Right Member of a pop group rehearsing in a garage

Below 'Penny for the guy': a Guy Fawkes Day group

Sunset over a playing field

Solvent extraction process is major advance in base metal recovery

Nchanga open pit, main source of ore for Nchanga Consolidated Copper Mines, which last year produced 433 000 tons of copper. Inset is the new tailings leach plant which includes a solvent extraction section. When this plant is opened it will represent the largest copper solvent extraction operation in the world

John Holmes

The Chingola division of Nchanga Consolidated Copper Mines Limited on the Zambian copperbelt is one of the great copper mines of the world, in terms of production second only to Chile's Chuquicamata mine. It was formerly known as Nchanga, and it started producing in 1938 as a member of the Anglo American Corporation Group of copper mines in what was then Northern Rhodesia. It grew rapidly, and in the period 1965–1969 achieved an annual average production of copper in concentrates of 210 000 metric tons. At the end of 1970 the Zambian government acquired a 51 per cent interest in the copper industry, and in consequence the companies in the Anglo American Corporation Group – Nchanga Consolidated Copper Mines Limited, Rhokana Corporation Limited and Bancroft Mines Limited – were incorporated as the Chingola, Rokana and Konkola divisions of the restructured Nchanga Consolidated Copper Mines (NCCM). Anglo American Corporation (Central Africa) Limited contracted to provide management, administrative and technical services to NCCM.

Chingola will become an even greater mine with the commissioning next year of a massive new plant which will increase capacity by 100 000 tons of copper a year. The plant has been designed to treat over 10 million tons a year of low-grade tailings and other materials and will incorporate the largest copper solvent extraction plant ever built. In the early days mining at Chingola was predominantly underground, the copper minerals being mainly of the sulphide type. The ores were concentrated in the usual way by flotation for both the sulphide copper minerals and the relatively small amount of oxide copper minerals present, and the concentrates were sent to the Rokana smelter at Kitwe, 51 km. away. As the overall production level was increased it became necessary to provide more appropriate treatment plant capacity for the increasing quantities of oxide concentrates produced. So in 1952 the leach plant was established, incorporating facilities for leaching concentrates with sulphuric acid and recovering the copper from solution by electrolysis. In the course of time prospecting proved the presence of additional ore adjacent to the underground orebody, much of which was sufficiently close to the surface to permit mining by open-cast methods. Mining of these ores commenced in 1957 and

was progressively increased until by 1969 the total mining rate at Chingola had increased to over 800 000 tons a month, of which some 550 000 tons a month came from open-pit sources. This necessarily involved corresponding increases in the capacities of all the metallurgical treatment plants, and by 1963 the leach plant had reached its present production rate of just over 100 000 tons a year of electrolytic copper.

A feature of the ores obtained from the open pits has been the higher proportion of oxidised copper minerals. One of the most common is malachite, a basic copper carbonate, well known in its massive form as the ornamental, dark green, semi-precious stone. Others which occur relatively abundantly are cuprite, a copper oxide, pseudo malachite, a basic copper phosphate, and chrysocolla, a copper silicate. Different proportions of these minerals and many others occur in different locations.

The flotation process is never very effective for concentrating copper oxide minerals and, except where malachite predominates, it has found little favour. At Chingola techniques have been developed and used which are reasonably successful for floating malachite, but the process applied generally to oxidised ores is relatively inefficient and unselective, resulting in recoveries and concentrate grades much lower than are commonly obtainable with sulphide ores. Vigorous attempts to modify the flotation technique for oxide minerals were made over a number of years, but only limited success was achieved and the amount of oxide copper in discarded flotation tailings remained unacceptably high. Thus in 1968 attention was directed towards alternative means of recovering the residual oxide copper tailings. It is worth noting that the total quantity of copper in tailings produced at the time amounted to some 4 500 tons a month, of which about 3 500 tons was present in the form of oxidised minerals. In addition there existed large dumps of tailings from past operations also containing appreciable proportions of copper in the form of oxide minerals. Taking the current and dumped tailings together the overall grade of the materials foreseen for treatment was 0,7–0,9 per cent Cu of which 0,5–0,6 per cent was present as oxide copper minerals.

The important common feature of most oxide copper minerals is that the copper can be dissolved readily by acid solutions. This fact was, of course, the basis for the leaching process installed earlier for treating the oxide copper concentrates. Preliminary test work on tailings indicated that the amounts of other acid-consuming minerals present were reasonably low and it was apparent that additional production of sulphuric acid from the Rokana smelter's waste gases could be obtained. Accordingly the investigation was based on the premise that the tailings would be leached with sulphuric acid and the study therefore centred upon determining the most economic way of recovering the dissolved copper from solution. One of the earlier possibilities investigated involved production of granular iron by electric furnace reduction of smelter slags, and using this to precipitate the copper from solution by the so-called cementation reaction. Other possibilities included precipitation of the copper as the sulphide using various precipitants, or as the hydroxide using lime. Several of these alternatives might have proved viable, but in the event

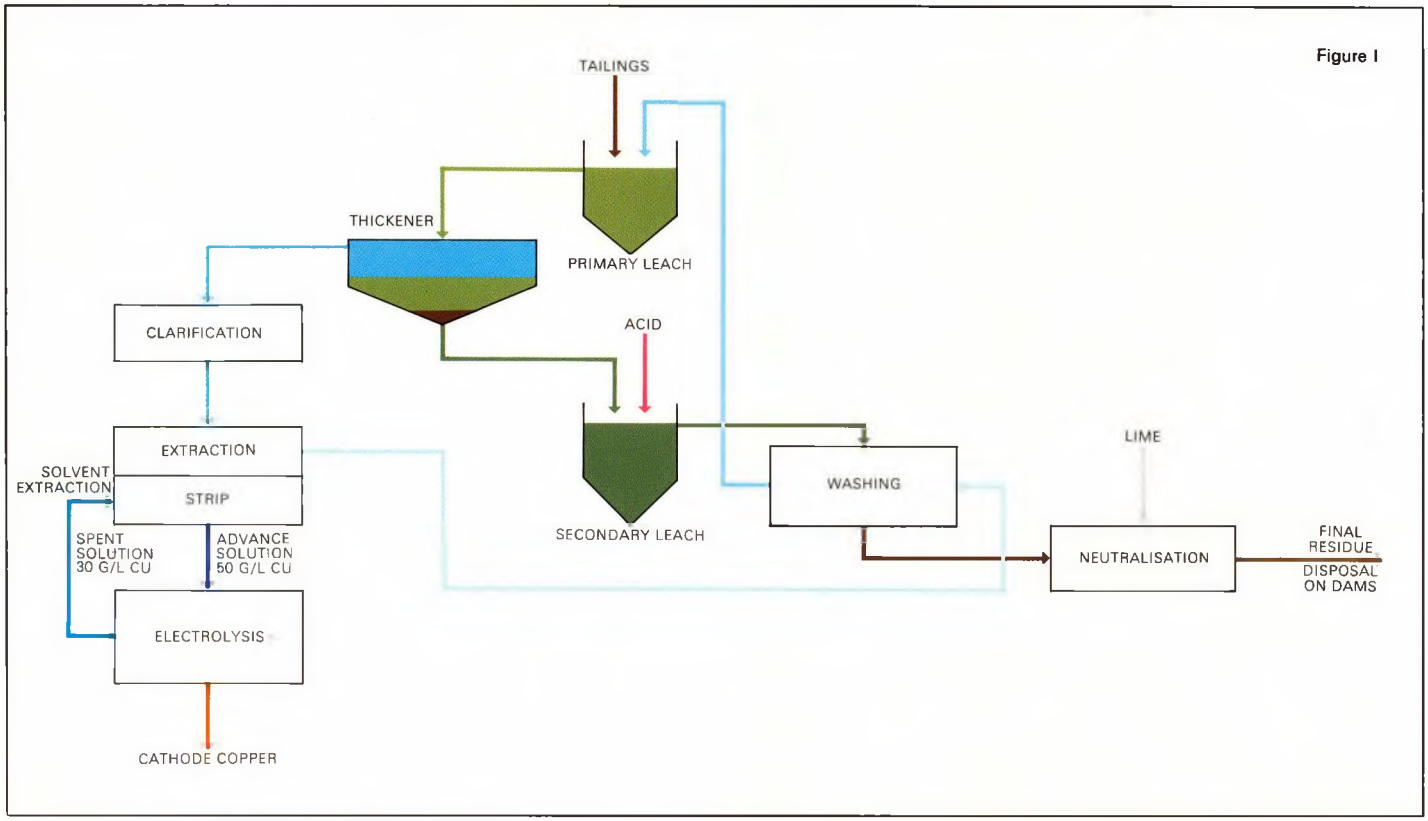

Figure I

CHANGE OF ADDRESS

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AUSTRALIA:
13th Floor,
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Melbourne,
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FULL NAME (block letters) .....

NEW ADDRESS IN FULL (block letters) .....

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they were overtaken by developments then occurring in the western United States.

During the mid-1960's there had appeared on the market new chemical reagents capable of selectively extracting copper from dilute aqueous solutions and regenerating a purified, concentrated copper solution ideal for electrolysis. This technique, known as solvent extraction or liquid ion exchange, was well known, but its use hitherto had been limited to the extraction and purification of the more valuable metals such as uranium. The first reagents to be marketed for copper on a commercial basis were developed and produced by General Mills Incorporated and bore the trade mark LIX for liquid ion exchange. Several small pilot plants were established by interested mining companies in the Arizona area, and in 1968 Ranchers Exploration and Development Company introduced the process in place of cementation on scrap iron to treat the dilute solution from heap leaching at their Bluebird mine near Miami, Arizona using the General Mills reagent LIX 64. The end product of the process was cathode copper of fair purity produced by electrolysis of the concentrated solution from the solvent extraction plant.

By mid-1969 it was apparent that the Bluebird operation was a technical and economic success and another American company, Bagdad Copper Corporation, constructed a similar small plant for their operation in Arizona. Following visits by staff of Anglo American Corporation to Arizona and an amount of test work on the copperbelt it was decided in October 1969 to abandon all other options and proceed with the detailed investigation of a solvent extraction based process using the General Mills reagent LIX 64N, an improved version of the LIX 64 pioneered at Bluebird.

An outline of the process flow sheet which is now incorporated into the final design of the tailings leach plant is shown in figure 1. The finely ground powdery tailings will be leached with acid solution in tanks supplied with air agitation. In designing this leaching facility much information was derived from a study of practices in the Group's gold and uranium operations, where leaching in similar sized vessels has been practised for some years. The peculiar arrangement of leach tanks, thickeners, and washing facilities (indicated on the flowsheet) was dictated by the need, on the one hand, for relatively high acid levels in leaching to extract the copper from the tailings, and on the other hand for a low acid level in the copper-bearing solution passing onwards through clarification to the solvent extraction plant.

Having dissolved most of the copper from the oxidised copper minerals, the pulp will flow to a thickener where the partially leached solids will be allowed to settle, leaving a relatively clear, dilute, copper-bearing solution. The solid residues will be removed continuously and after secondary leaching with more acid to complete the extraction of copper, will be washed with copper-free solution (derived from a later process step) to remove residual entrained copper-bearing solution. Once the copper has been removed in this way, lime will be added to neutralise and precipitate the remaining dissolved sulphates and so forth, and the final neutralised residue will be pumped to conventional tailings dumps for disposal. This last neutralising stage is necessary to avoid pollution of local streams.

Returning to the thickener overflow, the total flowrate at this point will be 55 000 litres a minute and the solution will contain about 2,5 grams a litre of copper, 2 grams a litre of sulphuric acid, minor amounts of other dissolved impurities such as iron, magnesium, aluminium and so on, together with about 100 milligrams a litre of fine suspended matter. In order to avoid problems in the solvent extraction plant, it will be necessary to reduce the level of suspended matter to below 10 milligrams a litre; hence the solution will be clarified by passage through a battery of sand filters operating under slight pressure. After clarification the solution will be passed straight into the extraction side of the solvent extraction plant. The basic chemical reaction involved in the solvent extraction process is illustrated by the equation:

$$\underset{\text{Phase: Organic}}{2\,HR} + \underset{\text{Aqueous}}{CuSO_4} \underset{\text{Strip}}{\overset{\text{Extraction}}{\rightleftharpoons}} \underset{\text{Organic}}{R_2Cu} + \underset{\text{Aqueous}}{H_2SO_4}$$

The symbol HR represents the solvent extraction reagent, LIX 64N, which is a mixture of complex synthetic organic chemicals of the oxime type. It will be used in the form of a 20 per cent solution in kerosene, and this solution will form the organic phase. The clarified copper-bearing solution from the sand filters will form the aqueous phase. As the equation indicates, the extraction process involves mixing the two phases so that the copper in the aqueous phase is extracted selectively into the organic phase forming the complex R_2Cu. A simultaneous exchange of hydrogen ions for copper ions occurs, with the result that as the aqueous phase is depleted of copper it is simultaneously enriched with acid. When the extraction operation is complete, the copper-enriched organic phase is separated from the almost barren aqueous phase and contacted with a smaller volume of a different aqueous solution containing a concentration of acid some 20 times higher. The result of this is to reverse the reaction and to strip copper back from the organic phase into the aqueous phase, leaving the stripped organic ready for re-use. By the adjustment of relative volume flows and concentrations it is possible to obtain a high concentration of copper in the high acid strip solution so that the copper can be removed economically by electrolysis in a very pure form.

The diagram in figure II illustrates how the operation will be conducted in practice in the tailings leach plant. For reasons associated with the properties of the reagent LIX 64N, the single extraction and strip stages implied thus far become three extraction stages and two strip stages arranged in series. This arrangement will permit achievement of the maximum possible efficiency of extraction and stripping consistent with reasonable capital costs. Each stage consists of a mixing tank equipped with an agitator of special design and a settling chamber large enough to allow separation of the mixed phases by gravity. The combination is known as a mixer-settler unit.

By following the flow lines on figure II it will be seen that the organic and aqueous phases flow against the current to each other through the extraction mixer-settlers, the aqueous phase being progressively depleted and the organic phase progressively loaded with copper. The final aqueous solution leaving the

third extraction settler will be returned to the washing section, where it will be used to wash the final leached residue free of entrained copper (see figure I) and where its acid content will eventually be used to leach more copper from the tailings. The loaded organic phase leaving the first extraction settler will be pumped across to the two strip mixer-settlers through which it will flow against the current to the high acid spent solution derived from the tankhouse. This solution strips the copper away from the organic phase and becomes the advance electrolyte to the tankhouse. The stripped organic phase leaving the second strip settler will be sufficiently depleted in copper to be used again in the extraction side. Thus apart from minor entrained losses which must be made up, the organic phase will merely circulate around both the extraction and strip circuits.

The final step in the process involves the production of cathode copper in the tankhouse by passing a heavy direct current between anodes and cathodes immersed in the electrolyte. Inert anodes made of antimonial lead will be used, although the possibility of replacing lead by other materials to minimise lead corrosion and contamination problems is still under study. The copper will be plated out on to cathodes made of thin copper starting sheets which will be withdrawn from the tanks after four days in the form of 70 kg cathodes measuring about 1m x 1m. The anodes and cathodes will be connected appropriately to copper busbars distributing the current from rectifier units and arranged alternately in tanks through which the advance electrolyte will flow. The electrolysis process involves the reaction:

$$2\,CuSO_4 + 2\,H_2O \longrightarrow \underset{\text{Deposited}}{Cu} + \underset{\text{Liberated}}{O_2} + H_2SO_4$$

The net result in solution, therefore, is depletion of copper, liberation of oxygen gas into the atmosphere and increase in acid concentration. The acid solution leaving the tanks is recycled to the strip section of the solvent extraction plant and used again to strip the copper from the loaded organic. Because LIX 64N is a highly specific reagent for copper, the advance electrolyte and hence the copper cathodes themselves will be substantially free of deleterious impurities and the cathodes will be processed further to wirebars or other marketable shapes of high quality without difficulty.

In his statement accompanying the 1971 annual report for NCCM, the chairman, Mr D. C. Mulaisho, referred to a planned increase in production of copper by Nchanga from approximately 400 000 tons a year in 1970 to 500 000 tons a year by 1974. The direct contribution of the tailings leach plant to this increase will be about 66 000 tons a year, obtained from the treatment of approximately 800 000 tons a month of concentrator tailings and leach plant residues, together with about 100 000 tons a month of reclaimed dumps or other materials. In fact due to planned rearrangements of treatment routes for various materials within the whole Nchanga metallurgical complex, the total cathode output of the tailings leach plant will approach 100 000 tons a year. Most of the excess over 66 000 tons a year will enter the plant in the form of impure and dilute copper-bearing solutions derived from the existing leach plant. These will join the main flow ahead of the solvent extraction/electrowinning sections and their treatment in this way will result in significant cost and operational advantages.

All the process development work leading to the complete process concept and the definition of individual operations has been conducted by the NCCM (formerly AAC (CA)), research and development department in Kitwe. From 1969 onwards the responsibility for detailed metallurgical planning has been vested in a project team who have set the priorities in research and development, arranged for feasibility and financial studies as required, and provided all the process metallurgical information required by the engineering design team. Overall metallurgical direction of the project has been exerted by the consulting metallurgist of AAC (CA) working in collaboration with the other AAC technical consultants. The project has moved through the normal stages of bench scale laboratory work, small-scale continuous testing, pilot plant construction and operation, to full-scale plant design and construction. Very close liaison between metallurgical and engineering staff has allowed engineering design and associated

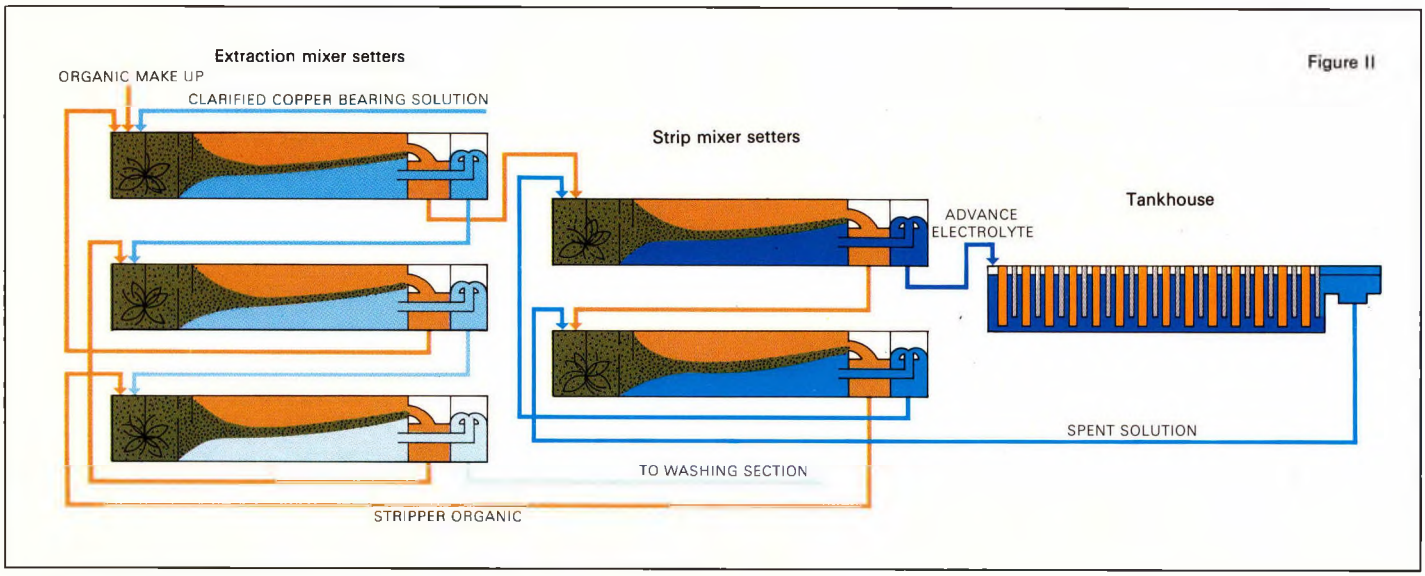


Figure II

activities to commence immediately final process decisions have been made. In many cases major process decisions have been taken on the basis of small-scale test results and ahead of proper piloting on the grounds that to wait for completion and analysis of all pilot plant work would have delayed the project to an unacceptable extent. There is no evidence to date, after ten months of pilot plant activity, that any serious errors of judgment have been made due to this policy.

The engineering of the complete plant has been the responsibility of the AAC, Kitwe engineering division, working under the direction of the consulting mechanical and electrical engineers for AAC (CA), and most of the design work, procurement, letting of contracts, and construction supervision functions have been undertaken directly by Kitwe staff. Exceptions are the solvent extraction plant itself, for which The Power Gas Company was granted a turnkey contract to supply a plant to specifications laid down by Kitwe, and the design work for the tankhouse which was contracted out to Holmes and Narver, Incorporated, of Los Angeles. Commissioning is expected to start in January 1974 and will be completed around mid-1974 with the construction of the last section of the tankhouse.

The overall capital cost for the plant at Chingola will be approximately K60m. However, when production of the extra acid and lime required for the process is taken into account, the overall cost will be closer to K100m. Acid will be made available by extensions and improvements to the facilities for collecting SO_2 gas at the Rokana smelter, and by increasing total acid plant capacity at Rokana to 800 tons per day. This project has been awarded to Mitsubishi Corporation of Tokyo on a turnkey basis at a cost of approximately K30m, and will incorporate many features of similar plants recently installed in Japan. Increased lime supplies will be obtained from Ndola Lime Company by the provision of a new rotary kiln and ancilliary plant and equipment at a cost of approximately K11m. This plant is being provided on a semi-turnkey basis, in this case by F. L. Smidth and Company A/S of Copenhagen. Overall control of both contracts is being exercised by the AAC Kitwe engineering division.

The total time from the commencement of feasibility studies on the whole K100m project to the presently planned date for completion of all commissioning will be five and a half years. During the initial planning period it was realised that the project could, with advantage, be handled in two stages, and that a limited production could be achieved very much earlier and with only a small fraction of the total required capital expenditure. In stage I it was therefore arranged to treat the stockpiles of low-grade oxide concentrates containing two to three per cent copper at a limited rate dictated by availability of acid and lime, by a process incorporating many of the steps planned for the ultimate tailings leach plant in stage II. The process chosen involved production of the dilute copper solution in the thickener overflow generally set out in the flow sheet in figure I, but then incorporated precipitation of the dissolved copper on scrap iron by the cementation reaction:

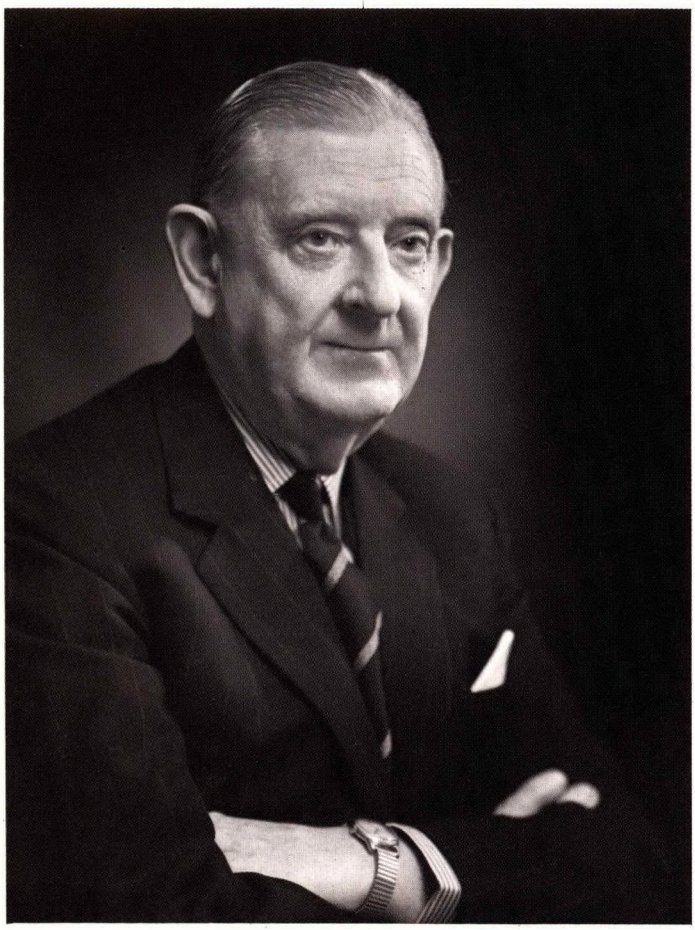
$$\underset{\text{Metal}}{Fe} + \underset{\text{In solution}}{Cu^{++}} \longrightarrow \underset{\text{In solution}}{Fe^{++}} + \underset{\text{Precipitated metal}}{Cu}$$

This process is widely practised in America for the precipitation of copper from liquors derived from dump or vat leaching. One particular technique using cone-type precipitators had been developed by Kennecott's metal mining division and the efficiency, simplicity and low capital cost of this method determined its adoption at Chingola.

The important feature of the two-stage concept was that most of the plant items involved in stage I would be installed as part of the requirement for the ultimate plant (stage II) and hence the capital cost attributable to stage I would be reasonably low. Preliminary financial analyses indicated a good return despite the limited life of the operation and the high cost of scrap iron which had to be imported from Europe, and the decision to install stage I was made late in 1969. The plant was commissioned in October 1971 and experienced a number of problems which prevented achievement of target production. However, by the end of 1972 stage I had produced 17 000 tons of copper and is currently producing at a rate greater than the target production of 2 000 tons a month. It will continue to operate until October 1973 when it will be closed down to permit incorporation of the common plant items into the ultimate tailings leach plant complex.

The solvent extraction plant included in the tailings leach plant will process about ten times the copper production of Bagdad, currently the largest copper solvent extraction operation in the world, and there is no doubt that its commissioning will herald a major advance in the application of the technique to the recovery of base metals. There are many reasons for believing that solvent extraction will be developed and used in the future to a progressively greater extent. For copper production the trend will be away from the conventional flotation smelting route and towards hydro-metallurgical treatment. This is because of the difficulties and costs of meeting more stringent air pollution legislation and because the lower grade and oxidised ores which will have to be processed to meet the growth of demand are likely to respond more favourably to such methods. For these reasons much hydro-metallurgical research is already being conducted and the role of solvent extraction in separating and purifying metals in solution is receiving much attention.

It is clear that both the chemistry and engineering of solvent extraction or ion-exchange systems applied to base metals are in their infancy, and that progress in the understanding and use of the technique will require close technical and financial collaboration between the metal producing companies and those expert in the specialist chemistry involved. Ideally it will be necessary not merely to synthesise new reagents to suit preconceived metallurgical processes, but to develop new and improved processes by combining all the chemical, metallurgical and engineering skills involved. Such processes may bear little resemblance to presently conceived flowsheets, but are likely to prove technically and economically more attractive. Given such collaboration it is believed that the application of solvent extraction techniques to base metal extraction generally will expand rapidly and will make possible significant improvements in ore reserves, extraction economics and metal purity. □



PROFILE

SIR RONALD PRAIN

Sir Ronald Prain, who recently retired from the chairmanship of the RST mining group, made his name in three continents and divided his working life mainly between three cities: London, New York and Lusaka. He learned the metal business in London, and the big international banks in New York came to know him as a shrewd negotiator for mining finance. But it was in Zambia that he really established his reputation in world mining and made his important contribution to the industrial development and social evolution of central Africa.

Ronnie Prain was born in Chile, like Zambia one of the world's great copper-producing countries. He was educated in England, at Cheltenham. His interest in mining in Zambia began even before the Copperbelt was developed. In 1926, when he was 18, he went straight from school to the London metal trading firm of Marshall Brothers. Technically speaking, he was with Marshalls all his working life, for in due course he became chairman of its two successors, Anglo Metal and Ametalco. Prain's progress in London was rapid and caught the eye of Sir Alfred Chester Beatty. In 1939 he was appointed to the boards of the principal companies of the RST group; in 1943 he was made chief executive, a post he held for 25 years; and in 1950 he succeeded Chester Beatty as chairman. Thereafter he steered the group through the changing political, economic and social complexities of the two Rhodesias, moving his headquarters first from London to Lusaka in 1953, to Salisbury in 1955 following the establishment of the Federation of Rhodesia and Nyasaland, and then back to Lusaka in 1964 when Federation ended and Zambia became independent.

Prain tackled the problems of his group in Africa in a positive way. The white mineworkers' unions on the Copperbelt called for his deportation when he fought them over African advancement; he played a major part in breaking through established colour attitudes in the mining industry at the time, and helped to create a firm foundation on which African progression in the industry could be built. In his quest for a fair deal for African employees, and in his support for multiracial development in other fields, his and his companies' popularity was often at low ebb in Salisbury – and sometimes in Lusaka. But he was never deterred by political pressure or adverse publicity; he stuck to what he believed to be right and in the best interests of his group.

He displayed the same doggedness in marketing and production policies. In 1955, and again in 1964, he broke away from the traditional method of selling on the basis of the London Metal Exchange price, offering the group's copper to customers at an 'RST producer price' which was often much lower than the market price. His action was widely criticised in market circles, but he had the backing of his shareholders and of others who recognised that in such a situation the long-term interests of the industry and the goodwill of customers are more important than the short-term profits of the companies.

The pattern of Prain's working life necessitated constant travel. Fortunately he is a tireless traveller who spends most of his flying time working. He figures that he has covered well over 3 000 000 kilometres in the 22 years since he became chairman, and most of this was long before the luxury flying of the jet age. His first flight from Britain to the Copperbelt in the early days of the second world war took 28 days – and 27 days to get back.

The outbreak of war had meant a dual role for Sir Ronald. As well as maintaining his RST position and helping to ensure continuity of export of a vital war material, he was drafted to the British Ministry of Supply, first to become controller of industrial diamond dies and tools, and later, additionally, controller of quartz crystal supplies for the electronics industries. His success in these posts was recognised by the award of the OBE in 1946 – and by the inclusion of his name on Hitler's list of those marked for execution in the event of a German victory.

But it is in Africa that he will always be best remembered,

and not only within RST, for he has done much to foster a close relationship between his group and the Anglo American Corporation Group, who have a long-standing interest in Mufulira, which was RST's biggest mine. In 1971 the Zambian government acquired a 51 per cent interest in the copper mining industry and Mufulira became a division of RCM, the government-controlled company that took over the RST group of mines. Much of Prain's work with Anglo American was carried out on the boards of the old Northern Rhodesia Chamber of Mines and the Power Corporation. In the difficult years after the war when the Copperbelt was short of coal and vast areas of woodland had to be cut to feed the furnaces, it was Prain who suggested that a temporary solution might be a link with the copper companies of the then Belgian Congo who were expanding their hydro-electric system. This led to the setting up of the Rhodesia Congo Border Power Corporation to integrate the Copperbelt's existing thermal generating plants with the hydro power of the Congo, and later with the Kariba system, thus creating Africa's longest power line. When Sir Ernest Oppenheimer opened Bancroft mine in 1956, he paid tribute to Prain for the leading part he had played in bridging the power gap until Kariba came into operation, and for his work in securing the finance.

Sir Ronald's other links with Anglo American have included membership of the Wankie Colliery board for ten years, and in the fields of banking, education and aviation. A further link was forged when Anglo American and its associate, Charter Consolidated, acquired a 30 per cent interest in Botswana RST, the company formed to develop a major nickel-copper mine in Botswana, and of which Sir Ronald, until recently, was chairman.

Prain is one of those rare executives who have the ability to keep the most pressing problems and anxieties in their proper perspective. The popular Press has called him 'Mister Copper' – which is a colourful way of saying that he is probably the world's leading authority on the industry in its broadest context. Many of his speeches and papers will endure; a lecture which he gave to the Royal School of Mines on 'The responsibilities of a mining industry to the community' is as valid today as when he delivered it 15 years ago, and it has become a standard work on the reading list of many universities. In everything he does Prain is precise and meticulous. He is an impatient man who often makes quite unreasonable demands on his staff. Those who serve him get their best rewards in his appreciation for he is as quick to commend a good piece of work as he is to condemn a shoddy one. He demands the highest standards of efficiency and endeavour both from himself and from those who work with him. He has always believed that perfection in the little things is a pre-requisite for success in more important matters. With such principles firmly in his mind and backed by most of the accepted qualities of leadership, he became one of the chief architects of industrial development in central Africa, an influence on the pattern and pace of its social evolution, and a leading figure in world mining, a position recognised by his chairmanship, since 1961, of the Council of Commonwealth Mining and Metallurgical Institutions.

Prain once referred to his professional experience as "one which has been obtained in the hard school of business with its perpetual conflicts between what is desirable and what is obtainable, rather than through the disciplines of scientific enquiry". This is certainly so, but while there may be some division of opinion about the depth of his scientific knowledge (and he does not claim any), there is no disputing his ability to evoke response from technical debate with a knack of guiding discussion in a direction best calculated to produce the maximum practical benefit. It was in recognition of such abilities that he was appointed president of the Institute of Metals in 1960, becoming one of the few non-technical members to attain this office. He holds the institute's platinum medal and the Institution of Mining and Metallurgy's gold medal. The New York Copper Club presented him with the Ankh award for "the industrialist who contributed most to the copper industry in 1963". Other American institutions have not always treated him so kindly. In 1956 he became the first Englishman to be subpoenaed in the United States for more than 100 years. Robert Kennedy served him with an order to appear before the Senate committee on government operations – of which Senator McCarthy was a member – but he satisfied their enquiries and the encounter ended with handshakes all round.

Outside of mining Sir Ronald's interests have been mainly in banking and in agriculture. He was the first chairman of the Agricultural Research Council of Rhodesia and Nyasaland in 1959, and it was his desire to do something to redress the imbalance in the economy of the Federation that led to RST's sponsorship of the Kafue Flats polder scheme, a large-scale experiment to test the agricultural potential of land which is now flooded for several months of the year. When the experiment was completed, Prain turned the results over to the Zambian government.

At first meeting Prain often gives the impression of aloofness, but this veils a warmth and humanity which have brought him deep and lasting friendships with people of many different races. He finds relaxation in a variety of ways: for example, in the MCC members' enclosure at Lord's, where he will subject a flashing cover drive to the same precise analysis that he will give to a new mining plan or a metallurgical process. Perhaps his greatest approbation will be drawn from a catch behind the wicket or a neat piece of stumping, for Prain was a wicket-keeper of high merit and carries with him a finger bent and broken by that prince of cricketers, K. S. Duleepsinhji. In his middle forties Ronnie Prain turned to tennis – of both kinds, 'royal' for preference, and of which he is still an enthusiastic player.

He is a lover of fine pictures, music and literature. He remembers nearly all that he reads and all that he hears, quickly classifying each piece of information, each gem of prose, each anecdote, and storing them away in their own mental cells to be drawn out, savoured and put to use whenever he wishes. Good conversationalist and after-dinner speaker though he is, he has a social 'correctness' which betrays an inherent shyness that he has never quite succeeded in conquering. To his colleagues in RST he was always 'The Chairman'; to his friends he is 'Ronnie'; somewhere between the two is the real Prain, who may never be defined with the precision which he himself would demand. □

PAPUA NEW GUINEA

COMPETING NATIONALISMS AND THE CRISIS OF EXPECTATION

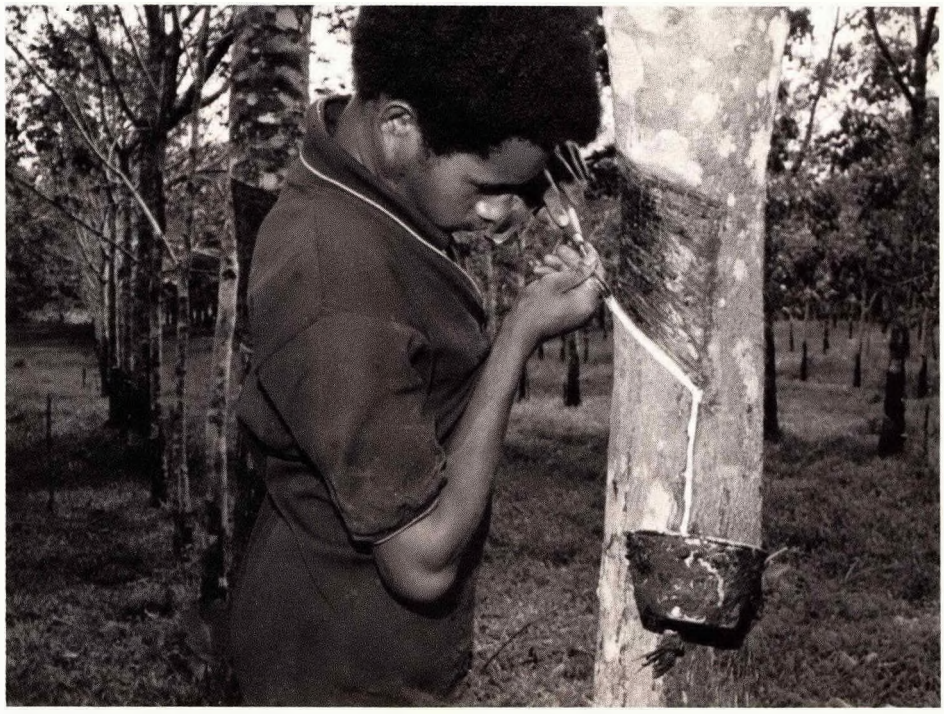
ANTONY MARTIN

ONE hundred years ago, New Guinea was the last unknown. Books of total fantasy which purported to describe its interior had to be taken seriously, because nobody knew what it was like. In 1876, for instance, a Captain J. A. Lawson published his *Wanderings in the Interior of New Guinea*. The marvels he had to relate included a mountain nearly a mile higher than Everest, a waterfall deeper than Niagara, and a striped cat bigger than a tiger. Then, in 1885, Britain and Bismarck's Germany agreed to divide up the island, in a fashion familiar from African history. By that time a few traders and missionaries had established themselves on the coast. But when the powers met in Berlin to draw their imaginary line through the middle, they were parcelling out territory that no European had ever seen. They assumed that the mountains through which their boundary passed were probably uninhabited. It was only 50 years later, in the early 1930's, that Europeans began to explore the highlands in search of gold. They were in for a surprise. Up in those remote fastnesses they found an enormous network of fertile plateaux and valleys, where hundreds of thousands of people were living in villages, practising quite an intensive agriculture with a limited but adequate technology. Their

communities were (and are) small ones. Each group of a few hundred or a few thousand people speaks its own language, usually unintelligible to the next group the other side of the valley. Before the Europeans arrived, they settled their differences – over women, stray pigs, and above all land – by a variety of sanctions which normally included the bow and arrow and sometimes also the cooking pot.

All unknown to these Stone Age people, their political status in the world at large had been going through continuous change in the half-century before they were 'discovered'. If their homes lay to the north of the mythical line, they were New Guineans, living successively in a territory administered by the German New Guinea Company, an imperial German colony, an Australian possession under military rule, and a League of Nations mandate run by Australia. If they lived to the south of the line, they were not New Guineans at all but Papuans, and following a period as British protected persons they became, after a fashion, Australian citizens. None of this made any impact on their lives. What mattered much more, when it came, was the introduction of new technology (steel axes for stone ones), new and useful goods, colonial law and order, and the moral and religious ideas of the Western world as expressed by missionaries. At the political level, the status of the territory was determined by the military ambitions and fears of Western powers, the results of world wars, and the search of Europeans for profits and raw materials. It was only after the second world war that the economic, social and political development of the local people began to be seen as worthwhile objectives, partly for their own sake and partly because world opinion on such matters had become a factor that the Australians, like other colonial powers, felt they had to take into account.

It is this process, speeded up since 1962, when a United Nations mission under the then Sir Hugh Foot visited the territory and urged Canberra to get a move on, which has brought Papua New Guinea within sight of nationhood. Full internal self-government is now scheduled for December, 1973, with independence expected to follow not long afterwards. So, in a year or two's time, the world's last major colony belonging to a power that accepts the principle of decolonisation will take its place in the United Nations, run up its flag and seek to shape its own future. What are its prospects? I have few firm answers, only some appreciation of what its new leaders are up against.



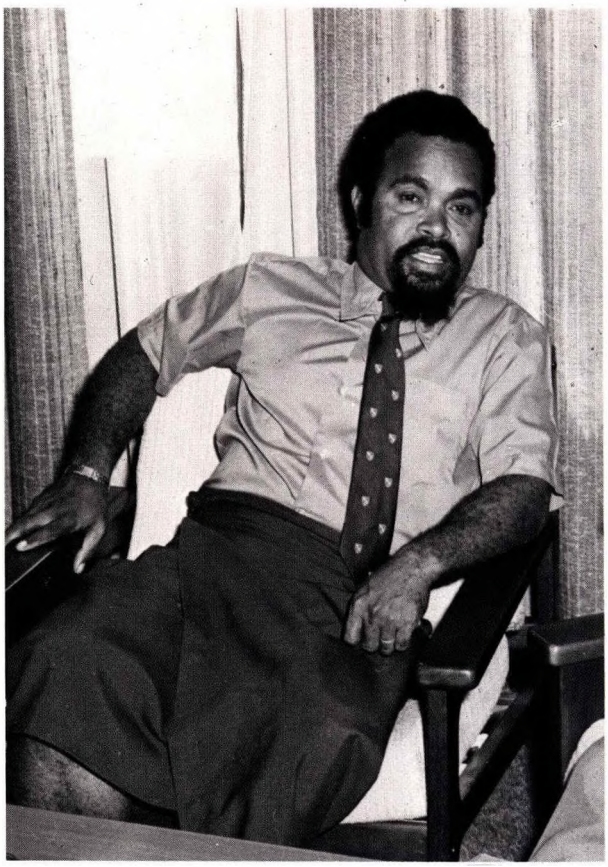
Above is a rubber tapper from a central district area. On the page opposite is a man from Asaro, wearing traditional mud mask and with his body liberally daubed with the grey clay of the mask. These 'mud men' are dancers who move very silently, use no drums and do not chant

More than most former colonies, Papua New Guinea suffers from a clash between history and geography. To begin with, the main island (the biggest in the world after Greenland) is split down the middle, from north to south, by one of those suspiciously straight lines. To the west of it lies West Irian, the former Dutch colony which the late President Sukarno of Indonesia managed to incorporate into his sprawling domains. This article will have nothing to say on that subject except that the frontier was hardly decreed by nature and that its existence is likely to pose diplomatic problems, if nothing more serious, for the government in the east.

Papua New Guinea itself consists of the eastern part of the main island, plus numerous smaller islands of which New Britain and Bougainville are the most significant. The government's first task is to build a nation out of this variegated material, and there are many potential sources of division. The very name of the country suggests one of them. 'Papua', which refers to the southern part of mainland New Guinea (as the main island is confusingly known for some purposes), comes from a Malay word meaning 'frizzy-haired'. 'New Guinea' proper, which is the political name for the northern part of the island, was given to it by a 16th century Spanish navigator who fancied as he sailed past that the scenery resembled that of 'old' Guinea in Africa. As one might guess from those origins, neither name stands for a real ethnic or cultural entity. But the clumsy double name is likely to stay, because 'Papuans' and 'New Guineans' have become conscious of themselves in those terms. An attempt was made not long ago to coin a more appropriate name for the combined territories, and the word 'Niugini' came into unofficial use among those who wanted to stress national unity; it seems to have foundered on Papuan objections.

The historical reality behind the distinction is a colonial one. Papua and New Guinea have always been separate administrative units, Papua under British and Australian rule and New Guinea under German and Australian rule, with a short interlude under the Japanese. Although the two are now going forward together, New Guinea is still constitutionally speaking a United Nations trust territory, whereas Papua is an Australian territory. The tone of government has also differed between the two segments. In Papua, particularly under the long rule of Sir Hubert Murray, Lieutenant-Governor between 1906 and 1940, and brother of Gilbert Murray, the

High school art class near Madang



Chief Minister Michael Somare

renowned professor of Greek at Oxford, the emphasis was on benevolent, high-minded protection of the natives from exploitation by business interests. In New Guinea, perhaps partly because of the German legacy, there was greater scope for European planters and commercial operators, with correspondingly greater economic development and worse race relations. Whatever the explanation, the numerically fewer Papuans fear domination by the New Guineans. Antagonism manifests itself in occasional riots at football matches and the like and is reflected in jealousies at the political level.

There are divisions, too, between coastal people and highlanders. They look different; they have a different history, notably so far as length of contact with Europeans goes. The Highlanders in particular, to the extent that they identify with a larger group than the clan, may well think of themselves as Highlanders rather than as Papuans and New Guineans. While I was in the capital, Port Moresby, a few months ago, a new political grouping known as the Highlands Liberation Front announced itself. Its leaders are mainly university students and may not have much ordinary political following; but its platform – that the Highlands have been left behind in the race for education and development, and that the only way to make up for this is for Highlanders to be allocated a goodly share of top government jobs, irrespective of merit – reflects a real, if inauspicious, state of affairs. The movement that says "the Highlands for the Highlanders" may still be in its infancy, although shrewd local observers are not inclined to discount it. The Highlands, after all, do contain a million of the total population of two and a half million, they have indeed been left behind so far as modernisation goes, and with independence looming, their political leaders may have to find a replacement for their old platform of simply opposing rapid constitutional change. But there are still more immediate potential threats to national unity. The most important concerns Bougainville, the copper-rich island which lies nearly 600 kilometres to the east of New Guinea proper. The Bougainvilleans, 80 000-odd in number, look strikingly different from the rest. They are jet black in appearance, as opposed to coffee-coloured, and refer to all other Papuans and New Guineans as 'red-skins'. Geographically, they are the northern end of the Solomon Islands and not a part of the New Guinea complex at all. They find themselves in Papua New Guinea because of another 19th century deal between Britain and Germany under which Germany got Bougainville and Britain took the rest of the Solomons (themselves today being prepared for independence in 1975).

For several years there has been an active secessionist movement on Bougainville, which has agitated for a referendum to let the people decide whether they want to stay with Papua New Guinea, go it alone, or go in with the British Solomons. The old argument that Bougainville would not be a viable entity has lost most of its force with the opening of the huge copper mine last year. On its own, Bougainville would be rather a rich country. The trouble is that Bougainville's copper would be the mainstay of the national economy, which explains why any administration, whether the Australians or their successors, has resisted and will go on resisting a referendum with the utmost determination. Many new nations, as Africa knows all too well, face these divisive pres-

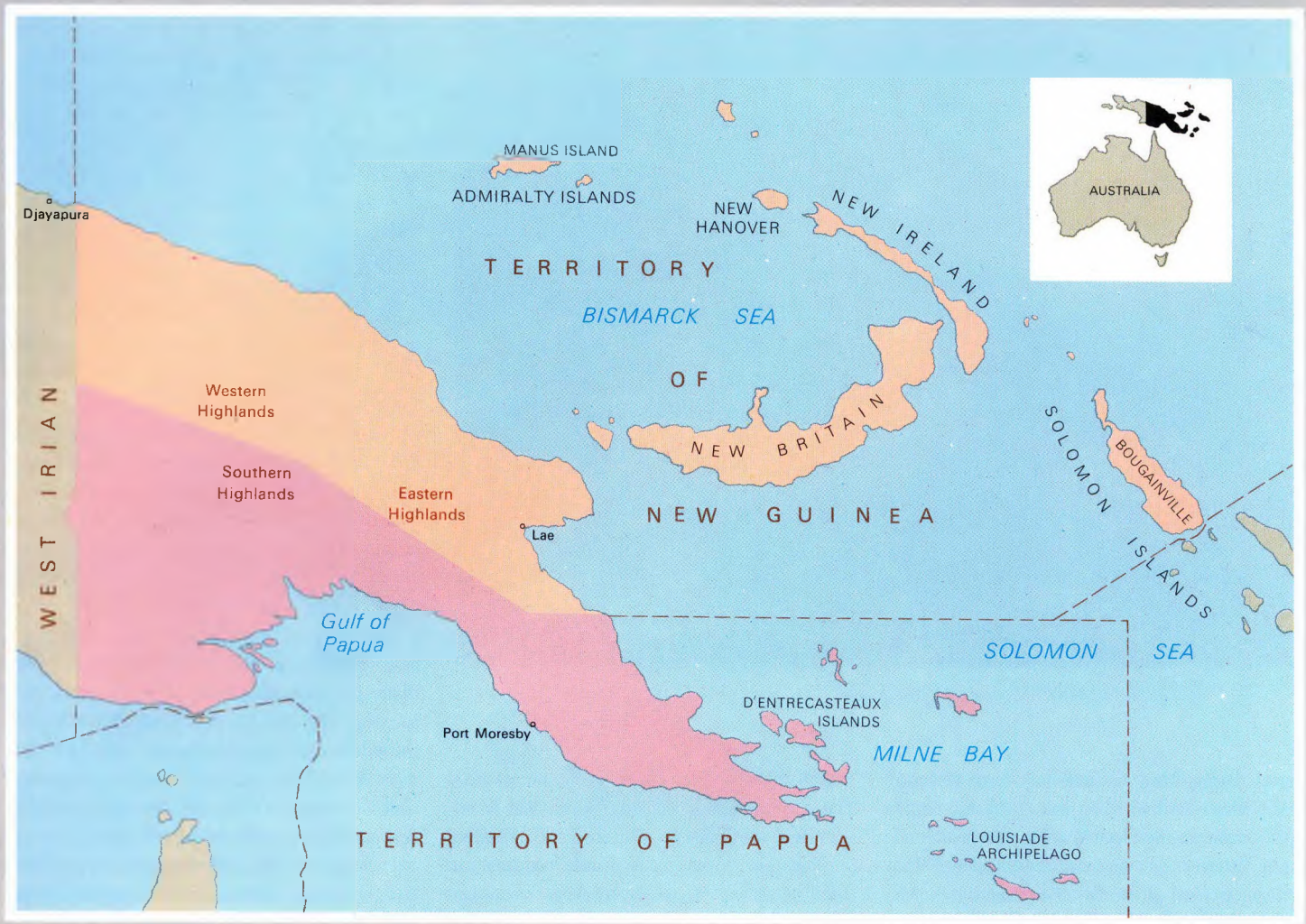
Active volcano on Bougainville

sures. Papua New Guinea may seem to have even more of them than most and one could add to the list without trouble: the potential split between town and countryside, the enigmatic but powerful movement towards some form of separate political identity for the formidable Tolai people, who live on the overpopulated Gazelle peninsula of New Britain. The big unknown is what happens in a country which is not just divided into largish tribes, as in most of Africa, but fragmented into a myriad of tiny clans.

A good indicator of 'nationality', meaning the units to which people feel they primarily belong, is language. New Guinea is a paradise for linguists; they believe there may be as many as 1 000 distinct languages in the area, differing from each other by at least as much as Spanish differs from Italian and usually by much more. Most of them number their speakers in the hundreds; only a few dozen have ten thousand or more, and the most widespread of all, Enga, in the western Highlands, can boast a mere 130 000 speakers. (A man owes his primary allegiance to his *wantoks*, Pidgin for 'one-talks'. This applies in the towns as well as the villages, and the '*wantok* system' is a phrase in frequent use.) The country needs a *lingua franca*, and there are two candidates: English and Pidgin. English, the medium of formal education, has obvious advantages, including a comprehensive vocabulary and international use. But it is hard to learn, and it cuts off the educated minority from the rest. Pidgin (or Neo-Melanesian as it is politely known) is easy to laugh at. When I was introduced to New Guineans as coming from England, the country was readily identified as "As ples bilong Queen" – place where the Queen sits down. Pidgin is also short on technical vocabulary. But it is widely spoken, easy to pick up, and capable of further growth. One of the country's daily newspapers, *Nu Gini Toktok*, published in Port Moresby, uses it exclusively (see facsimile on page 61). Physical communications are hardly less of a problem. Apart from one all-weather road which runs 650 kilometres from Lae on the coast to Mount Hagen in the Highlands, the only way of getting from one town to another is by air – or on foot. Papua New Guinea must be one of the few countries on earth where migrant labourers commute by air.

The political leaders who will have the difficult job of welding all this into one, holding it together and making it into some sort of meaningful nation are having to learn their trade in a hurry. Until a year ago it was almost meaningless to talk of politics on a national scale. Although political development had been part of Australia's declared objectives since the second world war, ministers and officials in Canberra usually assumed that the journey to self-government would be a long and leisurely one. After the war it was taken for granted that New Guinea was needed for Australian defence; political evolution would be gradual, and the country would stay firmly within the Australian sphere of influence. For most of the 1950's and early 1960's the responsible minister was Mr (now Sir) Paul Hasluck, who had well-defined ideas about how it ought to proceed. Political evolution, in his view, should not be forced: it would flow naturally out of economic and social advance, and meanwhile it was to be fostered at the local rather than the national level. It was outside events that forced the pace, notably the wind of change, new Australian defence requirements that made the nothern buffer seem less vital, the growing pressure for decolonisation, and the showdown between Indonesia and Holland over West Irian, when it became clear that the United States would throw its weight behind the anti-colonial nationalists.

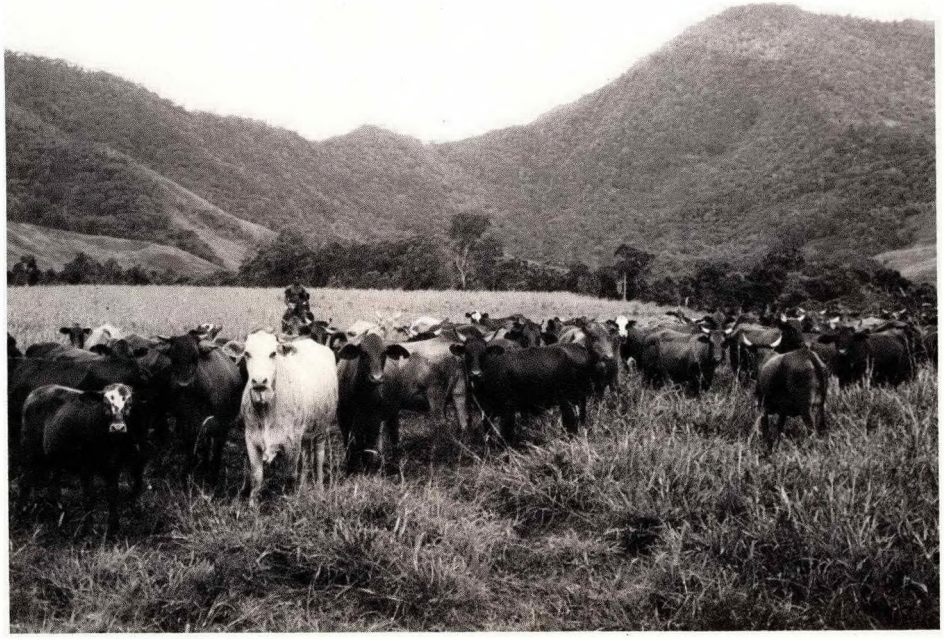
In 1961, for the first time, the Legislative Council had a non-official majority. But there were still only 12 indigenous members out of 37, and none of them was directly elected. In 1964, and again in 1968, there were elections for a new House of Assembly. One difference between it and most other parliaments was that nearly all the members owed election to their purely local standing as 'bigmen' (there are no chiefs in traditional Papua New Guinea societies, authority and influence being won by achievement, wealth and knowledge of religion and custom). The House rarely, if ever, divided on anything like party lines. In fact there was no political party at all until 1967, when a group of youngish, educated, mildly radical Papuans and New Guineans formed themselves into the Pangu Pati, standing for much faster preparation for self-government and independence. This was the first serious political organisation representing the indigenous people. But it only mustered ten members in the 1968 parliament of 94. By


MANUS ISLAND
ADMIRALTY ISLANDS
NEW HANOVER
NEW IRELAND
TERRITORY
BISMARCK SEA
OF
NEW BRITAIN
NEW GUINEA
SOLOMON ISLANDS
BOUGAINVILLE
AUSTRALIA
Djayapura
WEST IRIAN
Western Highlands
Southern Highlands
Eastern Highlands
Lae
Gulf of Papua
SOLOMON SEA
D'ENTRECASTEAUX ISLANDS
Port Moresby
MILNE BAY
TERRITORY OF PAPUA
LOUISIADE ARCHIPELAGO

the time the 1972 elections came around, in March, the Australian government had made it clear that self-government was there for the asking, and that the new House of Assembly was expected to ask for it. The two major Australian parties were agreed on that, differing only to a minor degree on the speed at which they thought it should happen.

Meanwhile, the level of political consciousness within New Guinea remained low, and campaigning for the 1972 elections once again concentrated heavily on local questions. But by then the pace of constitutional advance had emerged as the overriding political issue. In response to the formation of Pangu a number of other groups had come into being which could be roughly described as political parties. However, even after the elections it was impossible to know for sure how the new members would line up in the House. At one extreme was Pangu, now pressing for immediate self-government; here was the group that most closely resembled the typical African nationalist party of the last 20 years. But it only had 30-odd parliamentary seats out of 100. Ranged against it was the United Party, a looser and much less sophisticated grouping, mainly of Highlanders, which was anxious for a constitutional go-slow. It could claim more adherents than Pangu, but it relied quite heavily on its White settler members and most of these had been beaten at the polls. In between came a couple of smaller parties and a number of members who did not necessarily belong to a party at all.

It was an open question, then, when the new House met in April 1972, whether any government would emerge at all or whether it would be willing or able to work to a set timetable for constitutional change. But by intensive lobbying the leader of Pangu, Michael Somare, was able to put together a coalition supported by 60 of the 100 members. Appointed Chief Minister, he at once modified his party's demand for immediate self-government, indicating that a timetable of about 18 months was what he now had in view. The change was realistic enough, given the total inexperience of the new ministerial team; it also reflected the need to accommodate Pangu's more conservative partners in the coalition. Chief among these is the People's Progress Party, led by Mr Julius Chan, a businessman of part-Chinese, part-New Guinean extraction. Concerned about the danger of too rapid political change and the need for economic stability and a favourable climate for investment, he was able to insist on a high price for enrolling his party's 14 members in the coalition, including the four major economic portfolios.



Administration livestock station on the Baiyen river in the western highlands district

The period since April has been a honeymoon for the coalition. Mr Somare, an affable, 36-year-old former journalist, had the congenial job of accepting substantial doses of transferred power from the equally affable and even younger Andrew Peacock, Australia's Minister of External Territories at the time. The date for self-government has been agreed in principle, and since Australia has no objection to it, the opposition United Party has been left without an effective platform. After the Australian elections in December 1972, and the return of a Labour government under Mr Gough Whitlam, the ironic situation was even reached where it was Mr Whitlam who was pressing Mr Somare to accept that full independence must come not later than 1974, and Mr Somare who was voicing caution. Mr Whitlam has made it clear that the very last thing he wants is to exercise colonial responsibilities for a moment longer than he has to – to the point of refusing to rule out the possibility that Australia might unilaterally declare independence for Papua New Guinea if its leaders seemed to be moving too slowly. Remote though that kind of contingency may be, that it can be canvassed at all proves that to seek independence is to push at an open door so far as Canberra is concerned. Mr Somare has had an almost uniformly favourable press; Australian television audiences have responded well to his friendly personality and bland replies to tough questions. It is no disrespect to Mr Somare and his ministers to say that the honeymoon can hardly last. The underlying problems of Papua New Guinea are too serious to be smoothed away for ever by good public relations. As in all developing countries the leaders face dilemmas to which there are no immediate solutions.

In their first few months of office they have not had to commit themselves to a definite line on the most pressing issue. But an observer does not need to spend long in the territory to become aware how fluid the situation is and how rapidly the politicians may be forced to make their choices. When I was in Port Moresby, for example, two of the thornier problems found their way into public debate for the first time. One was the future of the agreement between Papua New Guinea and Bougainville Copper Pty. Ltd. which lays down the terms on which the company can operate its major new open-cast mine. Voices are being heard to say that the agreement is too favourable to the company and

Opposite General view of the Bougainville mine

Above Masthead of the territory's daily newspaper which is printed in Pidgin English, the *lingua franca*

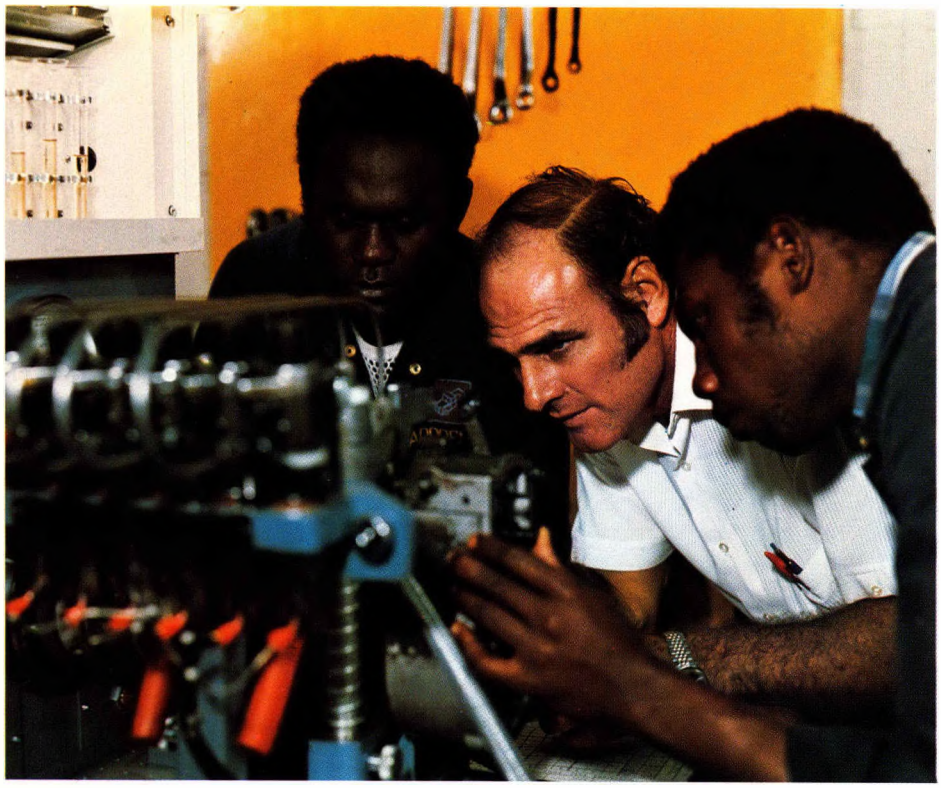
that an independent Papua New Guinea would have to renegotiate it. The other was what to do about the heavily expatriate-dominated civil service. No sooner had the chairman of the Public Service Board issued a white paper saying that the numbers of expatriate civil servants would not be reduced in the next few years than Mr Somare declared that he wanted to see them down from 7 500 to as few as 3 000 by 1975.

These are only the surface rumblings of a far-reaching debate that is now going on about strategies for economic development. Australian development policy has concentrated on increasing exports, encouraging subsistence farmers to enter the cash economy by producing tropical cash crops for which there is a world market (even if an uncertain and limited one), and providing the administrative framework and infrastructure needed for these purposes. If the test is growth in the modern sector, the policy has been highly successful. Gross monetary sector product (which excludes the value of subsistence output) grew at an average rate of over 15 per cent a year in money terms between 1966 and 1970, accelerating towards the end of the period under the massive stimulus of the A$400 million investment required to bring the Bougainville copper project on-stream.

Bougainville apart, the prime cause of these achievements has been Australian aid. Over the past ten years, Canberra has pumped very large and increasing sums of money into the place, and the level of financial aid last year – A$140 million of budget grant and Australian government expenditure – works out at well over A$50 for every man, woman and child in the population. It is claimed that this is the highest level of aid per head enjoyed by any underdeveloped country in the world. There may be room for dispute over how much of this is really 'aid'. What is clear is that it has not brought the country anywhere near financial self-sufficiency, and the question arises how long the Australians will be prepared to go on paying up to support a country for which they will no longer have direct responsibility. At present, the level of aid is fixed from year to year; the Papua New Guinea government would like a longer-term commitment. So far it has been unable to secure this, but there are signs that Australia's new Labour government may be more ready than its predecessor to consider a three-year undertaking.

A growing feeling that the government machine may simply be too expensive for the country to keep up after independence is one element in the thinking that led Mr Somare to propose his drastic plan to slash the civil service. Another motive is the desire to localise jobs, a natural aim for a colony approaching independence. But meanwhile, a more radical critique of past development strategy is beginning to find expression. It emphasises the extent to which 'growth' has benefited expatriates rather than the indigenous people and argues that a serious lack of balance, both between expatriates and indigenous and between different regions of the country, has been allowed to grow up because investment has concentrated too much on projects yielding the highest economic return. Critics who think along these lines want to see less regard for the interests of foreign investors and expatriates, more stress on local production (particularly of food, which is alleged to have been neglected in the interests of Australian producers of commodities like rice and sugar), and a generally more nationalist and socialist approach to development.

Such criticism received a major boost from a draft report, unpublished but extensively leaked, by a World Bank-United Nations Development Project team invited to suggest guidelines for the next five-year plan due to start this year. The team had some sharp things to say about former policies, and it made recommendations which were certainly radical in the Port Moresby context. One of them was that Papua New Guinea ought to think seriously about renegotiating the Bougainville copper agreement. This was a deal hammered out between the company, which is a subsidiary of the Conzinc Riotinto of Australia group, and the colonial administration, and ratified by the then House of Assembly in 1967. Very briefly it provides that the company should have a tax holiday for the first three years of production and that after writing off its capital expenditure it should start paying company tax at a rate starting at 25 per cent of income in the first year (the territory's normal rate), then rising in four years to 50 per cent and subsequently by degrees to 66 per cent. The company is not expected to pay tax before 1978, but this depends on the level of profits which in turn depend on unknowns such as the copper price. The Government has exercised an option to take up 20 per cent of the equity at par, on present evidence the best investment



Apprentice training at the Bougainville mine

it is ever likely to make. It also gets a royalty of $1\frac{1}{4}$ per cent of gross revenue, 5 per cent of which goes to the local landowners around the mine area near Panguna in Bougainville.

This is not the place to assess the merits of that agreement. Its opponents have attacked it on a variety of grounds, among them that the tax holiday is too generous, the Government's equity too low, or that the copper should be exported after smelting and refining instead of in concentrates. They are inclined to point to recent developments in other copper-exporting countries such as Chile, Zambia, Zaire and Peru, drawing the conclusion that Papua New Guinea gets less from Bougainville than those countries do from their mineral resources. The company might reply that Bougainville is a new mine financed largely with medium-term loan capital and that until the loans are paid off there is only a limited amount of net revenue to be divided between the Government and the shareholders. For that and other reasons, it might add, comparisons with other copper producing nations are not necessarily in order. In legal terms it could claim that the agreement was freely ratified by a previous House of Assembly. To which the reply might be that that House was a colonial rubber-stamp in no position to pass judgement on such a crucial matter, still less to bind its successors.

Whatever the merits of such arguments on both sides (and I have only mentioned a few of the most obvious ones), potential investors are possibly more interested in the nature and strength of the forces at work. They could do worse than begin by noting that the pressure against the agreement derives from two distinct sources: dissatisfaction on the island of Bougainville itself and the general hunch that Australia may not have struck as hard a bargain with the company as it could have done. Both play their part, but my impression is that the purely local pressure may be the more potent at the present time.

Many Bougainvilleans, especially among those directly affected, remain on the whole very unhappy about the new mine in their midst. Whatever its material benefits, in terms of cash compensation, employment opportunities, new markets for produce and general economic development, they see it as an intrusion on their way of life. Its social consequences have certainly been drastic. To mention only one, alcoholism is now a serious problem, whereas drink was previously unknown in these parts. The mine is also hard to reconcile with traditional attitudes to land. For Bougainvilleans, as for many others in Papua New Guinea, land is far more than a commodity. In fact, it is not a commodity at all, but a guarantee of livelihood and security, a status symbol, and a sacred abode of ancestors. In short, it is central to their whole world. Holding such beliefs about land, the people whose resettlement was required by the project were not to be easily persuaded that cash and other forms of compensation, at higher than market rates, were an acceptable substitute. Much more than the old lady whose home is threatened by a new highway, they deeply resented being compelled to move. They knew too, that their accustomed social life was in for massive disruption through the influx of Europeans, 'redskins', money and machinery. Nothing in their experience had prepared them to assess the trade-off between economic gain and social upheaval. Here, in its starkest form, was the confrontation between pre-industrial society and the implacable modern world – a clash which, as we shall see, has almost always produced bizarre results in Papua New Guinea. The lack of a common ground can be seen symbolically in the still unresolved dispute over compensation for virgin bush. The company's final offer of A$150 a hectare was met by the local community with a demand for A$2 500 per hectare *per year*. This was tantamount to saying 'not at any price'.

No doubt such conflicts are inevitable whenever large industries establish themselves in areas which have never known them before. But when they happen in a situation as fluid as that of Papua New Guinea today, they have political consequences. It is important that the two indigenous leaders who have spoken out against the agreement are both from Bougainville. Mr Paul Lapun, the Minister of Mines, has said that, after independence, Papua New Guinea will re-negotiate all its agreements with foreign investors, including that with Bougainville Copper. And Father John Momis, the influential young Catholic priest who is deputy-chairman of the constitutional planning committee, has urged forcefully that the Government should acquire at least 51 per cent of the mining company's share capital. Mr Lapun, at least, is primarily a champion of the Bougainville people. He is a member of Pangu, which stands above all for national unity, but has been associated with the Bougainville

secessionist movement. He embodies the pull of conflicting nationalisms. Father Momis, an intellectual, may well be influenced by a wider economic nationalism as well as by his Bougainville connections, but in his case, too, it might be misleading to discount the importance of the local factor. What has to be borne in mind is that these Bougainvilleans have staked their claim at a time when the whole constitutional future of the nation (including the place in it of a Bougainville with secessionist tendencies) is still in the melting pot. In the play of political forces that will determine both the constitutional future and policy towards foreign investment, the claims of Bougainville itself will exert an influence not necessarily smaller than that of theories about the proper relationship between Papua New Guinea and large mining companies. Mr Lapun will not have forgotten that he waged a long and ultimately successful battle against the Australian administration to have a portion of the nation's royalties allocated to his island – an achievement for which he won the honoured title of 'Mr Five Per Cent'.

When I asked Mr Somare whether the statements of the Mines Minister and Father Momis should be taken as Government policy, he stressed that the two had spoken in their capacity as members for Bougainville constituencies and that the issue had not come up before the Cabinet. He went on to say that Papua New Guinea needed foreign capital but wanted to be sure that any given investment would actually benefit the people. "We are communalists, not capitalists", he explained, "and we hope to get the best of both worlds". That useful phrase about keeping one's options open seems appropriate. The ambiguities involved were neatly illustrated in October 1972, when it was announced that the official opening of the Bougainville mine, scheduled for November 30, was to be cancelled. The cost of the ceremony would thus be saved, allowing A$100 000 to be donated towards famine relief for the 130 000 Highlanders who had just been afflicted by the unusual and horrible combination of drought and frost. It is not too cynical to conjecture that Mr Somare might have been embarrassed to fulfil the engagement he had accepted to open the mine, which could have implied endorsement of the terms under which it operates. The emotional force behind Bougainville separatism showed itself vividly in January, 1973, when Mr Somare visited the island. He met such hostility that there were fears for his safety, and at one point he had to make a rapid and unscheduled departure by helicopter. The reason had nothing to do with copper: it was that two civil servants from Bougainville who were stationed in the Highlands had just been murdered there when their car was involved in a fatal accident and they got out to render assistance.

Two final points need to be made about the Bougainville agreement and foreign investment generally. One is that the coalition government contains important elements – notably the Finance Minister, Mr Chan, and his People's Progress Party – who are sensitive to the susceptibilities of foreign investors and convinced of the country's need for private overseas capital. The coalition's ability to rule appears to depend on their support. The other is that if Papua New Guinea is to achieve financial independence in the sense of being able to balance its own budget at anything like the current level of public spending, or its foreign payments at the current normal level of imports, it may have to think hard about ensuring that further large mining and other natural resource projects are brought into production: Bougainville alone won't do the trick. And, in fact, such possibilities are in the cards provided that the Government maintains an appropriate climate. Kennecott, for example, has already spent something like A$15 million proving a copper orebody at Ok Tedi, in the remote mountains hundreds of kilometres up the Fly River near the West Irian border. Although no decision to go ahead has been taken, it is generally thought there is a viable mine provided the company judges that it can strike an acceptable bargain with the Government. In this case the social problems seem likely to be minimal, since the local population is very small and scattered. There are other promising copper deposits; large amounts of natural gas have been found in the Gulf of Papua; and Japanese investors are showing keen interest in the timber and fishing industries – both surprisingly undeveloped. So far as export prospects go, the establishment of major natural resource enterprises like these seems to offer the only hope of breaking out of the constraints imposed by oversupplied and volatile world markets for such tropical staples as coffee, copra and cocoa.

Of course, there are people in Papua New Guinea who are sceptical about the value of export-led development. They focus on the need for widespread, village-level improvement in living standards, and would place better subsistence higher on the list of priorities than growth in modern sector incomes. On social grounds there is much to be said for this point of view, which is likely to receive greater emphasis in the new economic strategy when it emerges. But if its proponents seek economic independence as well, their only alternative to large foreign investments is a painful cut in imports and public expenditure. They can argue that such spending benefits the few more than the many; but the fact remains that few countries have willingly accepted the austerity such a programme implies. It would take a crash gear-change to put the cash economy on a self-supporting basis at a much lower level of activity.

VITAL STATISTICS

POPULATION – indigenous	2 441 708
– non-indigenous	48 960
	2 490 668
INDIGENOUS EMPLOYMENT	
– monetary sector	321 630
– subsistence sector	1 094 489
TOTAL INDIGENOUS WORK FORCE	1 416 119
GROSS NATIONAL PRODUCT A$ MILLION	501,8
– of which subsistence income (estimated)	190,0
PUPILS AT SCHOOL (indigenous)	
– primary	208 420
– high school	17 737
EXPORTS A$ MILLION	71,065
– of which coconut products	20,965
coffee	20,181
cocoa	15,692
(N.B. Copper exports started early in 1972)	
IMPORTS A$ MILLION	214,161

Highlanders in festive garb

For better or for worse then, Papua New Guinea looks to be on the treadmill of growth, rising wants, industrialisation and urbanisation. It is committed to the search for a way out of the vicious circle of underdevelopment. Starting behind most other parts of the world, it can learn from their experience. It has at least one special advantage. The land-food-population equation is not yet as dire as it is throughout much of the poor world, a circumstance which gives rise to the concept of 'primitive affluence', much beloved of Melanesian experts. It has special problems too, many of which I have described. And one should never forget the sheer facts of underdevelopment: half the children not going to school at all, fewer than 20 per cent getting beyond primary level, about three-quarters of the people earning little or no cash.

The final impression left by the country is of the dauntingly complex problems that follow the confrontation between technologies and ways of life and thought that are utterly remote from each other. As it happens, Papua New Guinea can offer a startling illustration of the bizarre, tragi-comic way in which that clash works itself out. It is called cargo cult. This is the belief, widespread throughout the territory for a hundred years ever since the white man was first sighted, that large quantities of 'cargo' – European-type goods, weapons, ships and aeroplanes – have been consigned to Papua New Guinea by a divine shipper; that they are only failing to reach their destination because of interception by malignant influences; and that all will be well when the right ritual formula has been found that will compel benevolent deities and ancestors to see that the goods are safely delivered. Europeans normally laugh when they first hear about the cult, regarding it as the last word in grotesque primitive superstition. Later they shake their heads when told that the practice can involve destruction of crops and other necessities of life to shame the gods into doing their duty in the matter of cargo. But careful anthropological work has left no doubt that the cargo belief is a perfectly logical response to the arrival of the white man and his otherwise inexplicable cargo – perhaps, indeed, the only logical response, given the traditional economy and way of looking at the world.

In the traditional Melanesian situation the abundant environment provides the villager with all he needs in material terms. There is little or no need for specialisation, and the technology is easily learned and well adapted for a good subsistence. In this stable and relatively dependable world, the villager is able to adopt a comfortably materialist attitude to life. The environment has always been there, unchanging. It includes gods and ancestral spirits, who play a role in underwriting the operations of nature; but it is an automatic role in that they have no choice but to play it provided they are treated in the correct fashion. The arrival of the white man with new and patently useful goods has to be incorporated in this philosophy by assuming that he is another god or ancestor. The problem is to find the formula that will compel him to deliver the new goods in the required quantity. The story of almost a century of cargo belief in one particular area (Madang, on the northern coast of New Guinea) has been told by Professor Peter Lawrence in his *Road Belong Cargo;* it makes fascinating and pathetic reading. The first European in those parts was the brave and generous young Russian biologist, Baron Nikolai Miklouho-Maclay, who handed out goods and asked for nothing in return. He was clearly a god. Then he went away. Next came the Germans, who had the same goods but gave them out sparingly, if at all, and insisted on land and labour. They were evidently hostile ancestors. Hopes rose again with the arrival of the missionaries, whose teachings were carefully scrutinised for the light they threw on the cargo secret. In one version, Jesus-Kilibob (a local deity), who lived in Heaven (a suburb of Sydney, or a place above Sydney and connected to it by a ladder), was busily manufacturing cargo which he would soon consign safely to New Guinea. But finally it had to be admitted that the missionaries, too, had failed to expedite the cargo. And so it went on for generations, with the people frantically modifying their beliefs to take account of their experience with Europeans and the continued failure of the cargo to turn up, forced to veer between Christianity, paganism and strange mixtures of the two.

Cargo cult is still a reality, even if not quite so prevalent as it was. When I was in Bougainville I was told by missionaries that there had been a marked resurgence of it in the area of the mine since its establishment. 'Cargo thinking' is still pervasive. Its history is an extraordinary parable of what we call progress and development, as seen from the other side. It countains salutary and humbling lessons for over-enthusiastic apostles of modernisation. It also throws fresh light on the 'crisis of expectations': Papua New Guinea's new leaders, like others before them, are expected to deliver the goods.

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