to figures released by the West German Ministry of Scientific Research last week. The first table compares the actual expenditure with that envisaged in the 1967 programme, and the second shows how the Government's scientific budget has actually been divided between the different sciences and technologies.

Table 1. FEDERAL GOVERNMENT EXPENDITURE ON SCIENTIFIC RESEARCH

(millions of Deutschmarks)

Year	Actual	Per cent increase (over previous year)	Allocation (over July 1967)	Per cent increase (over previous year)
1968	1,922·3	19·9	1,930	20·4
1969	2,141·2	11·4	2,220	15·0
1970			2,550	14·9
1971			2,940	15·3

Table 2. BREAKDOWN OF 1969 FEDERAL EXPENDITURE ON SCIENTIFIC RESEARCH

(millions of Deutschmarks)

General Scientific Research	1,020·8	
Universities and technical colleges		700·0
Government research establishments		127·1
Max Planck institutes		131·8
Oceanography		6·2
Other items		55·7
Nuclear Research and Technology	709·5	
Nuclear research centres		285·6
Work outside nuclear centres		343·2
International organizations		78·3
Documentation		2·4
Research on Space and Air Transport	351·2	
Extraterrestrial research		24·5
Satellites, etc.		53·4
Basic programmes and international organizations		273·3
Data Processing and New Technologies	90·8	
Data processing		73·7
New technologies		17·1

The funds actually allocated for scientific research this year are some DM 80 million less than had been foreseen in 1967. One of the explanations is that federal expenditure on universities and technical colleges has not risen as steeply as had been intended. Whether any modification of the overall scientific research programme will be called for in the light of the latest figures remains to be seen, but considerably more money will have to be earmarked for scientific research for the next two years to keep in line with the ministry's forecast of an average growth of expenditure of 16 per cent between 1968 and 1971.

ROYAL SOCIETY

More Foreign Relations

THE Royal Society can boast that it had a Foreign Secretary long before the British Government. The society's continuing involvement in international affairs is now described in a progress report by the Foreign Secretary of the Royal Society (London: The Royal Society, 1969). There are now more than forty committees and subcommittees handling the society's international affairs, and together they account for more than a third of the budget. Contact with the National Academy of Sciences in Washington is close, but there are already many agencies devoted to cooperation across the North Atlantic and perhaps more important has been the Royal Society's recent ventures in Europe and elsewhere. The European science exchange programme has now been under way for two years, a programme in which every nation of Western Europe is cooperating. The Royal Society contributed £200,000 to the scheme in 1968, and hopes to give £250,000 this year. The money is spent on visiting fellowships, both junior and senior, and also on research conferences, modelled on the lines of the American Gordon Conferences.

The scheme is happily free of bureaucracy as it is, but even so the Royal Society is considering the possibility that science might be better served if its own scheme was merged with ventures like the EMBO fellowship programme. Meanwhile, separate agreements have been framed for exchanges with Israel and several countries of Eastern Europe. The Eastern European programme has been bedevilled to a certain extent by administrative difficulties, but there is a good chance that there will be greater flexibility in the future.

The Royal Society acts as the British member of the International Council of Scientific Unions, a task that grows more onerous as the activities of ICSU proliferate. The International Union of Nutritional Sciences was admitted to ICSU in 1968, so that there are now sixteen unions in membership, each entailing much routine administrative work. The Assembly of ICSU last year discussed a proposal to set up a committee on the social implications of science, but action was shelved pending the planned investigation of the topic by various agencies of the United Nations.

A sector of the world still without formal scientific ties with Britain is South America. The Royal Society sent a delegation to Brazil, Mexico and Cuba last year, and a reciprocal visit is planned. There is every likelihood that a planned series of exchanges will be set up with these and other South American countries before long. Nearer home, the closing two-culture gap is claiming the society's attention. Most European national academies cover both the sciences and the humanities, and it is natural that the increasing British cooperation with these academies should suggest the possibility of liaison between the Royal Society and the British Academy. As a first step the two bodies have planned a joint symposium later this year on the use of radioactive dating in archaeology. Similarly, the British National Committee for Geography has suggested that some needs of the subject would be better satisfied by the formation of a new committee including members from both the society and the academy.

TECHNOLOGY

When Britain led the World

THIS year is the bicentenary of the granting of patents for two inventions which played a crucial part in making Britain the most important nineteenth century industrial power. In 1769, James Watt patented his separate condenser, which proved to be the greatest single improvement ever made in steam engines, and Richard Arkwright patented his spinning machine, which, strictly speaking, was less an invention than a successful exploitation of a much earlier machine which never quite worked. To mark the occasion, the Science Museum in London has arranged a characteristically subdued exhibition of the two original patents, borrowed from the Public Records Office, a little biographical material, a couple of florid portraits and eight or nine cases containing recent and contemporary models and drawings of Watt's work and Arkwright's original spinning machines. More interesting than the exhibition itself is a short monograph, *James Watt and the Separate Condenser*, by Mr R. J. Law of the museum, which was published the day the exhibition opened; it is a pity that the museum did not produce a monograph on Arkwright, who was an equally colourful character.

Watt began his work on the steam engine when he was asked to repair a model of a Newcomen engine, to be seen at the exhibition, which then belonged to the Natural Philosophy class at Glasgow University. He quickly discovered that the model would never work satisfactorily because most of the heat was used to heat the cylinder instead of moving the piston. He tried making a cylinder of wood soaked in linseed oil and then baked but came to the conclusion that wood was no substitute for metal and began experimenting with an engine in which the steam was condensed not in the cylinder but in a separate condenser vessel. By 1769 Watt had associated with a Scottish colliery owner called Roebuck who put up the then large sum of £1,200 for the patent of the separate condenser in exchange for a two-thirds share in it. When Roebuck went bankrupt, one of his creditors, Matthew Boulton, accepted this share in the patent as part payment of Roebuck's debt and this led to the association of Boulton and Watt who, from their factory in Soho, Birmingham, "made engines for the world". In fact, they supplied the valves and drawings, a specially trained man to supervise erection of the engines, and specified that the cylinders must be bought from the ironfounder Wilkinson, leaving the purchaser of the engine, more often than not a Cornish copper mine owner, to build locally the beam and other simply made pieces.

Arkwright's success in making a spinning machine in 1769, when others such as Lewis Paul of Birmingham—who as early as 1738 had patented a spinning machine—had failed, stems from the exploitation of a succession of rollers to thin out the carded cotton. Paul had had the idea of using rollers in this way but his machine was too complicated for the mechanical resources of the eighteenth century, whereas Arkwright's was elegantly simple but ingenious. Once he had invented his machine, Arkwright, who was as daring a businessman as he was an inventor, set up a factory in Nottingham and began making his fortune. To protect his monopolistic position he kept up a running fight in and out of the courts which culminated in his defeat in the courts in London in 1785 when he had the whole of the Lancashire cotton industry arguing against his plea for an extension of his patents. But in spite of all his setbacks he continued to flourish, became a landed squire in Derbyshire, lent money to the Duchess of Devonshire to pay off her gambling debts, and rose from a poor barber to be the first cotton tycoon in Britain.

RECLAMATION

Waste Not, Want Not

WHAT goes into the dustbin is more valuable than it seems. This was one of the main themes of the International Reclamation and Disposal Exhibition, held at Olympia in London from July 14 to 18 in conjunction with a conference on new ways of dealing with waste. From many of the exhibits, it was clear that much ingenuity now goes into purifying and re-using waste products that were once quietly dumped in the nearest convenient place.

The reclamation industry claims that it is already indispensable to the British economy, saving £1,000 million a year in imports. This includes the obvious example of the steel industry, where nearly 53 per cent of last year's production was based on the re-utilization of scrap. Papermakers also hope to reprocess up to two million tons of waste this year, and are actually dependent on something like this figure being reached. It is, however, in less spectacular fields that the most imaginative attempts are being made to save money by reappraising rubbish. At the Warren Spring Laboratory the recovery of metals from domestic refuse has been improved by the development of a fluidized bed separator which can sort out metals of all kinds, non-ferrous as well as ferrous. Previously, while ferrous material could be removed magnetically, slow and unhygienic hand-picking methods were needed for anything else. Platinum can be recovered from discarded sparking plugs and silver from solder waste. On a larger scale, the residues from instant coffee production can be made into a wood-like plastic, so that even a literal "coffee table" is now a possibility.

Environmental pollution was not widely explored at the exhibition, which seems to have been aimed mainly at informing industry of the economic benefits of recovery. The more that is re-used, the less there is to be dangerous, although there is a danger that the effect of some processes is simply that noxious substances are discarded in a more concentrated form than before. A common opinion among exhibitors was that the control of pollution is basically a legal matter—manufacturers are more likely to spend money on treating what they reject if compulsion is impending. Prevention of a repetition of the recent Rhine disaster would not, it seems, be guaranteed by the normal course of research alone. It is even more difficult to know how to deal with materials such as waste plastics, which ironically are used chiefly because of their resistance to destruction. In a paper on biodegradation read to the conference on July 15, Professor D. E. Hughes of the University College of South Wales (Cardiff) argued that although biodegradable detergents are now a reality, "most of the present day polymers.... are so bioresistant that our age may be dated by future archaeologists by following the stratigraphy of specific polymers". A successful process which makes PVC fit for re-use is, unfortunately, exceptional. One solution for recalcitrant remains might be to seal them in mineshafts as these become disused, but geological considerations