of economic value met with include iron ores, mica, copper ores, manganese, rutile, as well as limestone and other building stones.

IT has always been a difficult matter to obtain pure lithium by the electrolysis of fused lithium chloride, which has been the method employed up to the present, and was originally used by Bunsen. In the *Zeitschrift für Elektrochemie* of March 9, Messrs. O. Ruff and O. Johannsen describe a process which they have satisfactorily worked out for its preparation by the electrolysis of lithium bromide. They prepare the lithium bromide by the action of hydrobromic acid on the carbonate. The electrolysing vessel is of copper, and is partially water-jacketed in order that the walls may be kept cool and thus protected by a coating of solid lithium bromide. The anode is of retort carbon, and the two kathodes of iron wire 4 mm. in diameter. The electrolyte consists of lithium bromide containing 15 per cent. of lithium chloride. A current of 100 amperes at 10 volts is employed, and the yield of metallic lithium is about 80 per cent. of the theory. From time to time the metal as it collects on the iron kathode is removed with a flat iron spoon, and at once placed on a cold stone surface, where it rapidly solidifies. Determinations of the melting point showed it to be 180°, which agrees with that found by Bunsen in the middle of the last century.

A SIMPLE arrangement for purifying mercury which is likely to prove of considerable service is described by Messrs. G. A. Hulett and H. D. Minchin in the *Physical Review* (vol. xxi., No. 6). The method consists in distilling the mercury in a Wurtz flask under diminished pressure, allowing bubbles of air to pass through the mercury during distillation so as to prevent bumping. The air also serves the very useful purpose of oxidising any metallic impurity, such as zinc, cadmium, or lead, which otherwise would contaminate the distillate. Ordinary distillation *in vacuo* of mercury containing one of these metals does not suffice to remove the impurity, but by using the method described an amalgam of zinc can be made to yield pure mercury in a single distillation. An electrical method of ascertaining the presence of one part of zinc in ten billion parts of mercury is described incidentally.

THE March number of the *Geographical Journal* contains an interesting table by Miss Nora E. MacMunn, compiled from planimetric measurements made on an orographical map at the School of Geography, Oxford, showing the areas of the orographical regions of England and Wales. As a rule, the plains have been measured to the 250-feet contour line, and the hills have not been considered to begin below that level. The average height of England and Wales, calculated from these measurements, is 385 feet. Of the total 58,324·3 square miles constituting the area of England and Wales, 26,481·6, or 45·4 per cent., are under 250 feet in elevation; 16,364·5, or 28 per cent., are between 250 feet and 500 feet; 10,476·3, or 18 per cent., are between 500 feet and 1000 feet; 4698·3, or 8 per cent., are between 1000 feet and 2000 feet; 300·0, or 0·5 per cent., are between 2000 feet and 3000 feet; and 3·6 are more than 3000 feet above sea-level.

MR. FROWDE is about to publish for the Radcliffe trustees a "Catalogue of 1772 Stars, chiefly comprised within the Zone 85°–90° N.P.D., for the Epoch 1900," deduced from observations made at the Radcliffe Observatory, Oxford, during the years 1894–1903, under the direction of Dr. A. A. Rambaut, F.R.S.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET (1906*c*).—A telegram from Kiel announces the discovery of a new comet by Mr. Ross, of Melbourne, on March 18.

Its position at 7h. 36·1m. (Melbourne M.T.) was

R.A. = 2h. 3m. 52s., dec. = −7° 41′,

which is about half-way between ζ and ο Ceti.

A second telegram from Kiel states that Mr. Morgan observed the comet at Glasgow (U.S.A.) on March 19. Its position at 7h. 40·9m. (Glasgow M.T.) was

R.A. = 2h. 9m. 31·4s., dec. = −5° 47′ 25″.

The comet is stated to be of about the eighth magnitude.

COMET 1906*b*.—Numerous observations of comet 1906*b* are reported in No. 4078 of the *Astronomische Nachrichten*.

Observing at Bamberg on March 4, the day after its discovery, Prof. Hartwig found that the comet had a diameter of about 10″ and a central condensation of about magnitude 11·0. The same magnitude was recorded by Dr. Wirtz at Strassburg on March 6.

Prof. Max Wolf reports that the comet is easily seen on his plates, and shows a tail of about half a degree in length; with the 10-inch refractor a sharp nucleus was observed on March 4, and it was seen that the tail extended to the north-west.

COMET 1906*a* (BROOKS).—In No. 4078 of the *Astronomische Nachrichten* Herr M. Ebell gives a further daily ephemeris for comet 1906*a*, extending from March 16 to May 3. The following is an extract therefrom:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Mar. 20	5 41 5	+46 31	0·2618	0·1986	0·25
24	5 42 18	+43 47	0·2710	0·2284	0·21
28	5 43 58	+41 23	0·2801	0·2567	0·18
April 1	5 45 57	+39 18	0·2891	0·2835	0·15
5	5 48 10	+37 27	0·2981	0·3088	0·13
9	5 50 34	+35 48	0·3069	0·3325	0·11

Brightness on January 27 = 1·0 = about 10·0 m.

Observing at Arcetri on January 31, Dr. Abetti found that the comet had a central nucleus of about the tenth magnitude or a little greater, and that the surrounding nebulosity extended for about 2′, chiefly towards the direction of lesser right ascension.

On March 22 this comet will pass near to β Aurigæ, about 11m. (R.A.) to the west, whilst on April 5 it will be only about 5m. west of θ Aurigæ.

A PROGRAMME OF SOLAR RESEARCH.—Now that the Mount Wilson Solar Observatory has fairly settled down to work, Prof. Hale has revised his "Programme of Solar Research," published several years ago, and gives an outline of the revised programme in No. 1, vol. xxiii., of the *Astrophysical Journal*.

Two principal studies are to be prosecuted. First, a study of the sun as a typical star, with reference to stellar evolution; secondly, the relationship between solar and terrestrial phenomena.

These studies are divided into five groups, each of which contains a number of subdivisions. The five main groups are:—(1) direct photography; (2) spectroheliograph researches; (3) spectroscopic investigations; (4) studies of the total solar radiation; and (5) allied laboratory investigations.

Most of these are now being prosecuted at Mount Wilson, and Prof. Hale points out that there are many other solar investigations which call for attention, and of which many may be carried out by amateur observers with modest equipments.

HARVARD COLLEGE OBSERVATORY.—Prof. Pickering's report of the work done at Harvard College Observatory during the year ending September 30, 1905, is the sixtieth of the series, and contains the record of an immense amount of work, too much even to summarise here.

One or two special features may, however, be mentioned. Eighteen eclipses of Jupiter's satellites and eight occultations of stars by the moon were observed with the 11-inch Draper telescope. Three of the occultations were photographed continuously on a revolving plate, so that the nature of the disappearance, whether instantaneous or gradual, could be recorded.

Numerous valuable observations of peculiar stellar spectra were made during the year, including the discovery of Nova Aquilæ No. 2 by Mrs. Fleming. This is the eighth Nova discovered by that observer from the Draper memorial spectrograms.

With the Bruce telescope 523 plates were obtained, making 7504 in all, from which Miss Leavitt has discovered 1129 new variable stars during the year.

The bibliography of variable stars compiled by Miss Cannon was nearly ready for publication when the Astronomische Gesellschaft appointed a committee to undertake a similar work. Prof. Pickering therefore proposes to publish the Harvard work in an abridged form.

CATALOGUE OF 3799 BRIGHT STARS.—A useful catalogue of 3799 bright stars has just been published by M. J. Bossert, of the Paris Observatory.

This catalogue gives the magnitude and mean coordinates (1900·0) of each star, and, in addition, the precession, secular variation, and proper movement, together with instructions and examples for finding the star's position at any given epoch.

The stars are arranged in zones of 1° of N.P.D., and in each zone they are given in order of R.A., this classification being considered the most convenient for meridian observers.

Stars down to the seventh magnitude are included, the magnitude of Aldebaran being taken as 1·0.

ECLIPSE OBSERVATIONS AT CATANIA.—On the occasion of the total solar eclipse of August 30, 1905, observations of prominences, by the Lockyer-Janssen method, and of the variations in the terrestrial electric field were carried out, during the whole day, at the Catania Observatory.

The results are published in No. 1, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani*, and show, among other things, that the maximum effect of the solar radiation corresponds to the minimum potential of the atmospheric electricity.

MICROMETER MEASURES OF STRUVE DOUBLE STARS.—No. 4078 of the *Astronomische Nachrichten* contains the results of a series of measures of eighty-one "Struve" double stars made by Dr. H. E. Lau, of the Copenhagen University Observatory.

The position for 1900·0, the position-angle, the distance, and the data and hour of each observation are given for each star, and are followed by brief notes by the observer.

SOME APPLICATIONS OF THE THEORY OF ELECTRIC DISCHARGE THROUGH GASES TO SPECTROSCOPY.[1]

THE luminosity produced by an electric current passing through a gas at low pressure varies greatly in character, not only when we alter the nature of the discharge, as, for example, when we pass from the arc to the spark, but also in many cases at different points of the same discharge. The luminosity may be of one colour at one place and of a very different colour at another, and spectroscopic examination shows that the spectrum of the same gas often varies considerably as we proceed along the line of discharge. As recent experiments have thrown a considerable amount of light on the processes going on in the different kinds of electrical discharge and at different parts of the same discharge, the study of the connection between the changes in the electrical effects and the changes in the spectra might be expected to throw some light on the very interesting question of the genesis of spectra. Many important points can very conveniently be studied by the aid of Wehnelt's method of producing the current. In this method the kathode is a strip of platinum or a piece of platinum wire on which either a little lime or barium oxide has been deposited. This when heated to redness emits large supplies of corpuscles, and by altering the temperature of the platinum very large variations in the current passing through the tube and in the potential difference between the electrodes can be obtained. In our experiments the current varied from a small fraction of a milliampere to several amperes, and the potential difference from a few volts to several hundred.

The apparatus used is shown in Fig. 1. AB is the platinum strip with the lime on it; a thermocouple—a platinum and platinum-rhodium junction—was fused to this strip, and served to determine its temperature; the strip was connected with the earth, and was heated by a current passing through the leads LM; a rheostat was placed in series with the heating current, and by means of this the temperature could be altered gradually. The anode was a platinum disc; this was connected with the positive pole of a battery of storage cells, the negative pole of which was earthed; to allow of gradual variations in the potential difference between the electrodes a potential divider of 100 resistances of 10 ohms each was used. The current through the tube was measured by a d'Arsonval galvanometer, and the potential difference between the terminals by a Weston's voltmeter.

Some of the most interesting features of the discharge are very prominent when the temperature of the platinum is high, say 1400° C., and the pressure of the gas low, less than 0·01 mm. of mercury. The discharge is light blue, and its spectrum shows the mercury lines and the band spectrum of nitrogen. In this case the relation between the current and the potential difference is represented by a curve like Fig. 2, the ordinates representing the current and the abscissæ the potential difference. In the case we are considering, when the wire is very hot and the pressure low, the change from the dark to the luminous discharge takes place very abruptly, an increase of the potential difference by 1/100 of a volt being often sufficient to convert a discharge where no light could be detected even in a darkened room into one where the light was quite bright. When luminosity appears there is a very rapid increase in the current; in some of the experiments an increase in the potential difference of 1/100 of a volt increased the current forty-fold. At this stage the thermojunction showed that there was no increase in the temperature of the platinum where the luminosity appeared; we shall see later on that it is possible by using large potential differences to get such large currents through the tube that the platinum becomes appreciably warmer by the passage of the current.

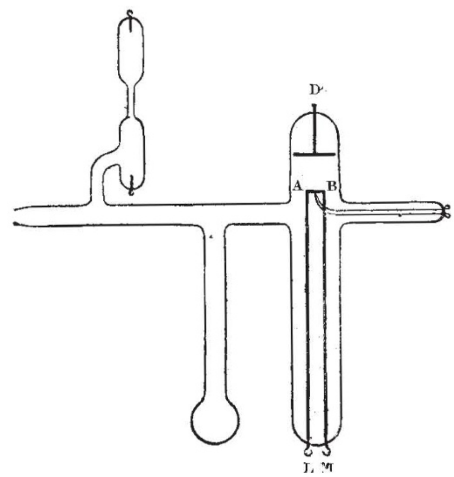

FIG. 1.

One point which I think very suggestive is the abruptness with which the luminosity round the kathode appears. We see that by a very small increase in the potential difference the discharge passes from a state in which no luminosity can be detected, even in a dark room, to one where the luminosity can plainly be seen in a bright light; thus the molecules of the gas in the tube, just when the luminous discharge is on the point of appearing, are in a state in which a very small change in the electrical

[1] Discourse delivered at the Royal Institution on Friday, January 19, by Prof. J. J. Thomson, F.R.S.