magnetometer method might be used more than it is at present *under suitable conditions*; I wished to direct attention to its practical limitations.

THE REVIEWER.

Nodules on the Intermediate Bladderwort.

I RECENTLY had an opportunity of examining living specimens of a very rare British plant, the intermediate bladderwort (*Utricularia intermedia*), and found that the leaf-bearing stems ended in a solitary terminal knob or nodule, the largest being the size of a small peppercorn. What are these knobs? Are they autumn plant-buds that will ultimately grow into plants? This seems to me a possible solution; but (my edition of) Bentham does not mention that the plant propagates itself in this way, nor are the knobs figured in the companion volume of illustrations by Fitch and Smith. HAROLD EVANS.

Llanishen, Cardiff, September 17.

NOTES ON STELLAR CLASSIFICATION.

III.

IN the year 1890 a photographic study of the spectra of stars was commenced by me at the Solar Physics Observatory at Kensington. The object of the investigation was not so much to make a spectroscopic survey of the stars generally as to examine with considerable dispersion the spectra of the brighter individual stars. Up to the end of the year 1900 there had been accumulated a large number of spectra, a catalogue of which was published in the year 1902. This contained 470 of the brighter stars.

In this catalogue the stars were classified according to their spectra after a minute inquiry of the lines due to each of the chemical "elements" involved.

The spectra of 105 of these 470 stars were photographed by Dr. F. McClean at the Cape Observatory.

Details of this classification were given in the publication above mentioned, but a brief summary may here be given. The stars were arranged in two main groups, one in which the stars were getting hotter ("hotting"), and the other in which they were cooling. The differentiation of these two groups was based, not only on their chemistry, but on other differences observed on the two arms of a "temperature curve."

On the temperature curve the stars increasing their temperature were located on the left-hand branch or ascending arm of the curve, and the cooling stars on the right or descending arm. The stars of the highest temperature were located at the apex of the curve.

The two main divisions of stars, *i.e.* those getting hotter and those getting colder, were each classified according to their chemistry and placed at their respective levels on each side of the temperature curve. At equal levels on each arm the stars were considered to be of the same temperature, each group being designated by a name derived generally from that of the "type star" which had been selected to represent that group.

Further experience with this method of stellar classification led to the detection of criteria which have suggested the interpolation of additional groups, and those have now been embodied in the general scheme as given below representing the classification in use at present, and to it has been added the Harvard scheme of classification of the type stars employed by me.

Harvard Classification			Harvard Classification
Oa Pec. Od	Argonian		
Oe5		IV	
B	Alnitamian	III	
B		II	
B		I	
B2	Crucian	Achernian	B5
B3	Taurian	Algolian	B8
B8 Pec.	Rigelian	Markabian	A
A2 Pec.	Cygnian	Sirian I	A
	—	Sirian II	A5
F8 Pec.	Polarian	Procyonian I	F5
G	Aldebarian II	Procyonian II	G
K5	Aldebarian I	Arcturian	K
Ma	Antarian	Piscian	N

The main routine work at the Hill Observatory at Sidmouth, since the McClean telescope was brought into use in September, 1913, has been a spectroscopic survey of all stars down to the fifth magnitude other than those published in the above-mentioned catalogue; incidentally the spectra of a number of stars fainter than magnitude five have also been photographed.

This programme of work is especially fitting for this observatory, because the same instrument is in use which Dr. Frank McClean employed in his spectroscopic survey of stars equal to or brighter than magnitude 3·5, the telescope having been presented to the observatory by his son, Frank Kennedy McClean.

The McClean instrument consists of an equatorially mounted twin-telescope with apertures of 12 and 10 inches, and focal lengths of 134 and 150 inches respectively. The former is fitted with an objective prism of 12 inches aperture and 20° angle, and is mounted in a metal frame in such a way that it may be moved clear of the objective. In the focal plane is placed a camera fitted with a swing back by Messrs. Hilger. This carries a plate-holder for plates $6\frac{1}{2} \times 4\frac{3}{4}$, but an adapter has been inserted to carry plates $4\frac{1}{4} \times 3\frac{1}{4}$ which are in use. The dispersion on the photographic plate between K and Hβ is equal to 28 mm. or 927 Angström units.

The telescope, built by Sir Howard Grubb, of Dublin, is driven by means of falling weights, and is fitted with electric control movements regulated by an electric pendulum. The governor is of the heavy ring pattern, and is adjusted by means of a cam. The declination circle is electrically illuminated, and viewed with the aid of one of two reading telescopes from the camera end. In addition to two finders of 4-inch and 2-inch aperture fitted to the 10-inch tube, a 3-inch finder deviated to the angle of the prism has been specially attached to the tube of the 12-inch; this serves the purpose of observing the amount of

clock rate and for "following" in the case of photographing the spectrum of a comet.

In order to obtain a serviceable width and the necessary density to the spectra, a rate of acceleration or retardation is given to the driving clock. This rate depends on the magnitude of the star in question, its type of spectrum, and its declination. The adjustment for rate is accomplished by regulating the speed of the governor ring by means of the cam mentioned above, the indicator being set to readings which have been derived from previous photographs.

The McClean telescope is mounted on three concrete pillars in a building with a circular concrete-block wall, internal diameter of 18 ft., on which is a hemispherical dome made of wood and covered with rubberoid. The wall is double—that is, has an air space in order to prevent rapid changes of temperature of the air in the dome. The dome rests on iron wheels running on a circular rail fixed to the upper part of the wall, and is easily revolved by hand by means of an endless rope round a grooved pulley fixed to the axis of one of the wheels. The shutters, also operated by hand, are made in two sections and run on rails at their upper and lower extremities; when open, a clear view of the zenith is obtained.

All the electric connections for the telescope and lighting purposes and for the driving-clock wire are led in a trough into an annexe in which are placed the electric pendulum, small accumulators, dark room, etc.

The building is situated on the top of Salcombe Hill to the east of Sidmouth; it is 580 ft. above sea-level, and commands an uninterrupted view of the horizon in every direction.

Since the instrument was first brought into use in September, 1913, the site has been found to have all the excellent observing conditions that were anticipated.

Smoke, mist, artificial-light glare are conspicuous by their absence, and on only one occasion has high wind in a clear sky prevented observation. The hill-top is often clear when the adjacent valley is filled with mist or cloud. Cloud on the top is rare.

The purity of the sky on almost all occasions when free from clouds is extremely advantageous for photographic observations. At South Kensington such clear, dark skies were extremely rare, and then only one or two hours in the early morning were at all comparable with the conditions here. The excellence of the atmospheric conditions is well shown by the extension of the spectra into the ultra-violet. A spectrogram of α Cygni taken with the 9-in. Henry prismatic camera shows the hydrogen series down to H_ω (λ 3667·8), *i.e.* twenty-three hydrogen lines on the one plate. The most refrangible hydrogen line recorded in the South Kensington reduction of the spectrum of α Cygni was H_θ (λ 3798). It may also be mentioned that the southern stars α Columbæ (dec. -34° 8′) and λ Scorpionis (dec. -37° 2′) have been seen with the naked eye. The steadiness of the image is normally greater than at South Kensington, and long exposures on faint stars give spectra showing definition of a very satisfactory character.

The working list prepared for use with the 12-in. McClean instrument contains all the stars of the Harvard revised photometry of magnitudes fainter than 4·0 and brighter than 5·0 to the north of dec. -15° which were not included in the catalogue of 470 brighter stars compiled at South Kensington. For these stars exposures of twenty minutes to one hour, according to magnitude and type, are usually amply sufficient to yield spectrograms of sufficient width and density to exhibit enough detail for the purpose of classification. Neighbouring stars fainter even than 6·0 magnitude are sometimes satisfactorily recorded.

A catalogue of the stars the spectra of which have been photographed and classified since 1913 at the Hill Observatory has been prepared; it contains 354 stars. The designations, positions for 1900, magnitudes, and Harvard classification have been taken from the Revised Harvard Catalogue (Annals of the Astronomical Observatory of Harvard College, vol. iv.). In the last column of the table is given the equivalent Kensington classification. The small letters *h*, *c*, and *a* indicate whether the star is increasing its temperature (hotting) (*h*), decreasing its temperature (cooling) (*c*), or at the apex (*a*) of the temperature curve or about the condition of being most hot. The letter (*p*) denotes that there is some peculiarity about the spectrum.

These small letters will save references to the groups in my classification in the case of those inquirers chiefly interested in temperatures. They also show that the Harvard classification includes both classes of stars under the same designation in the other cases.

Before the war Lieut. Lockyer, R.N.V.R., and Mr. Johnson and Mr. Goodson were the assistants engaged in photographing and classifying the spectra. Since Lieut. Lockyer and Mr. Johnson took up their military duties, their work has been carried on by Mr. Goodson.

NORMAN LOCKYER.

THE ATTACKS OF BIRDS UPON FRUIT.

UNDER the heading of "The Ravages of Birds" a correspondence has arisen in the *Times* which is apt to mislead both the general public and fruit-growers on a subject already overburdened with misrepresentation and error.

It is suggested by one correspondent that there are two simple methods for preventing the attacks of birds upon fruit, viz., (i) provision of drinking water, (ii) provision of food to entice the birds away from the fruit. That there may be a scarcity of water in some districts is quite possible, but at the time when the missel thrush, blackbird, blackcap, bullfinch, etc., attack fruit there is an abundance of animal food in the form of insect larvæ, insects, worms, slugs, snails, etc., in addition to wild fruits and seeds. Further, if a few of these fruit-eating birds are shot, and the