

correspondence

Facts

SIR,—Although I am reluctant to advertise my own philosophical wares in your correspondence column, I believe that some distinctions and definitions made in my book *Scientific Knowledge and Its Social Problems* may be useful for removing some of the confusions referred to in your leader "No longer so much solid ground" (February 13).

There I constructed a sequence of stages of development of materials towards the condition of being "facts" or "knowledge"; and in this it was clear why the published "research report" is not, and cannot be, completely reliable fact. In brief, I start with the problem, and consider the essence of scientific work as the *investigation* of problems (involving creation as well as solution). Contact (necessarily partial and indirect) with the external world is made in the production of *data*, this is then refined to form *information* about the conceptual objects of the scientist's enquiry. But the problem is solved by the *conclusion* to an argument about these objects; and in this structure the information functions as *evidence*. Of course, there is a cyclic interaction between the different phases of this work; and since logical certainty is never possible, it must be governed by socially imposed criteria of *quality* and *value*. For this reason, the social mechanisms of *quality control* are essential for the progress of science; *shoddy* and *vacuous* work (easily explained in this schema) are as "natural" as good work. The *published research report* stating conclusion and evidence is therefore fallible in a number of respects.

The *social* phase of the achievement of scientific knowledge proceeds by judgements of disinterested, competent colleagues. They ask: is this report *relevant* to my enquiry, and if so is it *reliable* for use? If it passes both these tests, it enters the current stock of *tools* for future work. There, it is *transformed* in various ways, depending on the context (descendant problems, application elsewhere, or teaching). If there remains some content that is *invariant* under the inevitable changes in meaning of its terms, then we can call it a *fact*. Facts which survive the demise of the area or field in which they took rise, are then considered as very reliable facts, or bits or *scientific knowledge*.

To be brief, I have omitted all mention of the elaborations of this schema, and of its unsolved philosophical problems. But it seems to provide a reasonable schema of scientific work, and a vocabulary for describing its products.

Yours faithfully,

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Probability

SIR,—I wish to suggest the use of a notation which I have found handy, and which seems to fulfil a real, if minor need. It is often necessary to use the phrase "the probability (of some foregoing value or result) under the null hypothesis" or, equivalently, "the probability, given H_0 ." I recommend that this phrase be rendered as $p|H_0$.

Yours faithfully,

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Food and allotments

SIR,—Your correspondent F. P. Hughes of Ontario, Canada (February 27) is right in stressing the possible importance of allotments in alleviating a food shortage, but he overstates his case. Allotments in Britain certainly did not produce more than half our food during the world wars. During the 1939–45 war there were 1,500,000 allotments, covering rather less than 150,000 acres of land. There were perhaps as many plots, of a similar area, on which vegetables were grown in private gardens. This area of some 300,000 acres made a useful contribution, perhaps as much as 5%, to our food supplies. It would be difficult to exceed this proportion in most Western countries.

Yours faithfully,

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Teleological vs teleonomic

SIR,—Larkins, MacAuley and MacIntyre (*Nature*, November 29) suggest "a teleological explanation for the siting of the 25 HCC-1-hydroxylase enzyme system in the kidney tubule, where it is able to sense and respond to fluctuations in calcium concentration in the main outflow site from the extracellular compartment".

I take issue with the use of the word teleological in that context. Teleology is defined as the "study of evidences of design in nature", and design as "a

deliberate purposive planning". I doubt that this is the kind of explanation intended by Larkins *et al.* for the siting of an enzyme system in the kidney.

C. S. Pittendrigh in *Behaviour and Evolution*, suggested that the word teleological should be reserved for cases where the idea of the end (goal) precedes the use of the means, and the word teleonomic for cases where the ends result from means that lack design (intent)—as when adaptive traits are produced by random mutations and natural selection.

Accordingly, I suggest that the explanation offered by Larkins *et al.* is teleonomic.

Yours faithfully,

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Taboo research

SIR,—Your correspondent H. Fraenkel-Conrat (March 6) makes one wonder whether after all there are not "two cultures".

Scientists should not think of themselves as the present-day equivalents of Plato's philosopher-kings, who "do good" to the rest of society whether we all will or not.

Robert Boyle wrote that "Gentlemen and scholars are apt to look upon the inquiry into manufactures as a Mechanick employment; and therefore beneath them". We do have, however, HM Factory Inspectorate, with a sound basis of rational "scientific" judgment; and on that basis, we, the whole of society, decide what kind of, for example, dusts, we shall allow in our working lives, and under what conditions and how we shall regulate our exposure to the hazards of our technological culture. By the same reasoning we should surely, the whole of us, decide what it is reasonable to do about self-replicating macromolecules.

Furthermore, Fraenkel-Conrat writes as though there were nothing else to the future of man but his material well-being; surely this is a Procrustean contraction of our attitude to and place in the cosmos—it may well have been for this reason that Prometheus was condemned by the gods to such a cruel punishment as to have his vitals continually eaten by predatory birds and then renewed?

"Man shall not live by bread alone".

Yours faithfully,

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