Ludgershall is the richest mediaeval site excavated in Britain; more than 5,000 iron objects have been recovered as well as numerous pieces of jewellery, a gilt spur, bronze and bone artefacts (see the photograph) and pottery. If a small fraction of the finds was put on display in a museum on the site, the ministry would no longer suffer from the complaints of disappointed visitors. And when the embarrassing wealth of material has been examined and catalogued, it should give a unique picture of almost every aspect of the daily life of the period.

MANAGEMENT

Too Late and Too Dear

WHAT do Concorde, the QE2 and Dungeness B power station have in common? All three are late, and all three are going to cost more than was expected. True, they are also all British—but delays and overspending are just as common abroad as in Britain. In the United States, the C5-A transport aircraft is way over budget, and may cost $900 million more than it should; the Boeing 747 is two months behind schedule, and delays on some nuclear power station contracts would make the CEGB blanch. The misfortunes of British technology are characteristic not of Britain but of technology itself. People are more conscious of the process when money is tightest, which is why in both Britain and the United States there is concern to bring it under control. The Institution of Mechanical Engineers last week organized a meeting at which project management was discussed.

Mr D. Rowley and Mr D. Metcalfe, from British Aircraft Corporation, pointed out why the original cost estimates tend to be far too optimistic. "Estimates for difficult research and development tasks are delicate things, comprising a series of judgments by many people. Often these judgments cannot be defended in argument, and only too often the pressures lead to unwisely reduced estimates." One way round this, the BAC men said, is to split the task into a mixture of cost-plus and fixed price parts. Another more provocative recommendation was that the ministries concerned should keep a semi-public league table showing how contractors' actual costs compare with estimates, and to use this as a guide in the placing of contracts. (Something of the sort is already done in the United States, and is said to have had salutary effects.) But they also criticized the Government for failing to appoint project directors, responsible for the smooth functioning of major projects; although these men exist in the Ministry of Technology, they generally have several projects under their control. As Rowley and Metcalfe pointed out: "If one cannot appoint a man of the appropriate seniority, experience and ability to run full-time on the Government's behalf a project costing, say, £100 million or more, one cannot complain if things go wrong".

The Central Electricity Generating Board, with a history of late completion which has almost become a tradition, has clearly done some heavy thinking on the subject. Mr B. C. Pyle and Mr R. N. Burbridge described the CEGB approach. One of the most important requirements is to convince designers that small changes in design late in the day are more likely to disrupt than to aid the project. "At some point in the design process, and usually when manufacture has commenced, any change must be designated as a 'modification'; these are most disruptive." The authors also stressed the need to stimulate among all the subcontractors a loyalty to the whole project rather than to their own sectional interests, and to encourage ruthless honesty from all concerned. Cheerful optimism about the outcome may make life easier for a while, but in the long run it is the recipe for ruin.

Motorway projects, because they involve fewer uncertainties, are more often on target. Mr W. T. F. Austin, of Freeman Fox and Partners, and Mr D. S. Elbourne, from John Laing Construction Ltd, had a good word for a form of programme presentation called "Cascade", which, they said, was better than critical path systems. The advantage of Cascade was its relative simplicity which made it possible for all involved to understand what was going on. They also made a plea for more feedback from completed projects which could prevent the same mistakes being repeated.

Many of these threads were brought together in an admirable paper by Mr H. H. Gott, managing director of Associated Nuclear Services. He made the same points about honesty in reporting of work done, and about the need to freeze the design at the right moment. Talking about power station construction, he pointed out that the man hours devoted to construction are roughly equal to the man hours expended by the operating staff during the whole life of the station, so that it is just as important to design a station to be easy to build as to be easy to operate. Another general point made by Mr Gott was the need for genuine communication between those involved in different aspects of the project, particularly by conversation. Geography and organizational restrictive practices often make this apparently simple aim hard to achieve: Mr Gott said that "one has known a number of chief draughtsmen who didn't like engineers talking to draughtsmen, and contracts officers who haunted engineering discussions like commissars requiring explanations of every point but not understanding them". Mr Gott also said that economists have tended to write textbooks about ideal situations, such as the quantity production of commodities, but nobody has yet tackled the much more difficult task of educating site managers.

EDUCATION

More Children for Science

from a Correspondent

MEMBERS of five organizations—the Institute of Physics and the Physical Society, the Royal Institute of Chemistry, the Institute of Biology, the Association for Science Education and the British Association for the Advancement of Science—met at the University of Birmingham on February 8 to discuss the shortage of science pupils in educational establishments. Opening the meeting Professor L. Rosenhead (University of Liverpool) recalled that the Dainton report has shown that although the number of students in sixth forms is increasing, the number studying science is falling at an ever increasing rate. The meeting discussed the reasons for this decline and possible ways for reversing it.

Several speakers doubted the need for more specialist scientists—there is a need of more graduates with a fundamental general knowledge but trained to think in a scientific way. Contrary to general opinion, they argued that to enter industry was not to narrow one's

career prospects—active brains are urgently needed in production, on the shop floor, in the sales office, management, communication media, politics and everywhere. Although technical education has expanded in the past ten years, business studies have been neglected and many people in industry may be underemployed because of bad management. Mr A. D. I. Nicol of the Cavendish Laboratory, Cambridge, said that the number of scientists and engineers on boards of directors is woefully inadequate, and many managers do not know how to analyse a situation scientifically.

The opinion seemed to be that a much broader and less mathematical education must be given up to university entrance. Professor Rosenhead suggested that perhaps O-levels should be abolished and A-levels modified to include more general subjects like "physical sciences" and "biological sciences". Universities would have to change their rigid entrance requirements, but they must all act together. Professor J. T. Allanson (University of Birmingham) considered that first degree courses in science and technology should be less specialized, and courses in social science and the arts should be modified to at least the same extent to include appreciation of modern technology and industry.

Speakers agreed that teachers of twelve to fourteen year olds must explain and interpret the facts about science and industry, but must make sure they know the facts. Professor J. Walker (University of Birmingham) said that teachers should show that science is not to blame for the bad things of the modern world but is responsible for many of the good things leading to economic wealth and a high standard of living. Mr E. E. Robinson (Enfield College of Technology) thought that all teachers must be given an accurate background of science in their training, whether at university or college of education, for it is often teachers ignorant of science and industry who influence pupils away from them. As Professor Walker said, teachers and pupils should see that technology is just as cultural, intellectually adequate and creative as the arts.

Professor Rosenhead pointed out that industry must take positive steps to make its inner workings known to teachers, parents and pupils, to eradicate the misconceptions and distortions illustrated on television and films. An industrialist's view was that pupils must be shown that industry is not as ruthless, incompetent or insecure as they are led to believe.

Mr Robinson thought that there should be more recognition of courses like the Higher National Diploma, and they should be extended to general rather than specialized subjects; they are little different from degree courses but there are strong forces against them, particularly from the professional institutions. Mr N. Booth (Her Majesty's Inspectorate) made a further suggestion—to try to attract more girls to science and mathematics teaching—and a female point of view was that part-time teaching and technical posts should be made available to women with families.

The meeting ended with a plea from Professor Allanson that everyone in contact with schoolchildren should be made aware that the standard of living depends on technology and engineering and should be given the facts about these subjects and the way they are applied in industry. Education and industry must find out what goes on in the other, rather than imagine what goes on as they seem to do at present.

Parliament in Britain

by our Parliamentary Correspondent

Oceanography

Mr Tam Dalyell has turned his attention to the subject of oceanography, and last week actually managed to extract some new information. Mr Wedgwood Benn reported that a Review of Marine Science and Technology by an interdepartmental working party had been completed, and had shown that research into the marine environment had "developed satisfactorily under the aegis of the NERC and the Secretary of State for Education and Science". When published, he said, the review would set out the guide-lines for future Government policy. To foster technological developments, an Advisory Committee on Marine Technology had been set up, taking in representatives from all the interested ministries. The purpose of the committee was to review the field, identify promising projects, stimulate users to define their needs and recommend to the appropriate authorities technological programmes to meet their needs. (Written answers, February 5.)

Kidney Transplants

Sir Gerald Nabarro's attempt to introduce a Bill which would make it possible to remove kidneys from cadavers without the permission of the next-of-kin was defeated on its second reading. (A previous attempt to introduce the Bill, in the last session, had failed for lack of time.) Sir Gerald said that he wanted to see a kidney bank containing thousands of kidneys, all refrigerated in bottles and ready for use. The Bill would make it possible, once two doctors had signed a death certificate, for another doctor to remove the kidneys, unless there were evidence on the person or in a central registry explicitly asking for this not to be done. Mr Julian Snow, for the Department of Health and Social Security, said that his ministry could not accept the Bill; it would be wrong to consider kidneys in isolation from other organs, and Sir Gerald had exaggerated the success which had been achieved in kidney transplantation. A central registry of objectors would not be workable, and there were religious objections as well. The second reading was defeated by 8 votes to 38. (Debate, January 31.)

Government Establishments

Mr Ernest Marples asked a series of questions about the most expensive projects in progress at several Government establishments. The five most expensive non-military projects at the Royal Aircraft Establishment, Mr Gerry Fowler told him, were civil transport aircraft (£742,000 this year), take-off and landing aids (£571,000), supersonic transports (£487,000), industrial applications, including Central Unit for Scientific Photography (£232,000), and satellites and launchers (£187,000). Corresponding figures were given for the National Physical Laboratory, where marine hovercraft trials (£148,000 this year) are the most expensive project. At the same time, Mr Marples was also told by Mr J. P. W. Mallalieu of the costs of the establishments of the Atomic Energy Authority. Harwell, including Wantage, will cost £13·4 million to run this year, and Culham £2·5 million. Winfrith will cost £3·3 million, Dounreay £4·5 million, and Springfields, Risley, Culcheth and Windscale taken together £6·1 million. (Written answer, February 4.)