what different heights. The results of the two sets of observations agree, and indicate that the phase advances by about 5° km.$^{-1}$ for heights between about 85 and 130 km. The meteor observations (J. S. G.) also indicate that the phase alters with seasons, and both sets of observations show that the magnitude of the rotating velocity-component increases with height. Although at greater heights movements of irregularities in the electron density will not necessarily follow the movements of the air (P. C. C.), or of the surrounding electrons, there is every reason to suppose that meteor trails, at levels near 90 km., indicate the movements of the air itself. Since the deductions made from observations of meteor trails are consistent with those made on the fading of reflected waves, it is reasonable to suppose that the latter, also, indicate air movements. It is then interesting to inquire what sort of movement might be expected from theoretical considerations.

The theory of semi-diurnal tides in the atmosphere (K. W., M. V. W.) leads us to expect a rotating component of the drift velocity of the order of the observed one in magnitude, but until now the phase has not been as expected. The new observations that the phase varies with height could be explained in terms of a temperature gradient, but it is difficult to explain why the phase changes with the seasons.

Since in the *E* region the electron movements seem to be determined by the air movements, it is interesting to consider what air movements might be produced by other than 'tidal' forces. It was pointed out (E. T. E., R. S. S.) that horizontal temperature gradients might be great enough to produce eddies, and that waves produced by the flow of air over obstacles near the ground could probably extend upwards into the *E* region. It was also pointed out (R. S. S.) that the technique of observing noctilucent clouds has been improved recently and that observations on a larger scale can be expected in the next few years.

The most interesting piece of new information (B. H. B.) about the lower *F* region was that simultaneous measurements made on large-scale ripples, and on the small-scale irregularities which produce fading, show that both these irregularities travel with the same speed. If this observation is correct, it has important implications for the theory, since the present tendency is to suppose that the 'ripples' represent the travel of a distortional wave-motion through the electrons, and that the movements of the small-scale irregularities are produced by the joint effect of electric and magnetic fields.

Spencer[2] has shown that the scintillations of radio stars are produced by irregularities of electron density, at heights above 400 km., which are elongated and are oriented along the direction of the Earth's magnetic field. These irregularities produce an anisotropic diffraction pattern at the ground, of which the direction of elongation changes through the day and through the year as the position of the star changes. The observations have now been continued (I. L. J.) for a complete year, and the expected results have been obtained. A more detailed analysis of the results has shown that the length of the irregularities is about three or four times their breadth, and not about ten or twenty times as was originally supposed. Because the irregularities are elongated, any measured drift velocity is biased towards a direction perpendicular to the long axis. In practice, only the component of the true drift in this direction can be observed. By making observations (M. D.) on two radio stars almost simultaneously, two velocity components can be derived and hence the true direction of drift can be deduced. In this way, it has been shown that the true drift is towards the south-west; not simply towards the west as previously supposed.

It is difficult to account for the occurrence of these elongated irregularities, which are detected only at night and at heights greater than 400 km. It was once thought (Ryle[3]) that they were produced by interstellar matter attracted to the Sun and intercepted by the Earth on its dark side. Recent work (A. H.) has shown that the irregularities, as evidenced by radio stellar scintillation, do not occur at the same time at Washington, D.C., Cambridge and in the Gold Coast. Scintillations are twice as common at sunspot minimum as at sunspot maximum. Theory suggests that, at these heights, movements of electrons would not follow movements of the air, so that simple turbulence is not a likely cause for the irregularities. If, however, there was turbulence in the *E* layer for any reason, it was suggested (M. D.) that the resulting irregular electrostatic field might be transferred, along the magnetic lines of force, to the *F* region in such a way as to produce irregularities of electron density there. In support of this idea it was stated that increased scintillations are sometimes accompanied by a magnetic disturbance, but there is no one-to-one correlation. It was also suggested (J. W. D.) that a type of electromagnetic disturbance could perhaps travel from the *E* to the *F* region along a line of magnetic force, in such a way as to produce irregular variations in the *F* layer.

Attention was also directed (M. R.) to recent studies on the counterglow by workers in the U.S.S.R. They have interpreted this as a result of streaming of the upper atmosphere away from the Earth on the night side. This atmosphere is supposed to be repelled by the Sun, much as a comet's tail is repelled. It would tend to stream along the magnetic lines of force, and possibly with an irregular density, and might be responsible for the scintillations.

J. A. RATCLIFFE

[1] Briggs, B. H., and Spencer, M., "Rep. Prog. Phys.", **17**, 245 (1954).
[2] Spencer, M., *Proc. Phys. Soc.*, **68**, 493 (1955).
[3] Ryle, M., and Hewish, A., *Mon. Not. Roy. Astro. Soc.*, **110**, 4, 381 (1950).

OBITUARIES

Sir Arthur Trueman, K.B.E., F.R.S.

WHEN Sir Arthur Trueman died on January 5 at the early age of sixty-one, in his house in London, his passing left a gap in many circles created by his wide intellectual interests and attainments. By profession he was a geologist, and few have attained greater eminence or contributed more to the science by research, by teaching, or thorough administration. His early training at the High Pavement School and later at University College, Nottingham, laid the foundations for his subsequent eminence as a palæontologist concerned with various aspects of the faunas and of the stratigraphy of Carboniferous and Jurassic rocks. These researches were carried out during an unusually full and rich academic career, which commenced with his appointment as lecturer at University College, Cardiff, in 1917, where he came under the influence of Franklin Sibly. This was followed by appointment to the chair of geology and geography at Swansea (1921), and the subsequent

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tenure of chairs at Bristol (1933) and at Glasgow (1937–46).

Trueman's researches, though closely related, fall into three main categories largely resulting from and conditioned by the experience gained from his detailed and original morphological, ontogenetic and phylogenetic studies on ammonites. Accounts of the evolution of several families of ammonites were followed by similar studies on gastropods and the lamellibranch *Gryphaea*. Characteristically, Trueman recognized the implications of his palæontological discoveries in terms of their practical application towards a fuller understanding of Jurassic chronology and of their usefulness in zonal subdivision of these rocks in the field. Thus concomitant work described the palæontology of the Lias rocks from Lincolnshire and South Nottinghamshire to Somerset and Glamorganshire.

There followed that part of his work concerned with appreciation of the fundamental conceptions involving genera and species, of populations and of variability, and of the impact of such considerations upon taxonomy. His contributions to the more philosophical aspects of palæontology ranged among other topics, from lineage and orthogenesis, to a reconsideration of the species concept in palæontology, and culminated during his revision of the Coal Measures Non-marine Lamellibranchs (1927) in the application of biometric techniques to a study of variation in fossil communities and to the use of statistical investigations in detailed correlation. Work by Trueman, and others who have since extended his conceptions, has led to radical changes in outlook and added considerably towards evaluation of fundamental processes in evolution.

Trueman's later work dealt with the palæontology and with varied aspects of the stratigraphy of the British Coal Measures. The purely palæontological studies of the Coal Measures non-marine lamellibranchs from South Wales soon enabled him to indicate their practical applications in the identification of coal seams, and resulted in a zonal subdivision of the South Wales Coal Measures in 1927, leading to a suggested correlation of the British coalfields (1933). The detailed application of this zonal scheme to every major British coalfield, and the utilization of the accruing evidence in exploration within coalfields, or during boring for extensions or for new fields, by Trueman, independent workers and by officers of the Geological Survey bear witness to its efficacy. Indeed, this subdivision has formed the accepted method of presentation in all important papers and memoirs since its inception, and has contributed largely to a rationalization of Coal Measures stratigraphy, as summarized by Trueman in his presidential addresses to the Geological Society of London. The publication of a Palæontographical Society Memoir on the Coal Measures non-marine lamellibranchs in collaboration with Dr. J. Weir marks still further an important permanent record of widespread researches which constitute a major contribution to geological science.

Acknowledgment of his work by election to the Royal Society followed in 1942; the Geological Society of London awarded him the Bigsby Medal (1939) and the Wollaston Medal (1955).

Sir Arthur was energetically concerned for the welfare of geological science at all levels and published a number of books, in general illustrated by himself, and which were of interest to the layman, the school pupil or the student. However, his interests and knowledge were considerably more widespread and embraced many aspects of the educational field and of its organization and its contacts with science and industry. This knowledge made him a welcome member of many committees, such as the Elliot Commission on educational problems in West Africa, the Advisory Council on Scientific Policy, and as chairman of the Geological Survey Board.

Those who were fortunate to come under his influence either as students or staff regarded him with respect and affection, for his kindness, integrity and sympathetic understanding made him a friend in whom one felt complete confidence. His charm of manner and keen sense of humour, combined with a remarkably quick grasp of problems and wise judgment in their solution, convinced one of his very personal interest in every member of his department, student and staff alike. No student ever sought Trueman's help or advice in vain. He was always ready to discuss work and ideas and contrived to make all feel their ideas were interesting and their results important. As a leader he was a deep source of inspiration and encouragement, and possessed that inestimable gift of putting a person at ease. His enthusiasm and zeal were combined with a vital and ceaseless energy which he imparted to others; his lucidity of mind and exposition made him a great lecturer and superb teacher, in the lecture theatre, and above all in the field.

This remarkable combination of wide university experience, achievement, leadership, organizing ability and high moral integrity led to his appointment as deputy chairman of the University Grants Committee in 1946, and its chairman in 1948. In this office, at a time of critical importance in the developments of the British university system, Trueman contributed much by his knowledge, influence and wise counsel. Unfortunately, his period of office was limited, for he fell ill late in 1952 and soon afterwards resigned.

During the last years of his life Trueman struggled with great and uncomplaining fortitude against increasing physical disability, his mind alert and active, his sense of humour unimpaired; and during this time, with indomitable spirit he wrote parts of, and edited contributions for, his last book, "The Coalfields of Great Britain", a project which had been in his mind for many years.

Sir Arthur is survived by Lady Trueman and their son, E. R. Trueman. Lady Trueman's companionship, help, understanding and encouragement contributed greatly towards his many achievements, and her unselfish devotion during the later years enabled him to face his disability with great courage.

LESLIE R. MOORE

Prof. Duncan Leitch

THE tragically premature death of Prof. Duncan Leitch at the age of fifty-two, a week after that of his friend and colleague, Sir Arthur Trueman, came as a shock even to those friends who knew of his grave illness.

Leitch was a graduate of the University of Glasgow and served there as assistant and lecturer in geology until, in 1947, he succeeded Prof. T. Neville George in the chair of geology at the University College of Swansea.

Leitch's main scientific work was concerned with the palæontology and stratigraphy of the Coal Measures. He collaborated with me in zoning the

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