Why down with metric?

SIR—Using as a pretext the story of a computer error in the satellite orientation, D.C Jolly launches a harsh attack on the metric system (*Nature* **316**, 480; 1985). Attempts to slow down the gradual metrication of the United States are hardly understandable in view of the benefits the metric system inevitably brings to any country adopting it.

Why did Japan during its rapid modernization in the late nineteenth century adopt the metric system (still little known at that time) and not the imperial or American system? Most other countries did the same including Russia after the 1917 revolution.

The metric system peacefully conquered almost the whole world. Its obvious convenience and progressiveness stems not from the French government decree of 1840 but from its inner accord with the way we count and from the entire commensurability of all metric units. We have 10 fingers and not 12 and this is why our numerical system is based on 10 and not on 12, despite the fact that 12 can be divided by 2,3,4 and 6 while 10 divides by only 2 and 5. One can ask if God or Nature made a mistake at this point, but this is the fact we have to live with!

In sharp contrast with the metric, the traditional English (and slightly different American) system of weights and measures has very poor inner self-consistency. It is not even based on the power of 12: while there are 12 inches in a foot, the inch itself is traditionally divided into 16 and not 12 parts. There are 16 ounces in a pound, 3 feet in a yard and 8 pints in a gallon. The two main units of length have no common basis at all — it is very difficult to find any meaning in the number 5,280 which is the ratio of a mile to a foot and which is, of course, remembered by almost nobody. The list of oddities goes on and on. The gallon, for example, is nicely equal to 277.3 cubic inches and an acre amounts to 43,560 square feet (!). Even leaving aside the US gallon versus imperial gallon, statute mile versus nautical mile and regular ounce versus troy ounce, how can anyone claim the superiority of all this jumble over the system based on the simple decimals? It is symptomatic that the units of the imperial system, lacking any common basis, are defined through their metric equivalents (legal definitions of foot, pound etc. in the United States).

There are many things in the world that divide nations and people. The metric system (along with the Western calendar) is one of the very few instruments that help to unite us.

The future belongs to metric. Science is already metric worldwide (including, of course, the United States) and so is any scientifically based technology. It is well known that the delay in metrication was one (although not the main) reason for Britain's loss of economic position after the Second World War. Some US industries already prefer to use metric in their operations. We just cannot afford not to be metric.

Almost all progressive innovations have been opposed in the past and often very violently. People resisted printing, telescopes, steam engines, railways, telephones (invasion of privacy), cinematographs (produce mental disorders), automobiles, blood transfusion and use of X rays in medicine. Now some resist nuclear science, cosmic studies and molecular genetics (expensive and dangerous). The opposition to the metric system just belongs to the same category. In other "hot topics" of public dispute today (abortion, star wars and so on) both sides have at least some argument to support their positions. But there is indeed nothing behind the imperial system except stubborn resistance to progress mixed with ignorance. It affords no honour to a nation to insist on the obsolete. Nostalgic superstitions are of no help to economic and social progress.

ALEX A. BEREZIN
Department of Engineering Physics, McMaster University, Hamilton, Ontario, Canada L8S 4M1

Freewill and entropy

SIR—Professor John Searle, in the final lecture of the Reith Lectures for 1984, was unable to justify freedom of the will. According to Professor Stuart Sutherland (*Nature* **313**, 163; 1985), "if the mind is merely the brain under another guise, and if the physical world is determined, then there appears to be no room for freedom of the will".

The *Oxford English Dictionary* (*OED*) defines freewill as "the power of determining one's choice of action independently of causation or fate", but is rather too optimistic, given the realities of life; certainly there are goals that may not be achieved by most people, despite the greatest of ambition. But the concept of freewill in the philosophy of life is definitely more attractive to the independent thinker than that of determinism, defined by *OED* as "the doctrine that human action is not free but determined by motives regarded as external forces acting on the will".

Freewill implies divergent thought, while determinism implies convergent thought processes. The scientist must be capable of divergent thought when arriving at an hypothesis and then must converge on the salient features in establishing whether the hypothesis is true or false.

As far as determinism is concerned, it is generally agreed that every effect has a cause or causes. This is a necessary condition for determinism but is not sufficient. For sufficiency, the causes must be determined. But this sufficiency may be unattainable. For all processes, the second law of thermodynamics gives $\Delta S > 0$ where S is entropy.

In all but the most idealized process, the entropy of the Universe is increasing and every cause has the effect of increasing the disorder of the Universe. Causes are lost in this increase of entropy and are indeterminate as far as predicting the future is concerned. Hence, in living systems, determinism will never catch up with events which we may therefore interpret as the results of freewill.

Consciousness may be interpreted as the manifestation of biochemical processes as electrical activity. But the firing and switching of the neurones combined with the release and binding of the various neurotransmitters at the synapses are processes which ensure that the brain functions far from thermodynamic equilibrium. In these circumstances, entropy production makes it impossible for the brain function of freewill to be determined.

D. H. EVANS
Department of Applied Physics, Sheffield City Polytechnic, Pond Street, Sheffield S1 1WB, UK

Data in dock

SIR—I wish to draw the attention of your readers to the unfortunate circumstances that may arise when erroneous scientific conclusions are published in the technical press.

In 1967, in a letter to *Nature* (**216**, 83; 1967), Dr Isabel Gal published evidence purporting to show an association between the occurrence of neural tube defects (meningomyelocele or hydrocephalus) and the administration of hormonal pregnancy tests to the mothers; Dr Gal, indeed, advocated the hypothesis that exogenous sex hormones of the oestrogenic/progestational type were the cause of these malformations.

As a consequence of this published report, I and others have recently been compelled to appear as defendants in civil proceedings in the United States federal courts and have in the process been put to a great deal of inconvenience and expense.

At the trial, however, Dr Gal's conclusions did not stand up to scrutiny. Although in her original report hormonal pregnancy tests were said to be the only reasonable cause of spina bifida in 19 cases of malformed births, it emerged at the trial that in each of the cases cited there was a more probable cause for the neural tube defects than originally suggested. Readers will note that it has taken 15 years for the falsity of these conclusions to be publicly established.

WILLIAM D. CRAWLEY
787 Chickamauga Avenue, Rossville, Georgia 30741, USA