growth should be slow. What Dr Fryers' critics will want to know is whether even a thoroughly innovative company can hope to spend some 25 per cent of its turnover on research and promotion and still hope to win profit to finance rapid growth from even a liberal taxation system. Undoubtedly there is still a great deal to be said about the link between profitability and innovation, but the iniquities of systems of taxation may be less to blame than the indifference of shareholders to the prizes which can be won by successful innovation.

INSTITUTIONS

Modicum of Unity

SIXTY thousand British scientists, all of them qualified and fully paid up members of their professional institutions, now have a new voice raised in their defence. The five bodies to which they belong announced last week that they have agreed to form the Council of Science and Technology Institutes, which will do for the scientists roughly what the Council of Engineering Institutions does for the engineers. The Institute of Biology, the Royal Institute of Chemistry, the Institute of Mathematics and its Applications, the Institution of Metallurgists, and the Institute of Physics and the Physical Society are the founder members of CSTI, which comes into being formally on February 1. There is in principle no reason why other institutions should not join it, but CSTI says that membership will be confined to institutions which require a degree or equivalent as a standard for full membership, and which cover general fields of science or technology rather than a particular industry.

The CSTI has given itself a number of objectives. One of the things it takes most seriously is the job of improving the image of science among the young, although there seems to be no immediate notion of the way this can be done. It will also act as something of a pressure group for the interests of scientists, when the five institutions have a common view to present; this function is likely to find its greatest usefulness in salary discussions, though it may also be used in the general run of science policy issues. More humdrum activities will include provision of joint services, collection of information and coordination on matters such as the description of qualifications and educational policy.

The new body does not see itself as a rival to the Royal Society—indeed, as is customary on these occasions, it believes that its activities will be complementary. Others are entitled to take a different view, and some will feel that in attempting to represent the interests of all scientists more clearly, the CSTI will be doing what the Royal Society should have been doing long ago. How effective the representation is likely to be will depend on how often the five institutions can agree on policy, which may not, perhaps, be often enough.

The five institutions already have some collaborative ventures under way. One is the Scientists' Appointments Service, an attempt to persuade British scientists to come back from the United States. There are plans for extending this service; one possibility is that the CSTI will run charter flights back from the United States, loaded with British scientists bound for interviews. At the moment, one of the drawbacks of the service is that interviewing can only be done if the British company can be persuaded to pay fares. (Although fares would represent a small proportion of the cost of recruitment, companies seem oddly reluctant to pay them.) The CSTI also inherits joint work which has so far been done on an *ad hoc* basis, principally concerned with NHC examinations, and a scientists' salary review.

ROYAL SOCIETY

Units

METRICATION is one of the few issues of public policy in which the Royal Society has recently been taking an active interest. Since 1967 it has convened two conferences to discuss the new SI units with school teachers and, as part of its campaign, is producing two pamphlets on the new units as guides for primary and secondary school teachers. The first of these, *Metrication in Secondary Education*, has now been published (Royal Society, £2 per 100).

This document has a complicated origin. To begin with, the Royal Society produced a single pamphlet designed for school teachers at all levels. At the meeting with teachers in March 1968, this was criticized for its unleavened style, and it was decided to publish two separate pamphlets—one for primary and the other for secondary schools. In the event, the society produced two drafts for the conference with teachers held last September. Both looked like style books for a learned journal, but the conference approved the secondary school pamphlet, which is now published. In an unremarkable way, it lists the six basic SI units and the accepted derived units with their symbols, and will no doubt be a useful, although dull, guide for the teacher and teenager.

The draft pamphlet for primary schools, a watered down version of its elder brother, was criticized in September as too stodgy and lacking flair. Teachers at that conference pleaded for a bright eye-catching paper that people used to primary school texts and children would read. The revised version is due by the early summer, and all kinds of people will be looking out for it.

TRACTION

Slow Start for Electric Cars

A SURVEY of the prospects for electric cars in the United States, commissioned by the Department of Health, Education and Welfare, reaches unsentimental conclusions. "It seems it can be done", the writers of the report conclude, "but a vast amount of further technical effort is called for if the large scale use of electric vehicles is to become a reality even twenty years from now". In particular, the report calls for "a major and sustained effort in battery development", with a coordinated research programme under Federal sponsorship. The report was prepared for HEW by J. H. B. George, L. J. Stratton and R. G. Acton of Arthur D. Little.

The report considers six types of vehicle, all of which make different demands on energy supply and power plant. The most demanding of the six, unfortunately, is also the commonest: the family car, which makes up 80 per cent of all the vehicles in the United States. Only one power source, the high temperature alkali/

metal battery, is likely to have capacity enough to drive family cars, but that, too, has its drawbacks. With masterly understatement, the report concludes that a 900 lb battery which might include alkali/metals, chlorine and sodium at a temperature of 600° C is "obviously not a particularly desirable feature of a family car". More modest demands are posed by more modest vehicles, like the commuter car and the utility car, and these might be met by rechargeable metal/air batteries. The demands of the six types of vehicle, and the potentials of several energy sources, are summarized in the tables.

Table 1. ENERGY AND POWER REQUIREMENTS FOR SIX VEHICLE TYPES

	Family car	Commuter car	Utility car	Delivery van	City taxi	City bus
CONVENTIONAL CONSTRUCTION						
Energy density (W h/lb)	135	41	26	50	96	81
Power density (W/lb)	94	46	40	55	45	36
LIGHTWEIGHT CONSTRUCTION						
Energy density (W h/lb)	87	28	18	33	64	55
Power density (W/lb)	60	31	28	36	30	25

The report is pessimistic about the prospects of using fuel cells to drive electric cars. The extra complexity and lower power density count against them, although the possibility of refuelling them much like existing vehicles is attractive. For motors, the most practical choice is a high-speed DC motor with a mechanical commutator, operating at speeds up to 19,000 r.p.m., air-cooled and with integral speed reducers. Motors like these, the report says, are already under development for aerospace and military applications. Speed control would be by a high speed chopper, which cuts off power to the motor and restores it rapidly; silicon power transistors or silicon controlled rectifiers could be used for this, and would consume less power than the conventional method of placing a variable resistor in series with the motor. Regenerative braking, in which the kinetic energy of the vehicle is used to recharge the batteries during braking, offers few advantages, except for vehicles which make frequent stops. Recharging of the batteries, the report points out, is best done slowly, so that in practice it will be sensible not to own the batteries but merely to hire them from service stations, replacing them on the way during long journeys.

Table 2. ENERGY AND POWER DENSITIES AVAILABLE FROM SIX SYSTEMS

System	Maximum energy density (watt h/lb)	Maximum power density (watts/lb)
High temperature alkali/metal batteries (rechargeable)	>100	>100
Metal/air batteries (rechargeable)	50–80	30–40
Alkali/metal batteries with organic electrolytes	75–100	15–20
Lead acid batteries	15–20	20–30
Special construction		60
Ni–Cd batteries	15–20	75–100
Special construction		300
Fuel cells		30–40

The cost of electric vehicles would be higher than conventional ones, and the report concludes that the difference might be as much as $1,000 a vehicle. If this price differential is acceptable, and high temperature alkali/metal batteries can be produced for around 95 cents per lb weight, then electric cars are feasible. But at least ten years' development of the power sources will be necessary, and a similar time will be needed for the manufacturing development of motors and controls. At the moment, the total scale of development, which costs about $10 million of public funds and $5–7 million of private funds a year, is probably inadequate. Perhaps the utilities, which have most to gain, could be persuaded to provide more money for the development; the report suggests that complete conversion to electric cars would increase electricity consumption in the US by 40 per cent.

In the meantime, the report recommends that most effort should be directed towards the development of alkali/metal anodes and molten salt or possibly ceramic electrolytes. Engineering also needs to be done on materials selection and on producing low-cost solutions for current collectors. More modest effort should be placed in metal/air batteries and possibly also in high rate lead/acid batteries for hybrid vehicles. The use of plastics in conventional vehicles should also be encouraged, anticipating the time when they may be needed in lightweight electric cars.

ENGINEERING INDUSTRY

Boom in Pressure Vessels

THE setting up of a public authority to recommend changes in inspection methods and to guide research and development is the chief proposal to emerge from the first part of the report of the committee of inquiry on pressure vessels (HMSO, 12*s* 6*d*). The ministry of Technology must have smarted at its ill luck in launching this workmanlike document on the morning after the tragic explosion in a polythene compressor at ICI's Teesside plant at Wilton, in which three men died. This accident will serve as a reminder that safety cannot be taken for granted in an industry where any mishap may have fatal consequences.

One of the strongest reasons for setting up a Pressure Vessel Authority, according to the report, lies in the need to coordinate the national and international activities of an industry the members of which are mainly very large and very small firms. The committee would rationalize the industry as a whole, and would implement a uniform set of standards to replace the haphazard variations on a theme at present in use.

Dr Jeremy Bray, Joint Parliamentary Secretary at the Ministry of Technology, gave an assurance on January 22 that the ministry would give speedy attention to the recommendations of the report. Certainly the committee's enthusiasm for exports of pressure vessels can be counted on to spur the ministry to action. In this field, the committee says, companies should concentrate on more technologically advanced