations the average was 83 per cent. and 80 per cent. respectively. The results for April and May show that at three stations the rainfall was less than 20 per cent. of the average, the total in London being 19 per cent. In 1893 the drought was more severe in parts of England and Wales, but the 1896 drought in the south of Ireland appears to be unprecedented; at Cork it lasted for sixty-four days.

THE numbers of the *Bulletino della Società Botanica Italiana* for May-July contain, in addition to papers of more local interest, one by Prof. G. Arcangeli on the elongation of the organs of aquatic plants (chiefly *Nymphæaceæ*), in which he expresses the opinion that the stress due to the weight of the superposed liquid is the chief stimulus for their adaptation to the depth of the water in which they live. The same author has a note on the sleep of plants, and the benefits which they derive from the varying positions of the leaves by night and by day.

THE contents of the *Nuovo Giornale Botanico Italiano* for July comprise four papers, of which the titles only can be given:—The conclusion of Sig. L. Nicotra's exhaustive essay on the statistics of the Flora of Sicily; Sig. A. Lenticchia on morphological variations in wild and cultivated plants; Sig. F. Tasci on the mycology of the Province of Sienna; Sig. U. Martelli on a new species of *Centaurea* (*C. ferulacea*).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—"The Determination of the Freezing-point of Mercurial Thermometers." By Dr. J. A. Harker.

The method adopted is to cool distilled water in a suitable vessel to a temperature below 0°, to insert the thermometer,