CORRESPONDENCE

Chinese Scientific American

SIR, — In the second of his three recent articles on the development of science and technology in China (*Nature* 7 February, page 516) Tong B. Tang makes the statement, based on his visit to China at the end of last year, that "There are no cover-to-cover translations into Chinese" of foreign scientific journals. It may interest your readers to know that this statement was not true then and is not now. *Ke Xue*, the Chinese-language edition of *Scientific American*, began regular publication in China with its January 1979 issue, lagging the parent English-language edition by 14 months. Beginning with the January 1980 issue *Ke Xue* will lag the parent edition by only four months. The paid monthly circulation of this "cover-to-cover translation into Chinese" of a foreign scientific journal is currently 25,000.

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How safe are safety cabinets?

SIR, — There has been much concern about the performance and testing of microbiological safety cabinets built before the publication of the new British Standard (BS 5726) (*Nature*, 278, 29 March, 1979, p.384). This concern is now being extended to cabinets built after the introduction of the standard and claiming conformity with it. Many of the problems are centred on the Class II Safety Cabinet which is designed to provide protection both to the work and the worker. In terms of safety, the two most important features of such cabinets are:

- that pathogenic aerosols are adequately contained by the inflowing air-streams; and
- the reliability of the filtration system is assured.

The BS allows that once the performance of a prototype cabinet has been validated, the subsequent production versions may be assumed to have satisfactory performance, provided that they have the same physical dimensions and that the air-flows do not differ by more than $\pm 10\%$ from those of the prototype. We do not believe that this principle is in practice adequate to provide safe working conditions, particularly in open-fronted Class II cabinets.

We have undertaken trials to evaluate production versions of a number of these cabinets and to correlate different methods of determining operator protection factors. Early in these trials the disturbing fact emerged that several cabinets reputedly identical in design to prototype models which had performed satisfactorily, failed to provide the required operator protection. The monitoring instruments of the cabinets indicated safe working conditions, and it was only from the results of aerosol containment tests that faults were revealed.

Most of the defects like faults in fan motors and their controls, or defective filter seals could have been rectified on site. But, more important, we have found that relatively low air movements in laboratories can severely affect containment; the approved design may not be adequate in such circumstances.

We urge most strongly that commissioning of new cabinets should include tests for containment, filter integrity and the quality of their seals; without these on-site tests there can be no guarantee that the cabinet will perform within specification.

Section six of the Health and Safety at

Work Act places an onus on suppliers, manufacturers and installers to provide cabinets suitable for the use for which they were designed and complying with the requirements of BS 5726. The customer should satisfy himself that these obligations have been met. Such tests must be included in the purchase price and not left as options for intending purchasers.

The DHHS operates an effective evaluation scheme for Class I cabinets, and there is clearly a need for a similar service for Class II types. This should cover all the requirements of the British Standard, but should in our view be supplemented by a test following installation on site. Agencies operating a rigorous approval scheme should be accredited by the British Standards Institution.

The results of the recent trials will be reported in detail in due course. One finding can be mentioned now: namely, that when tests using micro-organisms are unacceptable an alternative method making use of an aerosol of potassium iodide may be a suitable substitute.

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Synergism v. cost benefit

SIR, — In a disturbingly high proportion of experiments on mixtures for pest and disease control, decisions are based on questionable criteria. Many biologists appear to have become convinced that the ultimate goal is synergism. In screening candidate mixtures for further study a mixture that is not considered synergistic is sometimes abandoned.

Certainly, it is desirable to gain understanding of the mechanism of joint action, but often the need is only to assess the net observable effect of applying one mixture or another. The purpose is usually to minimize an overall cost, where the cost or loss function may include not only the cost of materials, equipment and labour, but also the losses in terms of environmental and health hazards, and damage to non-target organisms. On this basis, even mixtures with some degree of antagonism may sometimes be worth considering.

The point at issue is illustrated in Fig. 1, which shows contours of equal effect (isoboles) and of constant cost, plotted against rates of application of the components of a two-component mixture, assuming each component to be individually active. If the cost is linearly related to the amount of each component (Fig. 1a), a mixture can have no advantage over a single material unless the isobole at the required level of response is

sufficiently concave upward. The requirements for upward concavity are more severe if the cost curve is also concave upward (Fig. 1b), but if the cost curve is concave downward (Fig. 1c) even a mixture with a concave-downward isobole might be of practical value. Cost curves such as these can arise, for example, if either component has adverse effects on non-target organisms or on the environment, often the very reason for investigating a mixture.

All this may seem to be so obvious as to need no stating, but mathematically-inclined scientists might be surprised to discover the extent of the primary emphasis on synergism, and the relatively slight or belated consideration of cost-benefits.

Even if demonstration of synergism is considered relevant, there are varied concepts of what constitutes synergism, except in the case where only one component of a mixture is active on its own. I have elsewhere reviewed some of the confusion that exists in one field of application, a confusion that has its roots in failure to realise the importance of defining an appropriate reference model to represent absence of synergism (and antagonism). For example, many weed scientists, using a method due to Colby, consider that any mixture is synergistic if the proportion surviving is less than the product of the proportions that survive the separate components. On this basis, a "mixture" of two aliquots of the same material would be judged synergistic.

Other biologists consider a mixture to be synergistic only if its isobole is concave-up. The models corresponding to absence of synergism by these two definitions are, in general, quite different. Either of them, or neither, may be biologically relevant. Occasionally both definitions are even treated as if synonymous. Another common misconception is exemplified by the "definition" in the *Herbicide Handbook*. "Complementary action of different chemicals such that the total effect is greater than the sum of the independent effects". On this basis, a mixture for which the percentage responses to the separate components sum to more than 100 would always be classified as antagonistic.

The problems of definition are neither easy to resolve nor to explain and demonstration of synergism in a fundamental sense may require specialized biochemical experimentation.

The aim of this communication is to plead for recognition of the real purpose of any study of joint action, and for appropriate assessment of the results. Cost curves may be difficult to establish in absolute terms, but even a rough idea of their forms could usefully influence the focus of screening and field trials of mixtures.

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Fig. 1 Curves of constant response (broken lines) and curves of constant cost (solid lines) for mixtures of two materials S_1 and S_2 at doses Z_1 and Z_2 respectively. The cost attributable to S_2 has been assumed to be proportional to Z_2 , so that in each diagram any two cost curves are at a constant vertical distance apart. Examples in which a mixture would be economically advantageous have isoboles shown by dashes (---); mixtures with dotted isoboles (....) could not cost less than S_2 applied alone.