equal images on the photograph. This is secured by means of a rotating shutter, a neutral screen, or the use of a grating in front of the objective.

The purpose of (3) and (4) is to make any residual errors the same for the parallax star and the comparison stars, and so far as possible the same on all photographs.

The knowledge of the distance of a star gives us immediately its luminosity or the amount of light it emits as compared with the sun. There is a very great range in luminosity even for stars of the same spectral type. Now the stars have been arranged in an order according to the spectra, which agrees fairly well with their order in colour from blue to red, and is essentially an arrangement according to temperature. This may be regarded as an extremely good first approximation to a classification of stellar spectra. But it does not detect any differences attributable to absolute luminosity, though presumably density and gravity at the surface layer of the star from which the lines in the spectrum have their origin must be widely different.

A few years ago a very fruitful investigation was commenced at Mount Wilson by Adams and Kohlschuter. By a close comparison of the spectra of stars of the same spectral class, but differing greatly in absolute luminosity, they detected lines the intensities of which differ. Adams and his coadjutors at Mount Wilson have pursued this research with very great success. They have found in stellar spectra a number of pairs of neighbouring lines, one line of each pair being independent of the absolute luminosity, while the other changes in intensity with the luminosity of the star. They have measured the relative intensities of these pairs of lines, and compared their measures with the luminosities of 650 stars already known through the trigonometrical determinations of parallax made at Allegheny, McCormick, Mount Wilson, and Yerkes. Thus they have found the luminosities of stars corresponding to different intensities of the lines. They have recently published a catalogue (*Astrophysical Journal*, March, 1921) giving the luminosities and parallaxes of 1680 stars.

The advantage of this method is that it extends the range of parallax determinations beyond the limit (say) 0·02″ of the trigonometrical method, the limit of the spectroscopic method being determined only by the capacity of large telescopes to give measurable spectra. In the table a comparison is given with unpublished results at Greenwich obtained by the trigonometrical method :—

No.	App. mag.	Mag. at 10 parsecs	Parallax	
	m.	m.	Mount Wilson ″	Greenwich ″
B 1673	5·6	4·2	0·052	0·034
B 2897	6·1	4·3	0·044	0·040
B 2971	7·8	7·2	0·076	0·088
C 1604	8·2	4·9	0·022	0·015
B 3983	6·9	5·7	0·058	0·052
B 4181	5·0	1·7	0·022	0·041
B 4234	6·4	2·4	0·016	0·013
C 2242	7·6	5·4	0·036	0·046
B 4322	4·8	3·6	0·058	0·031
B 5009	4·8	3·8	0·158	0·171
B 6129	6·6	6·7	0·105	0·076

Comparison of these results, obtained by entirely different methods, shows the accuracy of 20 per cent. claimed for Mount Wilson, and ±0·010″ for Greenwich is reached.

A third method is being employed extensively for determining stellar distances depending on the fact that the masses of stars lie within very restricted limits. It is applicable only to double stars, and depends on Kepler's third law, $M+m=a^3/P^2$, where M, m are the masses, a is the mean distance between the components, and P the period of a double star. When P is known and $M+m$ assumed, a is found, and, further, as the cube root of $M+m$ is involved, an error in the assumed mass produces a much smaller error in the mean distance. Now the *angular* mean distance is determined by direct observation for all double stars the orbits of which can be calculated. At the present time this amounts to more than 150. But it has been shown by Hertzsprung and Russell that for double stars which have completed too small a portion of their orbits for their periods to be known it is still possible to obtain their "hypothetical" parallax with considerable probability. The method has been recently applied at Greenwich to obtain the parallaxes of a large number of stars, and the accordance with the results found by the trigonometrical and spectroscopic methods is very satisfactory (see a paper in Monthly Notices R.A.S., November, 1920, by Messrs. Jackson and Farmer).

I believe there is in preparation by American astronomers a catalogue giving the parallaxes of 3000 stars, about half of which have been determined by two at least of these three methods. We may expect that in the course of a very few years the distances of all stars visible to the naked eye in the northern hemisphere will have been determined, as well as those of many fainter stars. This great accession of knowledge of stellar distances carries with it a corresponding increase with reference to the luminosities, sizes, masses, densities, and velocities of stars of different spectral classes.

Obituary.

William Warde Fowler. 1847–1921.

WARDE FOWLER, like Arthur Sidgwick, was one of the men we can least spare—a classical scholar of distinction and a writer of great charm who sympathised warmly with the aims and methods of science, and strove to give them a larger place in the life of his University. It would scarcely be possible to gain a clearer insight into the strength and weakness of an Oxford education as it was nearly twenty years

ago than by reading his "Oxford Correspondence of 1903" (Blackwell, Oxford; Simpkin, Marshall and Co., London) between a college tutor and one of his pupils whose eyes are opened to the meaning of research by meeting a Zürich Professor in the Long Vacation. Warde Fowler's opinions and the long experience on which they were based appear in the charming letters of the tutor. We owe it to him and many others like him in this respect that the years since 1903 have brought a steady growth in the amount of original work and in the significance attached to it by the University.

In the brief space available I do not propose to say more of Warde Fowler's writings, excellently described in the *Times* of June 16, than just this—that he brought to his classical work the spirit of the naturalist, always seeing through the beautiful veil of literature to the everyday human lives and interests that lay behind, and as he delighted in them himself, so he made them a delight to others.

He was a most interesting and arresting lecturer, and had the supreme gift of selecting and describing an observation so that it both illuminated and fixed in the mind some far-reaching conclusion. No one could forget that the lines of bird-migration are determined, and may be varied, by sight and memory, after hearing him tell of the misty autumn day when he stood on the chalk cliff near Swanage and watched the little bands of swallows arriving from the west and flying round the English coast to the north of the Isle of Wight, on their eastward journey, to cross near Dover; and lo! as he stood watching, there suddenly arrived a band which acted very differently, circling up into the air and darting directly eastward across the sea; and then, following their flight, he saw for the first time what they had seen, that the mist had lifted and the Needles were in sight. Then, and then only, had they taken the direct and shortest eastward route along the chalk midrib of the Isle of Wight.

Or he would tell of the thrush that, in the middle of its song, saw one of its young carried off by a cat, and expressed its emotions by singing more loudly and passionately.

Or it was the want of attention in observation that was illustrated by the fishermen, he being one of them, who, after their day's sport was over, began discussing the position of the fins of the trout, and, unable for the life of them to remember the arrangement, paid a visit to the larder to find out!

It is interesting to compare with this experience the unconscious yet keen attention and the sure memory which come into play when man observes his fellow man. And this is to be expected. There have been long periods when the recognition of a man by his shoulder or head seen from behind, or by his gait, has meant the difference between life and death.

The memories I have recalled belong to the early days of the Ashmolean Natural History Society of Oxfordshire, and probably all are more than thirty years old. The charm and arresting personality of the speaker have left them clear and bright. E. B. P.

R. E. Dennett.

Mr. R. E. Dennett, who died in London on May 28 at the age of sixty-four, was a student of the religions, languages, and customs of the indigenous races of West Africa, and his work was marked by great ability and originality. Son of an Anglican clergyman of unusual individuality—a Devonshire man—Mr. Dennett was born at Valparaiso, and had his early education at Marlborough School. He went out to West Africa in his early twenties, and he spent more than forty years in Nigeria and in what are now the French and Belgian Congo territories. Comparatively early in his career he was brought into association with that remarkable woman, Mary Kingsley, and his mind, already sympathetically disposed towards the native races, received an additional powerful impetus in the same beneficent direction. Thereafter he bent a great part of an intellect naturally strong to the attempt to interpret the character and institutions of the Africans to the reading public in Great Britain.

Mr. Dennett had special opportunities for observation, for in turn he was trader, explorer, and official, a combination not often found in one person. It was (indeed, still is) work highly necessary, for it is probably safe to say that the main impression left upon the minds of most people in Britain as the result of reading the accounts of the Stanley expeditions was that all Africans are absolutely primitive and all at the same stage of development. Nothing could be more grotesquely inaccurate, and Mr. Dennett's careful, patient, above all sincere and sympathetic, researches did much to make clear the truth, which is, of course, that the greater facts of man's life are represented among Africans by institutions and observances much the same in root significance as those of Europeans, but in some respects less highly developed. He believed firmly that the most hopeful course in British West Africa was, while suppressing accompaniments of native rule which are inconsistent with individual rights, carefully to preserve and support the main body of African custom, which he held to be essentially just and based upon the life and needs of the people. That is to say, he wished the African to be governed by his own people in his own way, the European Powers keeping the peace while the native races gradually advanced along their own lines.

Of several noteworthy books that by which Mr. Dennett will best be remembered is probably "At the Back of the Black Man's Mind," a close and penetrating study of the great subject indicated by the title. Others are: "Seven Years among the Fjort," "Nigerian Studies," "My Yoruba Alphabet," "Universal Order," and "Periodic Law." One of the most painstaking of inquirers,