be undertaken by Prof. L. Picard, of the Geological Institute, Jerusalem. The Committee invites suggestions about other research projects which might suitably receive Unesco support. In evaluating suggested projects, the Committee, in addition to a consideration of their general merits, is also guided by the following criteria :

(1) The project should be of importance to several Unesco member States having arid and semi-arid areas ; (2) it should come within the scope of the Unesco Arid Zone Programme at the time the project is proposed ; (3) it should be of a type that can reasonably be expected to achieve definite results within a specified period ; (4) if already under way, it would be completed or its value would be increased through financial aid from Unesco ; (5) the results of the research project will be freely available to the public ; (6) financial assistance will not be granted to defray the salaries of the permanent staff or the purchase of permanent equipment, buildings or land.

In order to help the work of the Committee, Unesco has appointed, or will appoint, in the various member States, honorary consultants who are authorities in the principal fields of arid zone research, at present including hydrology and hydro-geology, climatology, biology and sources of energy supply. These consultants, having specialized and local knowledge, will be able to assist the Committee in collecting technical information and in giving well-informed advice.

METAL ECONOMICS

IN organizing a whole-day discussion on "Metal Economics" in London on October 17, the Institute of Metals turned to a subject outside the range of its regular meetings and papers, which hitherto have almost always dealt with some aspect of the science and technology of non-ferrous metals. The innovation was justified by the obvious importance of the current crisis in metallic supplies to all concerned with technical and commercial developments in metallurgical industry. The large attendance at the morning and afternoon sessions and the close attention with which the addresses and discussion were followed demonstrated the interest of members of the Institute and visitors.

Earlier in the year the presidential address to the Institute* had been largely devoted to a plea that it should devote attention to the resources of metals on which the non-ferrous metallurgical industry is based and to the most efficient utilization of those resources. The three elements tending to produce a long-term shortage of metals are : the rate of increase in the population of the world, adding annually one per cent to its numbers ; the exhaustible, non-renewable characteristic of mineral resources ; and the world-wide demand for higher standards of living. It is necessary to consider what can be done to improve supplies of primary metals, how to make better use of the metals already in service and what substitutes can be used in place of the metals which have become difficult in supply.

The morning session of the meeting was devoted to "Primary Resources of Ferrous and Non-Ferrous Metals". The first paper, on "The World Supply of Non-Ferrous Metals", by R. Lewis Stubbs, secretary of the British Non-Ferrous Smelters' Association, presented the view of the primary producer. According to this, in the long-term prospect supplies of non-ferrous metals as a group will be forthcoming in quantities adequate to meet anticipated demand, although it is possible that aluminium and magnesium will constitute a larger proportion of the total consumption of non-ferrous metals than at present. The paper was strongly documented, and one interesting table is reproduced in this article (Table 1), showing the relation of stockpiling by the United States during the period 1948–50 to other normal consumption and production. The item "Total U.S. special account purchases for 3 years" is considered to represent the additions to the stockpile.

Table 1. World Production and Consumption (thousands of tons) of Copper, Zinc, Lead, Aluminium and Tin during the Three-Year Period, 1948–50

	Total production	Total consumption	Excess or deficit	Total U.S. special account purchases for 3 years	Total excess or deficit
Copper	7065	6940	+ 125	384	− 295
Zinc	5063	4868	+ 97	273	− 78
Lead	4549	4072	+ 564	354	+ 123
Aluminium	3529	3447	+ 82	31	+ 51
Tin	506	406	+ 100	107	− 7

Table 1 shows that, during 1948–50, of the world's total production 5 per cent of the copper and zinc, 8 per cent of the lead and 21 per cent of the tin were stockpiled. It is also seen that, but for stockpiling, production would have exceeded consumption in all the major non-ferrous metals. It is believed that, when the abnormal circumstances of stockpiling and re-armament have ceased, the historic processes of price mechanism will stimulate the discovery and exploitation of new ore resources and the rapid growth of declared reserves. Moreover, it is anticipated that this development will continue at a rate corresponding to the changes in demand. Referring to immediate shortages, Mr. Stubbs considers that the deficit is only a few per cent and that the rate at which new mines are being opened up affords hope that the shortage will not last much longer. An admitted difficulty here is to judge to what level the demand would rise if supplies were not restricted.

The United States and Great Britain and other countries are trying, by the agency of the International Materials Conference, to ensure a fair distribution of raw materials throughout the world. If this scheme were to break down and competitive purchasing were to be resumed, Mr. Stubbs considered that Britain would be rather badly placed because the biggest increases in metal production are in dollar areas. He suggested that, to deal with the threatened change, action should be taken along three lines : by placing long-term contracts ; by encouraging production in non-dollar areas, especially in the British Commonwealth ; and by fostering mining ventures with headquarters in London.

Prof. S. Zuckerman, chairman of the Natural Resources (Technical) Committee, in his paper "Metals as Natural Resources", did not share the optimism of Mr. Stubbs, observing that the disparity between supply and demand is due not to an unexpected rate of increase in demand but rather to a surprisingly slow increase in the production of primary metals. Measures to remedy this situation should include, as well as attention to intensified exploration, including domestic ores and improved efficiency of extraction and recovery, the encouragement of investment in the raw materials industry in order to

* Murphy, A. J., *J. Inst. Metals*, **79**, Pt. 3, 122 (1951).

balance the existing and projected investment in manufacturing industry. At the same time the supply of other essential imports, such as foodstuffs and textile fibres, must be maintained, and a problem exists in Britain in reconciling these competing claimants on the resources of exchange and exportable manufactures.

In his analysis of world demand and resources in the case of iron ore, Dr. T. P. Colclough, of the British Iron and Steel Federation, stated that the world production of steel in 1949 was 160 million tons. To produce this (plus foundry iron) 110 million tons of pig iron was required, in addition to about 80 million tons of scrap. The iron ore yielding the 110 million tons of pig iron amounted to 220 million tons. The United States and Canada, producing 46 per cent of the world's iron and steel, absorbed 40 per cent of the total ore consumed; Western Europe made 30 per cent of the world's iron and steel, taking 37 per cent of the iron ore; the U.S.S.R. group made 18 per cent of the iron and steel and used 17 per cent of the world output of iron ore. The countries outside these three groups accounted for 5–6 per cent of the iron and steel produced and of the ore consumed.

The United States and Canada are augmenting their ore reserves by the beneficiation of low-grade taconite, the opening up of high-grade ore fields in Venezuela and Labrador, and some importations from Sweden and West Africa. The American continent is judged to possess known resources of iron ore satisfying demands for more than a hundred years. Western Europe including North Africa, must increase its ore supply from 80 million to 120 million tons annually to permit the desired increase of 15 million tons per year in iron and steel production. This is believed to be possible by technical improvements in the use of ore fines and by development of new African resources. Provided that the very large-scale measures planned, including special ships for transport of ore and installing blast furnaces in favourable locations, can be put into operation, Dr. Colclough believes the supplies of iron ore in America and Western Europe will keep pace with the expanding demand for steel.

In the ensuing discussion Prof. W. R. Jones, of University College, Cardiff, said that alarming predictions of imminent exhaustion of metal resources arise from a failure to distinguish between the known reserves declared by mining concerns and the true mineral wealth remaining in the earth. 'Known reserves' increase from time to time as fresh explorations are made in response to continuing or expanding demand. Prof. Jones demonstrated this with detailed returns for zinc. L. Tarring, joint editor of the *Metal Bulletin*, deplored the policy of stabilizing world prices of metals, because while ensuring remunerative levels for existing mines they might have a deterrent effect on the search for new sources to meet the requirements of the future. The attractions to investment in new mining ventures are further weakened by world-wide high rates of mining taxation. C. F. Carter, of Emmanuel College, Cambridge, joint editor of the London and Cambridge Economic Service, was not satisfied on the validity of some of Prof. Zuckerman's conclusions from the comparative data on different primary commodities; but he was impressed by the geometric progression of consumption of non-ferrous metals. E. H. Bucknall, of the Mond Nickel Co., described the procedure of the International Materials Conference, which is trying to ensure that strategic metals are distributed among the consuming countries in accordance with true needs. To achieve this the Conference is making the fullest use of technical advice, which it is invoking in deciding the measures of substitution and conservation to be required from the participating countries.

In the afternoon session, under the heading "Scrap Reclamation, Secondary Metals and Substitute Metals", papers were read dealing with measures for economizing in the use of metals. C. A. Bristow, A. J. Sidery and Dr. H. Sutton, of the Ministry of Supply, indicated the need for the engineer to make prompt use of metallurgical advances permitting savings in strategic and scarce metals—for example, niobium in stainless steel. Design of engineering components must attach more importance to the reduction of the amount of metal consumed in making each item. The segregation and recovery of scrap can be organized on a much more effective basis than at present. Corrosion represents a heavy leakage of metals which could be reduced by the correct application of known materials and methods. Substitution will rely more and more on the use of aluminium, magnesium and titanium, which offer good prospects of availability for a long period ahead.

The paper on "Economy by Standardization of Alloys and of the Method of Reclamation of Scrap Metals", by C. Dinsdale, of British Railways, gave an account of the simplification in the range of alloys used as the amalgamation of the railways in Britain progressed from a multitude of separate concerns to the present single control. In an annual consumption of thirty thousand tons of non-ferrous metals for rolling-stock, a list of thirty-seven different copper-base alloys has been reduced to five, and eighteen white-metal compositions have been reduced to four. Substantial savings are anticipated in costs of metal melting and scrap segregation, with corresponding economies in the actual consumption of non-ferrous metals.

F. Hudson, of the Mond Nickel Co., in his paper on "The Influence of Specifications on Productivity and the Economic Utilization of Ferrous and Non-Ferrous Metals", extended the theme of Mr. Dinsdale's paper to engineering industry generally. He suggested also that improvements in the quality and uniformity of castings, by permitting a reduction in present factors of safety, would lead to useful economies in metal, and that advance in the same direction would result from the greater use of high-strength alloys.

E. H. Jones, of Messrs. Capper Pass and Sons, Ltd., gave a paper on "Secondary Heavy Metals", in which he quoted the annual consumption in tons of five non-ferrous metals, other than for stockpiling, including secondaries, as follows: tin, 180,000; copper, 2,800,000; zinc, 2,100,000; lead, 2,400,000; and antimony, 50,000 tons. Table 2 shows the distribution of the consumption among different modes of application and the recovery through secondaries in each type of use. Estimates are included for the weights of metal in current use which might be reckoned as ultimately recoverable. Of the total quantity of each metal going into use each year 32 per cent of the tin is recovered, 58 per cent of the copper, 29 per cent of the zinc, 60 per cent of the lead and 45 per cent of the antimony. The irrecoverable fractions are lost through such causes as: use in small portions as in solder and small castings, completely dispersive uses such as copper salt fungicides, lead tetraethyl (which is said to account for 10 per cent of the total consumption of lead), and sacrificial

Table 2

		Element (%)	Alloys (%)	Coatings (%)	Compounds (%)	Recovered (%)	Recoverable stock in use (mill. tons)
Tin	used	4	46	48	2	32	1·5
	recovered	2	24	6	0		
Copper	used	57	39	—	4	58	40·0
	recovered	38	20	—	0		
Zinc	used	7	45	36	13	29	11·0
	recovered	4	25	0	0		
Lead	used	40	40	—	20	60	32·0
	recovered	32	28	—	0		
Antimony	used	—	60	—	40	45	0·5
	recovered	—	45	—	0		

protective coatings. Tin is recovered satisfactorily from tinplate; but a reduction in the thickness of the tin coating might easily prevent effective recovery and result in an increased overall consumption. Other factors which can have a deterrent effect on recovery of secondaries are the insistence on unnecessarily low contents of impurity in specifications and the introduction of new alloys containing troublesome elements, such as tellurium in lead. Mr. Jones concluded by saying that reserves of the heavy non-ferrous metals, primary and secondary, are sufficient to supply the non-replaceable uses "for a time stretching well beyond that within our power to foresee".

The final paper, by Colonel W. C. Devereux, of Almin, Ltd., on the subject of "Secondary Light Metals", reviewed the development of the industry from a production by the smelters of 10,000 tons in 1935 to a rate of 100,000 tons in 1951. This represents more than a third of the total raw material used by the aluminium fabricating industry. At the present time refining of scrap for the production of pure aluminium or magnesium, though technically possible by a variety of processes, is not practised because all the metallic material coming forward can be incorporated into useful alloys. The treatment comprises sorting and fluxing to separate metallics from non-metallics. At the end of 1949 a stock of 118,000 tons of secondary aluminium alloy ingot had been built up in Great Britain, but at the present annual rate of consumption of forty thousand tons the stocks will be exhausted by the end of 1952. Current consumption of scrap arisings exceeds supply by twenty thousand tons per year. There is thus a prospect of a severe shrinkage of secondary ingot. An important factor in the future will be the slow return to use of the aluminium employed in building houses, involving 250,000 tons since 1945, and the virtual loss to Great Britain of the metal incorporated in exported manufactures. On the other hand, the increasing amount of aluminium used in packaging now becomes available for re-use in a very short cycle. Colonel Devereux's last point was that a shortage of scrap for recovery must be anticipated during the next few years, and it is of great importance to improve the efficiency of scrap salvage, collection and utilization. In the final stages of the discussion G. L. Bailey, D. A. Oliver, Dr. U. R. Evans and H. J. Miller briefly directed attention to special points.

In spite of the wide range covered by the papers and the discussions, certain clear impressions remain. The first is the confidence of the primary producers and the secondary smelters of the heavy metals that, in the long term, adequate supplies of metals will be forthcoming to meet anticipated requirements. The economists, although not pressing the contrary view strongly, appear to doubt whether this optimism has taken full account of the statistical evidence on the rapidly growing demand and of the delicate balance, at least in Great Britain, between the exportable manufactures made at home, on one hand, and the requisite imports of metals, food and other raw materials, on the other. It is not to be overlooked that, although the primary producers are hopeful of meeting any likely demand for 'non-ferrous metals' as a whole, they expect that, in achieving this, aluminium and magnesium will be substituted for some of the applications now met by the heavier metals. It was generally agreed at the conference, however, that it is well for technical metallurgists, representatives from the commercial side of the metal industry and economists to exchange views, and it would not be surprising if more meetings of the same kind were to be called for in the future.

A. J. Murphy

OBITUARIES

Prof. Allan Ferguson

Allan Ferguson, who died peacefully on November 9 at his home in Bishop's Stortford after a long and distressing illness, was born at Entwistle, near Bolton, on May 11, 1880. His scientific career began with his entry at the age of twenty-two as an exhibitioner to the University College of North Wales, Bangor, where, after graduating, he became assistant lecturer in physics in 1905, and held this post until 1919. After two years as lecturer in physics in the Manchester College of Technology, and having taken the degrees of M.A.(Wales) and D.Sc.(London), he joined the physics staff at East London (later Queen Mary) College. He retired in 1945 with the status of assistant professor and Fellow of the College.

Ferguson's special scientific interest was in general physics, particularly surface tension, and he made important theoretical and experimental contributions in this field. As a teacher he was outstanding, armed as he was with profound knowledge and exceptional power of imparting it lucidly to his students, with whom he was most popular. He will be remembered, perhaps best, for the large part he played in promoting scientific publication. The Physical Society especially owes him much. He was president during 1938–41, having been previously papers secretary for ten years; and it was he who was chiefly responsible for the initiation in 1934 of the Society's Annual Progress Reports, which he edited for the first six years. He