

meter now used for the realization of the temperature scale above the gold point.

The last subject dealt with is called "spectroscopic thermometry" and contains reference in the titles to "population" temperatures in hot gases, electron density and temperatures in plasmas by line broadening and temperature measurement in arcs.

The papers occupy 439 pages of the book and another 60 pages are devoted to a bibliography which comprises NBS monograph 27 1953-1960 and its supplements (1) 1960-1962 and (2) 1963-1965.

Almost all the contents of this book have been published previously, albeit scattered in time and space through the literature. Very little typesetting has been involved in producing the book, the pages being reproduced from the originals. The effort involved seems to be well worth while, for it is a great advantage to the specialist reader to have this collection in one cover at a comparatively low price. By its very nature, however, there are bound to be significant omissions in the subject and an introduction to the book filling in briefly these omissions and surveying the contents in the light of the latest information would have added considerably to the value of the work for reference purposes.

C. R. BARBER

ATMOSPHERIC PHYSICS

Exploring the Atmosphere

By G. M. B. Dobson. Second edition. Pp. xiv + 209. (Clarendon Press: Oxford; Oxford University Press: London, January 1969.) 42s boards; 21s paper.

WITH the advent of satellites and sounding rockets, the experiments performed to measure the physical and chemical properties of the Earth's atmosphere have been brought very much before the public eye. Although the scale of this work in the United States and the Soviet Union perhaps eclipses that done elsewhere, it is as well to remember that Great Britain has made a considerable contribution, not least of which has been the highly successful satellite Ariel 3. As a result of wide press publicity, many people, especially scholars and students of physics, geography and astronomy, have had their interest awakened in the fascinating subjects of atmospheric physics and geophysics.

This book is written for them; its exposition is simple and non-technical and the text is interspersed with many clear diagrams. The first edition of this book (published in 1963) presented a summary of the results obtained during the International Geophysical Year of 1957-58. This second edition brings the subject up to date and includes the observations made in the further international year, 1964-65, which was a period of minimum solar activity.

The book begins with a review of the whole atmosphere up to heights where it merges into outer space; then the reasons for the existence of the stratosphere and troposphere are set out. The formation of cloud, rain, frost and hail is discussed, special reference being made to the possibilities of artificial control of the weather. Lightning and thunder are next dealt with, for although these subjects have been studied for many years we now have a much better understanding of them. The discussion of ozone, that vital atmospheric constituent which absorbs the harmful ultraviolet radiation, is followed by a chapter on solar terrestrial relationships and the effects of the variable solar activity on the Earth's ionosphere. Included in the subjects for this chapter are sunspots, solar rotation, solar flares and the solar wind. The aurorae and airglow are discussed and mention is made of the new knowledge obtained of the upper atmosphere by the injection of sodium vapour into this region. The book ends with chapters on the effects of the Earth's magnetic

field on the ionosphere and cosmic rays, the production of the Van Allen belts, and the magnetosphere.

This is an excellent book, clear, and most rewarding to the reader. It presents this vitally alive subject in a fascinating way, emphasizing the facts and also stressing the uncertainties of our present position where knowledge and theories are in a constant state of flux.

DAVID W. HUGHES

Correspondence

Did Fertilization Occur?

SIR,—The interesting note "Early stages of fertilization *in vitro* of human oocytes matured *in vitro*", recently published in *Nature* by Edwards, Bavister and Steptoe¹, merits critical examination and comment. For this purpose it is useful to know what fertilization is, that is to define it, which can be done as follows: Fertilization is the incitement of an egg to development by a spermatozoon, together with the transmission of male hereditary material to the egg. At fertilization the spermatozoon contributes the stimulus for development and a set of chromosomes embodying the paternal contribution to the genetic make-up of the zygote. Without wishing to engage in semantic hair-splitting, one must observe that the "early stages" of fertilization may be and, in the note by Edwards *et al.*, are so early as to raise the question whether fertilization, if the word is to have a meaning, occurred at all.

Everyone knows that development involves the repeated division of the egg into more and more cells. No division was achieved in the experiments of Edwards *et al.*: so the first criticism of fertilization as defined above was not realized.

Neither the juxtaposition of the sperm and egg nuclei (identified as such), nor their "fusion", was observed by Edwards *et al.*: it follows that the second criterion, concerned with the intermingling of hereditary material derived from the father and mother, was not realized.

These observations in no sense imply that I disapprove of the work; nor that I do not admire it as a preliminary experiment, although similar work has been done before, as reported by Professors W. J. Hamilton and T. W. Glenister in *The Times* on February 18 this year. Nevertheless, the claim to have fertilized a human egg outside the mother, albeit as far as the "early stages" (only mentioned in the title, but not in the text or summary), is premature. Every gametologist knows how difficult it is to be sure that a mammalian egg has been fertilized (see Austin²), which is why a rigorous definition is needed. Parthenogenesis and the entry of a spermatozoon into an egg without fertilization are well known phenomena.

Yours faithfully,

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11 Herschel Road,
Cambridge.

¹ Edwards, R. G., Bavister, B. D., and Steptoe, P. C., *Nature*, 221, 632 (1969).
² Austin, C. R., *The Mammalian Egg* (Blackwell, Oxford, 1961).

SIR,—We consider the earlier stages of fertilization include attachment of spermatozoa to the zona pellucida, their movement through it and the presence of spermatozoa in the perivitelline space. Our data¹ gave convincing

evidence in many eggs of the accomplishment of these earlier stages, and this has been a major difficulty over the past years. Later stages of fertilization are attachment of spermatozoa to the egg surface, activation of the egg and pronuclear formation and growth. These stages are usually considered as achieved if pronuclei and sperm tails are seen in the cytoplasm of the eggs. We provided and evaluated some evidence of pronuclear formation and growth; our data on these stages are obviously preliminary until sperm tails can be positively identified in human pronucleate eggs *in vitro*. Fusion of pronuclei (syngame) is the final stage of fertilization.

If Rothschild had asked "Was fertilization completed?" we would certainly have agreed that it was not. We made no attempt to culture the eggs to syngame and beyond, since it is critical to control the earlier stages first. To demand that syngame is concluded and cleavage advanced before evidence of fertilization can be accepted is far too stringent. It could also be misleading since, as is well known, cleavage (parthogenesis) can proceed without fertilization. It should also be noted that conclusions in many papers reporting fertilization in progress have been based on the evidence of pronuclear stages (for example, 2 and 3). Indeed, Rothschild is hoist with his own petard, for the frontispiece to his book on fertilization⁴ shows a mouse egg with a spermatozoan in the perivitelline space and labelled "A live fertilized mouse egg showing the whole spermatozoan in the cytoplasm". This illustration shows fertilization in the same early stage as that in our figure 4B¹ which presents a human egg with a perivitelline spermatozoan.

Hamilton and Glenister mentioned Menkin and Rock⁵ and Shettles⁶. In fairness to others they should have quoted Petrucci⁷ and especially Hayashi⁸. We gave these four references and discussed them in an earlier communication⁹ quoted in our *Nature* paper. When work on the fertilization of human ova is debated, major consideration must be given to the maturation of these ova. Follicular ova are in the dietyate stage; it is unrealistic to use them for fertilization unless they are freshly at metaphase-II and possess a first polar body. The detection of bodies extruded from eggs alone is insufficient evidence of maturation, for many artefacts resemble polar bodies. It is vital to identify diakinesis, metaphase-I or anaphase-I in some maturing oocytes, since these are transitional stages providing the clue that maturation is in progress. We have furnished critical data on the identification and timing of these stages^{10,11}; earlier work has failed to do so adequately. Some previous workers made attempts to recover human eggs shortly before or after ovulation from the ovary or oviduct, but the difficulties in timing, identification of ovulatory follicles and recovery of eggs are considerable.

Yours faithfully,

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¹ Edwards, R. G., Bavister, B. D., and Steptoe, P. C., *Nature*, **221**, 632 (1969).

² Yanagimachi, R., and Chang, M. C., *J. Exp. Zool.*, **156**, 361 (1964).

³ Barros, C., and Austin, C. R., *J. Exp. Zool.*, **166**, 317 (1967).

⁴ Rothschild, Lord, in *Fertilisation* (Methuen and Co., 1956).

⁵ Menkin, M. F., and Rock, J., *Amer. J. Obstet. Gynec.*, **55**, 440 (1948).

⁶ Shettles, L. B., *Amer. J. Obstet. Gynec.*, **66**, 235 (1953).

⁷ Petrucci, D., *Discovery*, **22**, 278 (1961).

⁸ Hayashi, M., *Proc. Seventh Intern. Conf. IPPF, Singapore 1963*, p. 505.

⁹ Edwards, R. G., Donahue, R. P., Baranki, T. A., and Jones, H. W., *Amer. J. Obstet. Gynec.*, **96**, 192 (1966).

¹⁰ Edwards, R. G., *Nature*, **196**, 446 (1962) and **208**, 349 (1965). *Lancet*, **2**, 926 (1965). *Proc. Sixth World Cong. Fert. Ster., Tel. Aviv, 1969* (in the press).

¹¹ Henderson, S. A., and Edwards, R. G., *Nature*, **218**, 22 (1968).

University News

Professor H. F. Downton has been given the personal title of professor of statistics at the **University of Birmingham**.

Professor N. N. Das Gupta has been appointed Palit professor of physics at the **University of Calcutta**.

Professor E. W. Horton, University of London, has been appointed to the chair of pharmacology at the **University of Edinburgh**.

Appointments

Sir Frank Schon has been appointed chairman of the National Research Development Corporation in succession to Lord Black.

Announcements

Unesco International Cell Research Organization is organizing an international training course on **Energy-transducing Systems at the Subcellular Level** to be held jointly by the Wenner-Gren Institute and the Institute of Biochemistry, University of Stockholm, August 11-30, 1969. The course will comprise experiments, demonstrations, seminars and lectures. The experimental programme will include isolation and sub-fractionation of mitochondria, electron microscopy, experiments involving oxidative phosphorylation and related reactions. Dr G. F. Azzone, Padova, Italy, Dr J. Bremer, Oslo, Norway, Dr B. Chance, Philadelphia, USA, and Dr M. Klingenberg, München, Germany, have been invited to join the teaching staff of the two institutes for the course, which will be in English. Information regarding the selection of participants can be obtained from Professor O. Lindberg, Wenner-Gren Institute, Norrtullsgatan 16, S-113 45, Stockholm, Sweden.

ERRATUM. In the article "Rotating Neutron Stars and Pulsar Emission" by B. Bertotti, A. Cavaliero and F. Pacini (*Nature*, **221**, 624; 1969) the following corrections are necessary: formula (2) should not contain the factor π ; formulae (3) and (4) should read

$$P_{rr} = \frac{H_0^2 \sin^2 i}{4 c^4} \frac{a^6}{r^2} \omega^4 \left\{ I - \sin^2 \theta \cos^2 \left[\omega \left(\frac{r}{c} - t \right) + \varphi \right] \right\}$$

$$P_{r\varphi} = \frac{H_0 \sin^2 i}{2 c^3} \frac{a^6}{r^3} \omega^3 \sin \theta \sin^2 \left[\omega \left(\frac{r}{c} - t \right) + \varphi \right]$$

Instead of "radiation pressure" always read "electromagnetic stress"; page 625, column 2, lines 24 and 29, m_e should be replaced by m_c ; page 626, column I, line 3 from the bottom, ref. 13 should read "ref. 14, Richards, D. *IAU Circ. No. 2114* (1968)".

ERRATUM. In the review of the book *Functions of the Adrenal Cortex* (*Nature*, **221**, 782; 1969) the word "d-cxy-corticosterone" in line 7 of the third paragraph should read "deoxycorticosterone"; in line 8 of paragraph 4 "C21" should read simply "21".

ERRATUM. The first sentence in the article "Respiratory Activity of Mitochondria from Legume Root Nodules" by P. S. Muecke and J. T. Wiskich (*Nature*, **221**, 674; 1969) should have read "Work on subcellular elements of legume root nodules has concentrated exclusively on the symbiotic bacterial components which form the bulk of these elements and are responsible for nitrogen fixation, but no work has been published on the mitochondrial components."