

Eddington

SIR,—The letter you published by H. W. Grayson (*Nature*, 242, 317; 1973) must, on internal evidence, be judged to be fraudulent: the strong implication of a pre-1926 date in the letter does not agree with a reference to Sir Arthur Eddington—Professor A. S. Eddington was awarded a knighthood in 1930.

Yours faithfully,

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Complementarity

SIR,—The book review by E. H. Hutten, "Microphysical Phenomena" (*Nature*, 241, 220; 1973), suggesting the need for a new approach to such problems after fifty years of discussion, has just come to my notice.

Complementarity is invoked, but it is the principle of interdependent incompatibility which needs to be applied. According to this principle, the co-existence of mutually exclusive states is possible when each state determines the other and is thereby instantaneously excluded (like the concepts "position" and "displacement from that position", for instance), so that the two states alternate so rapidly within any given period of time that they appear to co-exist at the same time.

The Greeks worried about this problem, but notoriously never made experiments. Now, some 2,000 years of test results later, it pays to look once more at the problems they posed, in the light of these results.

I have postulated the principle of interdependent incompatibility not as an abstruse hypothesis, but because it is simple, obvious and fits the observed facts better than any other—as I could show, given the chance, or as could be worked out by others who put their mind to it. So far, I have hawked the principle variously, in vain. What good is the demand for a new approach if, when such approach is made, no one wants to know?

Yours faithfully,

U. LIGHT

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Fossils of Creation

SIR,—I feel that I really must argue with E. C. Lucas (*Nature*, 242, 355; 1973) on his suggestion that fossil evidence supports the Hebrew creation myth. The old ideas of the "ages" must be dropped; the age of fishes, the age of the coal forests and so on, have no reality.

Fishes appear in the Devonian but must have had a long evolutionary history which has not been preserved. Reptiles and mammals appear in the Perino-Trias, again fully evolved. One cannot interpret the six days of creation in terms of artificial geological epochs; it is taking credulity too far and is interpreting "Neolithic science" in terms of modern science. Why six days? The Neolithic farmer would have known that the phases of the Moon repeated every 28 days. His natural submultiples of numbers would be obtained by halving. The smallest whole number which would be obtained by repeated halving is seven. Seven days becomes a week. Four weeks becomes a month (lunation), thirteen lunations becomes one year of 364 days. Thus he had seven days to the week, four weeks to the month and thirteen months to the year. The "science" of numerology led to giving magical significance to these numbers. I need elaborate this argument no further.

The Neolithic farmer would work for six days and worship on the seventh because the seventh day was "magic". Naturally he would extend such reasoning to the creator who would labour for six days on his creation. As to the order of creation he would start at the "bottom" and work his way up to the "top". The ocean, the land, the heavens. Man, naturally, would occupy a special phase as the last and most perfect of all the creation.

The *Bible* is a collection of stories, songs and legends not necessarily in the correct chronological order. The *Bible*, like the *Iliad*, or Geoffrey of Monmouth's history of the Kings of Britain, contains a strong element of historical fact (or should it be inference?) which we must be careful not to interpret too literally.

I am sorry, but the Hebrew creation myth has no support at all from the fossil record. If Mr Lucas wishes to believe in it then he must evoke an act of faith—a highly unscientific mental process.

Yours faithfully,

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Caithness*

Games with GNP

SIR,—Although grateful to *Nature* for printing my paper "Features of a Closed System Economy" (*Nature*, 242, 561; 1973), I should point out in connexion with the editorial, "Fun and Games with GNP", that Boulding's writing, and especially his books, *Economics as a Science* and *Beyond Economics*, in fact led to my paper, and in both the professor is apparently guilty of the "curiously

subjective" error which I am accused of, because he roundly equates GNP to gross national cost with, I think, rather brilliant reasoning based on thermodynamics. My question of gross product to the sum of gross consumption (and the rest used to improve society) is a precise quotation from the professor's book *Economics as a Science* (page 45).

I have gone further than did the professor in analysing "good" and "bad" costs but the idea is his. There is also no difficulty on real cost. The real cost of an activity is the amount of non-renewable resource converted by it from potential energy in the ground to useless and irrecoverable waste (plus the personal effort involved in it). It is obviously akin to entropy in physics although essentially a vector rather than a scalar quantity. The difficulty of avoiding some arbitrariness in drawing the line between activities which obviously increase entropy and those which decrease it (Boulding's negative entropy of "structures of increasing improbability") is because we are dealing with a social science and not physics. But difficulties of definition do not destroy realities.

The illustration given about education is mistaken, and does not invalidate Boulding's argument (or mine). Clearly the contribution of policies towards discouraging the kinds of investment which merely add to further wasteful or unnecessary consumption must in the end be to limit the supply of unnecessary goods—and the consuming public (including the school teachers) can only buy what is available. The difference is clear enough, I think, between the likely behaviour pattern of a potentially rational society and the situation of the artificially stimulated captive consumers so well described in Vance Packard's book, *The Waste Makers*.

The technological optimism of the last paragraph is, I believe, of the wrong kind, and here I draw attention to recent published work of the US Geological Survey relating to energy resources for power production. This makes it clear, I think, that one of the risks of absolute or near shortages could be increasing rigidity, as substitution technology is invariably power hungry. From this kind of thinking I would guess that the oceanic uranium referred to will probably remain where it is! I believe the true direction of future technology is towards more advanced conservative systems as suggested in the last part of my paper, to which no space or regard is given; this, along with quite far-reaching changes in values and habits of mind, which are at present almost hopelessly one-tracked. And are we so sure that we are on the right track, in looking at the possibilities of tearing the Earth apart merely to sustain a high level of activity and a rapidly ageing body of dogma

which many economists seem to believe in with almost incredible persistence?

Finally, on relevance to the real world. First, the exercise has to do with the need for major regional projects of the Russell-Spoffard kind on the European side to at least provide the infrastructure of more advanced systems should the cultural difficulties ever be overcome; second, for greater investment in recycling and recovery projects of the kind currently undertaken and publicized by the National Research Development Corporation; and third, it clearly concerns changes in design thinking by the engineering industries, in the direction of durability and reducing obsolescence.

Yours faithfully,

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Physical Units

SIR,—An article under the title, "Natural Units in Atomic and Molecular Physics", from Professor R. McWeeny which appeared in your issue of May 25 (243, 196; 1973) draws attention to an area in which there is need of common international usage. It has already been announced that the IUPAC Commission on Physicochemical Symbols, Terminology and Units might consider this question and opinions and suggestions have been requested by its Chairman, Dr M. A. Paul, NRC Division of Chemistry and Chemical Technology, National Academy of Sciences, Washington DC 20418, USA. The need for an authoritative examination and agreed recommendation is brought out by McWeeny's article since most scientists feel that if letters such as H, as, aV and aT have internationally agreed meanings as the Henry, attosecond, attovolt and attotesla, it is objectionable for them to have special meanings of hartree, atomic second, atomic volt and atomic tesla in special contexts. What is one's reaction to the statement $1 \text{ as} = 24.1889 \text{ as}$?

Yours faithfully,

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Announcements

International Meetings

July 1–7, **The Study of Time.** (Secretary, J. T. Fraser, International Society for the Study of Time, P.O. Box 164, Pleasantville, N.Y. 10570, USA.)

July 1–7, **Ninth International Congress of Biochemistry.** (The Secretariat, 9th International Congress of Biochemistry, c/o Svenska Kemistsamfundet, Wenner-Gren Centre, 6tr S-113 46 Stockholm, Sweden.)

July 2–3, **Neutron Activation Analysis Symposium.** (Mr Peter Duggan, Symposium Secretary, Neutron Division, Marconi-Elliott Avionic Systems Limited, Elstree Way, Borehamwood, Herts.)

July 2–6, **The Sun in the Service of Mankind.** (Congrès International The Sun in the Service of Mankind, 28, Rue de la Source, Paris-XVIe, France.)

July 2–6, **Second AIC Congress "Colour 73".** (Professor W. D. Wright, Applied Optics Section, Imperial College, London SW7 2BZ.)

July 3–5, **Conference on Scanning Electron Microscopy Systems and Applications.** (The Institute of Physics, 47, Belgrave Square, London SW1X 8QX.)

July 3–6, **Molecular Motions in Liquids.** (Dr C. Troyannowsky, Secrétaire Général Société de Chimie Physique, 10, Rue Vauquelin, 75, Paris.)

July 4–5, **Anglo-French Symposium—Freeze Etching.** (The Administrator, Royal Microscopical Society, Clarendon House, Cornmarket Street, Oxford.)

July 4–6, **Fourth Canadian Wood Chemistry Symposium.** (Professor R. H. Marchessault, Department of Chemistry, Université de Montréal, C.P. 6128, Montreal 101, Quebec.)

July 5–6, **A Symposium on Genetic and Structural Aspects of Virus Genomes.** (The Meeting Assistant, Society for General Microbiology, Harvest House, 62, London Road, Reading RG1 5AS, Berks.)

July 6, **Symposium—X-ray Microanalysis of Biological Material in the Electron Microscope.** (The Administrator, Royal Microscopical Society, Clarendon House, Cornmarket Street, Oxford.)

July 8–14, **Twenty Years of Health Education: Evaluation and Forecast for the Years Ahead.** (Secretariat, VIIIth International Conference on Health Education, 20, Rue Greuze, 75 Paris 16e, France.)

July 9, **The Structure of Biological Molecules.** (Dr Lars-Johan Norrby, Structure of Biological Molecules, Department of Inorganic and Physical Chemistry, University of Stockholm, Roslagsvaegen 128, S-104 05 Stockholm, Sweden.)

July 9–20, **The Physics of Quantum Electronics.** (Professor Stephen F. Jaco and Marlan O'Scullly, Optical Sciences Center, The University of Arizona, Tucson, Arizona.)

July 10–12, **Conference on Video and Data Recording.** (The Information Officer, 8–9 Bedford Square, London WC1B 3RG.)

July 10–13, **Synthesis in Organic Chemistry.** (Dr John F. Gibson, The Chemistry

Society, Burlington House, London W1V 0BN.)

July 10–13, **The Fourth International Colloquium on Gasdynamics of Explosions and Reactive Systems.** (International Academy of Astronautics of the International Astronautical Federation, 250 Rue Saint-Jacques, 75 Paris, France.)

July 11, **Biochemistry and Treatment of Depression.** (Dr J. F. Cavalla, Society for Drug Research, John Wyeth & Brother Ltd., Huntercombe Lane South, Taplow, Maidenhead, Berks.)

July 11–13, **The Hundred and Seventy-second Meeting of the Genetical Society.** (Professor D. A. Hopwood, John Innes Institute, Colney Lane, Norwich.)

July 11–13, **European Nutrition Conference.** (Dr E. M. Widdowson, Dunn Nutritional Laboratory, Milton Road, Cambridge CB4 1XJ.)

July 11–13, **British Society for the History of Science—Summer Meeting.** (BSHS Office, 47 Belgrave Square, London SW1X 8QX.)

July 12, **The Annual General Meeting of the British Society.** (BSHS Office, 47 Belgrave Square, London SW1X 8QX.)

July 15–20, **Second International Conference on Culture Collections.** (Dr Antonio Fernando Pestana de Castro, Palácio das Convenções, Parque Anhembi 02012, São Paulo, SP, Brazil.)

July 15–20, **Symposium: Biotransformations and Fermentations.** (John M. Cassady, Ph.D., Chairman, ASP Publicity Committee, School of Pharmacy and Pharmacal Sciences, Purdue University, West Lafayette, Indiana.)

July 16–19, **Ninth International Shock Tube Symposium.** (Symposium Secretary, Department of Aeronautics and Astronautics, Stanford University, Stanford, California.)

July 16–27, **Capri, Italy.** (Dr E. R. Pike, Royal Radar Establishment, Malvern, Wores, U.K.)

July 16–28, **The Second International Conference on Permafrost in Yakutsk, Siberia.** (Dr Troy Péwé, Chairman, U.S. Planning Committee, National Research Council, 2101 Construction Avenue, N.W., Washington, D.C.)

July 17–20, **Conference on Pollution Criteria for Estuaries.** (Dr P. R. Helliwell, Department of Civil Engineering, The University, Southampton, SO9 5NH.)

July 17–20, **Biochemistry of Inositol Lipids Control of Fatty Acid Synthesis and Related Metabolism.** (Dr D. N. Brindley, Department of Biochemistry, University of Nottingham Medical School, Nottingham NG7 2RD.)

July 17–20, **Association for the Study of Animal Behaviour.** (Dr A. W. Ewing, Department of Zoology, West Mains Road, Edinburgh EH9 3JT.)