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Documentation and Analysis of the Mineral Industry in North America, United Kingdom, and France

by

L.C. Noakes

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SUMMARY

The main purpose of the study tour was to seek ideas and techniques of use in the conduct and re-organisation of the Mineral Economics and Mining Engineering Sections of the Mineral Resources Branch. The visit therefore centred on current practise in Governmental organisations dealing with the documentation and assessment of the mineral industry and with advice and assistance to both Government and industry.

Governmental groups were visited in U.S.A., Canada, United Kingdom and France; although each contributed some useful ideas or processes, appropriate organisations in U.S.A. and Canada provided by far the most helpful information and ideas, largely because our own basic approach to the mineral industry follows that pursued in North America. Governmental groups in United Kingdom, currently in the process of major re-organisation, are following rather than leading in these matters and the French system, although fairly well developed, has a different structure suited to the intimate association existing between French Government and industry.

All countries have some continuing problems in obtaining adequate basic statistics of the mineral industry and changes in basic systems are difficult to bring about. All have trouble in documenting stocks, actual consumption and costs. In general, younger countries have some advantages in that their systems have been developed under somewhat newer philosophies and with some knowledge of the problems already apparent in older countries. Our own system compares well with others except for the apparent shortsightedness in gearing our integrated census to our own particular fiscal year instead of to the universal calendar year; overseas organisations concerned with the mineral industry heaved sighs of relief on confirmation that at least our documentation of the Australian mineral industry will remain basically on the calendar year.

Commodity studies remain the basis of the analysis of the mineral industry and the trend in U.S.A. and Canada in particular continues to emphasise specialization whereby most staff cover only one or two minerals, but study in greater depth with more time and opportunity for vital contact with the mineral industry itself. The commodity group in the U.S. Bureau of Mines at Headquarters in Washington, dealing with minerals on the domestic side, numbers 40, but these are supported with information gathered from a number of field centres, by a mineral index and a statistical staff of about 100, by an international commodity group of 25 and by a new division of Mineral Economics of about 20 staff, carrying out special studies.

The Mineral Resources Branch of the Department of Energy, Mines and Resources in Canada, with functions similar to those of the Mineral Resources Branch, B.M.R., has a staff of 80, about half of whom are professional; about 25 of these staff the commodity division supported by a mineral index, statistical staff, a new section of economics research (6-10) and by two staff on special projects. In addition, 5 professionals deal with problems of taxation and

legislation.

The commodity approach is of course basic and traditional; what is newer is the extension of depth of coverage and, particularly, considerably more sophisticated assessment and analysis of many facets of the mineral industry, including study of costs, carried out by special groups in U.S.A. in close liaison with commodity staff. These special groups are still experimenting in certain directions although they have already well established a need for their services. Of particular interest to us are the study of short and long term projections of mineral supply and demand in U.S.A. (import orientated in their case), studies of feasibility of marginal projects such as the exploitation of oil shale and the analysis of the effect of higher prices for metals like gold on the domestic and foreign mineral industry etc. On the Canadian side, the mineral economic study of one Province has lead to keen demand for similar studies by several Provincial governments.

Some of the concepts and techniques of these groups can readily be adapted to Australian environments and problems, particularly in fields such as mineral processing and there is little doubt that B.M.R. cannot adequately serve both Government and the burgeoning mineral industry until it has the staff and facilities to extend its studies in these directions.

Discussions with organisations in North America reveal a number of useful guidelines in shaping our organisation.

(1) There is universal agreement that both commodity and special studies require staff whose basic training is technical, e.g. Economic Geologist, Mining Engineer, Metallurgist, Chemical Engineer; formal study in economics is desirable but not basic. However, both American and Canadian organisations have added the support of pure economists to one special section.

(2) Staff need experience at least in their own field of the mineral industry as a basis for their studies and to ensure their effectiveness in liaison with industry; raw graduates are not employed in these groups.

(3) Continuing close liaison with the mineral industry in field, office and laboratory is essential; commodity groups overseas, like our own in B.M.R., work largely with a background of information provided by industry partly on a confidential basis.

(4) The groups need to work in a technical environment and to form part of a technical organisation, be it Bureau of Mines or Geological Survey; close contact with field geologists and mining engineers of other branches is very important. The larger the organisation, the more difficult this liaison becomes and

both Canadians and Americans were very conscious of a growing need for closer liaison within their branches.

Specific guidelines for re-organisation within the Mineral Resources Branch are formulated in the final section of the report.

INTRODUCTION

The writer completed a study tour of Governmental organisations closely concerned with mineral industries in North America, United Kingdom and France in six weeks toward the end of 1968; details of the itinerary are shown in Appendix 2. The main purpose of the tour was to study in broad terms the latest concepts and techniques used in documentation and analysis of mineral industries to establish some guidelines in completing re-organisation proposals for the Mineral Economics and Mining Engineering Sections of the Mineral Resources Branch; opportunities were taken to visit some organisations concerned with geosciences and mineral resources offshore, but these matters will be covered in another Record.

The principal organisations visited were the Bureau of Mines and the United States Geological Survey in U.S.A., the Department of Energy, Mines, and Resources in Canada, the Institute of Geosciences in the United Kingdom, and the B.R.G.M. in France; these visits were necessarily brief, but the generous co-operation afforded by all hosts made it possible for the writer to study the current organisation in broad terms and to examine in more detail those sections carrying out the functions of our Mineral Resources Branch. Time did not permit any detailed study of specific techniques or projects, but concepts, purposes and the interplay of techniques and expertese were sought in each organisation. Collation and synthesis of the information gleaned has, of course, revealed deficiencies but these do not confuse the guidelines which the study tour has emphasised.

The organisations are not dealt with in the order in which they were visited; the organisations in the United Kingdom and France are mentioned in early chapters because they warrant less emphasis than do organisations in North America, where concepts and development much more akin to our own have produced the type of organisation likely to guide Australian planning.

Acknowledgements are commonly relegated to the end of a Report, but the generous co-operation of my many hosts overseas demands prominent mention; so much was accomplished so quickly as a direct result of faultless planning and whole-hearted co-operation. Among many hosts the following should be specifically mentioned:

U.S. Bureau of Mines	-	Denver	Mr. O.M. Bishop
		Washington	Dr. Vogely
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UNITED KINGDOM

Major re-organisation of earth sciences has taken place in the United Kingdom since 1965 with the inauguration of the Natural Environment Research Council in that year, following recommendations by the Brundrett Committee. In this re-organisation, the N.E.R.C. became responsible for geology, geophysics, oceanography, the Nature Conservancy, hydrology, forestry, etc; each of these fields has been provided with an advisory committee to establish policy and make recommendations.

This re-organisation particularly affected geological groups, in that erstwhile independent bodies - the Geological Survey of Great Britain and the Overseas Geological Survey - were combined to form the Institute of Geological Sciences to which Sir James Stubblefield F.R.S. (then the Director of the Geological Survey) was appointed Director in June, 1965. Dr. S.H. Shaw, formerly Director of the Overseas Geological Surveys, became Chief Geologist, Overseas and Mineral Surveys, and some details of the organisation of the institute are given in the accompanying chart. Dr. K. Durham became Director after the retirement of Dr. Stubblefield, about the end of 1966 and widespread changes in direction and organisation have stemmed largely from Dr. Durham's knowledge and insight.

The re-organisation has vitally affected both role and operation of the erstwhile Geological Survey in particular by emphasising economic geology and mineral intelligence within the United Kingdom itself. These changes have been rightly hailed as major steps forward which have already noticeably increased the tempo and vitality of the survey, but the new organisation is beset with difficulties in this transition period, stemming from lack of professional experience in

the economic role and from deficiencies in organisation and infrastructure in coping with new commitments.

The new look has particularly affected statistics and mineral economics which played no part in the work of the old geological survey and was directed toward the British Commonwealth and foreign countries, rather than toward the United Kingdom by the erstwhile Overseas Geological Surveys. In fact, a mining year book or mineral review has been unknown in the United Kingdom since 1880 and the collection of mineral statistics has continued to be a difficult and unrewarding exercise because they have been fragmented to appear amongst the statistics of three separate organisations - the Board of Trade, the Ministry of Power and the Department of Customs and Excise.

The role of the new Institute of Geological Sciences includes collation of mineral statistics, the publication of an annual volume dealing with mining and minerals and mineral intelligence for the United Kingdom. However, these plans are still in a stage of development and consequently, United Kingdom organisations are following rather than leading in matters concerning the documentation and assessment of their mineral industry.

In the new Institute, mineral statistics and documentation will be carried out by the Mineral Resources Division which for the most part, is the old Mineral Resources Division of the Overseas Geological Surveys; although the personnel remain much the same, the primary role is changed, as has been noted, and will principally be concerned with the United Kingdom.

This new division is divided into three groups - Mineral Intelligence, Mineral Assessment and Mineral Statistics; staff from equivalent sections of the old O.G.S. form the first and third of the groups, but Mineral Assessment is a new concept. Mineral Intelligence (strictly mineral economics in our sense) with a staff of ten, including three female indexers, should be sufficient in numbers to provide a broad but not detailed or sophisticated coverage of mineral economics, now concerned with the United Kingdom, rather than with foreign countries; this group continues to be supported by a most useful mineral index taken over from the O.G.S., but occupying the time of three out of the staff of ten. On the other hand, the Mineral Statistics group with a present staff of five, of which four positions are currently filled, appears much under-staffed for its proposed commitments; problems lie not only in the lack of staff, but in the need to revise and re-organise statistical coverage of the mineral industry to extend the coverage and to provide figures on uniform and meaningful bases.

It should be noted that in the past, a major function of the Mineral Intelligence Section of the O.G.S. has been the preparation of world reviews of particular commodities, e.g. "Bauxite", "Cobalt", "Sillimmanite", while a monograph on "Wollastonite" and an important study of "Phosphate" are in the press at the present time.

Likewise, a major function of the Statistical Section was the preparation of the annual review "Statistical Summary of the Mineral Industry", a widely used collation of world production, exports and imports on a calendar year basis for the preceding 6 years. With the new commitments for these sections, these compilations seem likely to be discontinued if the sections are to carry out the new commitments without significant increase in staff. The Statistical Summary is of particular value and it is hoped that this compilation at least can be continued.

The work of the Division, indeed that of other groups in the Institute, is assisted and guided by an interdepartmental Mineral Consultative Committee on which the Institute, the Statistical Office, Treasury, Board of Trade, Ministry of Power, etc. are represented; arrangements are being made for mineral statistics to be channelled to the Institute from the present collectors - trade figures from the Board of Trade, imports, exports and re-exports from Customs, production from Ministry of Power - but definitions and bases differ and gaps occur particularly in consumption figures.

It is interesting to learn that the Statistical Office, although carrying out little of the actual collection, is a powerful organisation which trains statistical officers for collecting departments and must be consulted in plans by departments to extend or improve statistical collections. At present, departments collecting mineral statistics do so under their own Acts, approved by the Statistical Office, on a basis of official forms distributed to the mineral industry each calendar year. Most mineral statistics are therefore on a calendar year annual census and carry much the same rules as regards confidentiality as our own Commonwealth Act. The Board of Trade collects some salient figures from industry and Government mainly for the purpose of compiling indexes of production, etc., but the statistics collected under this Act are strictly confidential and are not available to other Government departments. In addition, some collecting departments carry out a more comprehensive census every five years, including information on purchases and sales, but it normally takes years for them to collate the results.

It is realised that this fragmentation of mineral statistics does not provide any clear picture of the mineral industry, hence the aim of the Minerals Consultative Committee to rectify the situation by channelling statistics to one group within the Institute for the compilation of a mineral year book and ancillary documentations. However, the Mineral Statistics group within the Institute are well aware that present collections must be revised and extended to provide a meaningful coverage and that their staff needs to be increased to cope with the new commitments. Initial attempts to revise and extend collections have apparently found another hurdle in that the Board of Trade plans a major re-organisation of statistics in five years' time and is loath to review mineral statistics in isolation before this planned review of statistics over a wide field.

Another minor hurdle involves legal considerations in that, in theory, the staff of the new Institute are no longer bona fide public servants and thus have no legal access to the statistics collected under the present Acts of Parliament; the Institute is now the equivalent of a statutory authority in our terms and hence some revision of the Acts is presumably necessary to allow the Institute access to the statistics collected. It is also interesting to learn that quite a number of the professional staff of the Institute are averse to this change of status from public servant to members of a statutory authority; they apparently feel that the public servant has a somewhat higher and more permanent status and presumably the change has no advantageous affect on salaries.

The mineral index which has been maintained by the Mineral Intelligence group for many years, is straightforward, but very effective and indeed the mineral industry index proposed for the Mineral Resources Branch, B.M.R., is largely based on that maintained in the Institute of Geological Sciences. This index covers subject only, and main subdivisions follow mineral categories; the 5" by 3" cards within each category are subdivided, as importance requires, under headings such as country, uses, mining, prices, etc. Headings are also included for reviews of general geology which are of use to officers compiling reports on mineral resources. This comparatively simple type of index does not lend itself to quick sorting or any type of mechanical analysis, but is well suited to the important day to day work of the group in that it provides quick answers or ready access to information required.

The Mineral Assessment group, presently staffed by five professional officers, introduces a new role to the erstwhile Mineral Resources Division of the O.G.S.; this is the actual assessment of mineral resources and reserves within the United Kingdom. The Mineral Resources Branch, B.M.R., does of course compile and on occasions checks reserves and resources, but the difference between the work of the two groups lies in the fact that the Mineral Assessment group in the United Kingdom supervises contract drilling aimed at exploring reserves and may complete the calculations and assessment themselves.

The group are presently concentrating on reserves and resources of construction materials - principally sand and gravel - with the twofold purpose of indicating useful supplies to industry and insuring that development is planned with full knowledge of resources which might otherwise be built on and virtually lost.

This emphasis on assessment of mineral resources extends to most other sections of the Institute, but it is obvious that the modus operandi is still being worked out. One major change within the Institute is that field geologists mapping one mile sheets, for example, are required to devote special attention to any mineral resources and to compile and assess reserves. Present emphasis in this regard falls on the 107 Sheet areas currently being mapped or remapped out of a total of 500 one-mile Sheet areas

covering the United Kingdom, but is appears obvious that many field geologists with little or no training on the economic side will need assistance from officers of the Overseas and Mineral Surveys group or from the Geochemical division if the scheme is to work effectively; no doubt suitable arrangements and liaisons will eventuate.

With present emphasis on sand and gravel, the Mineral Assessment Group employ three drills on contract on areas whose priority depends on requirements for industry or planning and to some extent, on the amount of detailed geological knowledge available. Treatment of samples - mainly sizing - is also carried out by contracting laboratories, but final analysis and calculation of reserves is done by the Mineral Assessment group.

In summary, the bold re-organisation of surveys in the United Kingdom to form the Institute of Geological Sciences already promises, at least under present leadership, a vital and resources-orientated organisation, although considerable difficulties have yet to be overcome in the transition period.

Proposals to re-organise mineral statistics and to provide an annual mineral review and associated services in mineral economics is a courageous advance which is likely to face more serious difficulties than other aspects of the re-organisation. In the circumstances, it is understandable that the Mineral Resources Division of the Institute is currently following rather than leading in documentation and assessment of the mineral industry and that, apart from their practical mineral index, there is little in present practices of the Division which is of interest in our own re-organisation, although no doubt the future will provide interesting developments.

FRANCE

Three working days were spent in Paris (4th-6th November, 1968) principally with the Bureau de Recherches Geologiques et Minieres (BRGM) including an interview with officers of the Ministry of Industry. The documentation and analysis of the mineral industry in France involves principally the BRGM, the Ministry of Industry and the National Institute of Statistics; the role of these organisations in these matters is briefly described below.

B.R.G.M.

Although following much the same basic philosophy as ourselves in regard to mineral search and development, the French pattern which encourages more intimate relationships with private enterprise than does our own, is reflected in the role and organisation of the BRGM and in the organisation of statistics and analysis of the mining industry. The BRGM, as a Government agency,

has two main roles, one referring to commitments in continental France and the other to commitments in overseas countries, including French territories or ex-territories.

The role in France is basically that of a national geological survey and includes the collection and collation of geoscientific data, some of which is collected by BRGM under statute. (e.g. sub-surface data from mines or bore holes, deeper than 10 metres, is by law collected by BRGM). The organisation is committed to geoscientific surveys and research in continental France and to the search for and assessment of mineral resources, apart from petroleum, coal and radio active minerals which are the responsibility of other agencies.

However, the organization is not directly linked with French Government mineral policy, which stems largely from the Ministry of Industry, although that Ministry may call on BRGM for information and advice; in this respect, BRGM has a status similar to that of a statutory authority in the Australian sense, but differences lie in the channelling of some statutory information to BRGM and in their relationship with private enterprise. In addition to collecting and analysing data on mineral resources and potential in France, BRGM has the right to prospect or to join other organisations, including private enterprise, in exploration and in so doing must apply to the Provincial Mines Department in the ordinary way for appropriate tenure.

The second role of BRGM refers to overseas commitments which may take a number of forms in co-operation with the Ministry of Industry, Ministry of Co-operation or the Ministry of External Affairs. The basic role is still the carrying out of geoscientific surveys and exploration for mineral resources, but this may take the form of aid, contracts with French territories or ex-territories or foreign countries, or exploration - indeed exploitation - initiated by BRGM or in conjunction with French or foreign companies or with foreign Governments.

It is interesting to note that both in France and overseas, BRGM can initiate exploration and can form exploration groups in foreign countries (e.g. Serem in Australia) with or without partners, but with the approval of the Ministry of Industry. However, the policy in regard to exploitation seems more restricted; BRGM can participate in exploitation, with the approval of the Ministry of Industry who authorises the funds, but normally as a minor partner with perhaps 5-10% equity. BRGM's equity and control is usually major in the stage of exploration but are not intended to be so in exploitation, where the burden is meant to fall on private enterprise or on some foreign Government concern.

To date, BRGM has only restricted interests in exploitation in the form of equity in some syndicates in France and North Africa and it is intended that additional minor equities may eventuate from current exploration programmes. However, as one of the express aims of this policy is to channel mineral supplies to France, the French contribution to mineral development overseas could well be guided in specific cases by the attitude of the Ministry of Industry to the mineral supplies in question.

The BRGM totals about 2,000 officers of which about half are professional; of the total staff, about 50% of both professional and others are permanent and the other 50% are on contracts of one sort or another. The annual budget is currently about 90 million francs (about $A16.3 million) provided mainly by the Ministry of Industry, but including funds for foreign aid and co-operation provided by the Ministries of Co-operation and Foreign Affairs. Any income from mining ventures accruing to BRGM may not be retained by the organisation, but is passed back to the Ministry or the Treasury. BRGM occupies a multi-storey building in Paris which houses headquarters and many senior officers, but many sections of the organisation and associated laboratories are based in a complex of new buildings at Orleans about 40 miles south of Paris.

The organisation of BRGM includes two major branches. One deals with the various fields of geoscience - geology, geophysics, hydrology, gitology, etc. - and includes regional geological groups in France; the work of this branch embraces commitments both in continental France and overseas. The second branch deals with mining and mineral studies including mineral economics and mineral intelligence and is directed more toward foreign commitments with small groups of about 2 men each assigned to world regions - France, Africa, the Americas and Asia and Oceania.

Groups within BRGM with interests similar to those of the Mineral Resources Branch are included in the second branch devoted to mining and mineral studies. The section of major interest is attached to the headquarters of this branch and is termed "Mineral Studies"; the chief is M. Bedouret, who has a staff of 5 engineer-geologists, but with access to a computer and a programmer. Staff are all experienced "engineers" in the French sense and most seem to have a background of mining rather than of geology. According to Bedouret, the section is under-staffed, but could cope with their commitments if enlarged to a total of 8. The section has the support of the excellent index scheme which has been a feature of BRGM for many years and, in this respect, is very well served. This index to the literature of geoscience in many categories has now been computerised so that it can cope with future expansion; but it is interesting to note that, after analysis, no attempt has been made to computerise the index of past literature which would have taken 60 man years to complete. It should be noted that the French also have come to the conclusion that data and bibliography are incompatible in terms of computer systems; they

have computerised their index first and now are tackling a computer system for the search and retrival of scientific data.

The work and role of the Mineral Studies section differ from those of our own. The 6 professional officers in the BRGM section apportion the major metals and minerals between them and become specialists in that sense, but the section is not committed to consistent and regular documentation and analysis of the mineral industry in France or overseas. Their programme is essentially "ad hoc" in the sense that documentation and analysis are restricted to those minerals included in the current programme of BRGM or in their forward planning; the workload on the section is thus much restricted and appropriate for a staff of about 8.

The work includes feasibility studies arising from prospects of interest to BRGM or from contract commitments and the section is this concerned with cost data for which the responsibility is shared. Cost data are subdivided into mining costs, treatment costs, land transport, rail transport, shipping, etc. and apportioned to officers who keep themselves up to date in their sector by a combination of literature search and field inspections. Thus feasibility studies become something of a team effort.

Studies carried out by this group are rarely published as they constitute internal advice from BRGM or may be part of contract services to a BRGM client. This mineral study section apparently works closely with both branches of BRGM and benefits from the data collected by both; it uses official figures on the French mineral industry compiled by the Ministry of Industry and the National Institute of Statistics.

One interesting feature of current BRGM organization is the use of special officers entitled "Promoteurs"; these are very experienced officers, seconded as it were from their normal duties to spend perhaps a year on a roving commission with, in theory, no other commitments than to seek new programmes, approaches or techniques in a specific field. I do not know how many Promoteurs are currently appointed but the concept could of course apply to a number of fields. The one I spoke with dealt with economic geology and was concentrating on possible areas or projects overseas which BRGM might profitably investigate. The concept is good and provided the officer is sufficiently experienced in his field, official recognition of the position as part of the organization's programme provides the conditions most likely to lead to results; the officer has all the necessary liaison with colleagues and laboratories of the BRGM, visits other institutes and can seek approval for field visits in France or overseas to collect additional data or to clarify his ideas.

MINISTRY OF INDUSTRY

The Ministry of Industry is a normal Government department staffed by civil servants and dealing with many aspects of industry in France. On the mining side it seems to have two main branches, one concentrating on iron and steel, etc. and the other, of more interest for our present purpose, dealing with energy; this branch has 3 main subdivisions dealing with gas and electricity, coal and general mining. The last named division, called the Directorate of Mines, carries many of the functions common to Mines Departments throughout the world. Thus, one section staffs and controls the 12 provincial Mines Departments which monitor and service the mineral industry of France; other sections deal with coal, technology in the mining industry and with non-ferrous metals and other raw materials. The last named section is divided into the following sub-sections:

Geology, Mining Research and Co-operation

Non-ferrous and other minerals

Raw materials for construction

The first of these sub-sections provides the link between Government and BRGM. These three sub-sections carry a staff of only 5 or 6 each, of which half are experienced engineers and half clerical or sub-professional officers, and appear to be mainly concerned with the administration of the industry and with policy matters.

The Ministry convenes a General Commission of Mines as a high level advisory body on which Directors of Mines in the provinces and other senior officers are represented. The Ministry has close contact with industry and works through the Federated Chambers of Minerals and Metals.

The collection of basic statistics for the mineral industry in France is carried out under statute and principally under the authority of two Government agencies, the Ministry of Industry and the National Institute of Statistics and Economic Studies; however, the Federation of Chambers of Mines is apparently consulted in these matters and assists in the collection. Forms dealing with production, consumption, labour force, etc., provide an annual calendar census and record of imports and exports are provided by the Customs who compile them monthly and publish the data at two-monthly intervals.

The responsibility for collation of all statistics principally lies with the National Institute of Statistics, who also carry out many compilations and analyses of industrial and other statistics including those dealing with the mining industry. Calendar year statistics for the industry appear in a monthly publication called "Annales des Mines", usually in the September issue in the year following the census; this appears to be the

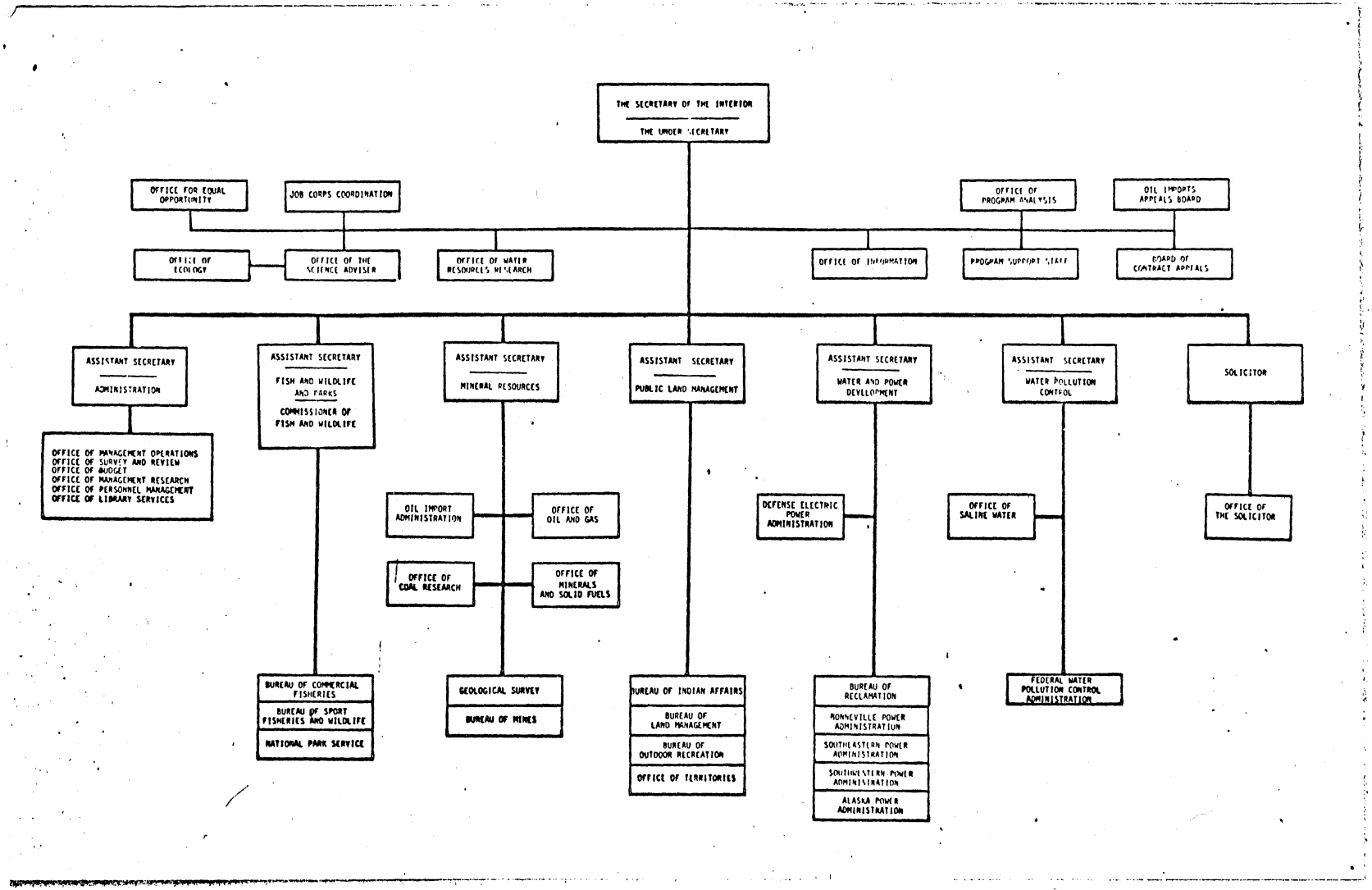
equivalent of our Mineral Industry Review, but is much less comprehensive. "Annales des Mines" is controlled by a commission of 32 very prominent men in the mining industry, representing many Government and private organizations and some universities and appears to be another example of the close knit combination of Government and private enterprise in France. A copy of this publication with a review for 1965 and copies of various forms with the collection of mining statistics are held by the writer. No detailed analysis of these forms has been attempted; the coverage appears orthodox and probably suffers from the usual deficiencies in regard to stocks which are mentioned rarely in the forms.

In summary, the French system of documentation and analysis of the mineral industry appears to offer nothing outstanding for our purpose and indeed seems more involved than our own. The complex pattern of orthodox Government departments and authorities which are to some degree in competition with private enterprise, tends to inhibit communications within the mineral industry; although the policy makers no doubt have access to comprehensive data if they call for it, it does not appear to be channelled to them automatically and the system does not produce the flow of impartial analysis and advice to Government and industry in general which our system is geared to provide.

The French comprehensive index of geoscience literature is of course excellent and computerisation should ensure continued efficiency as literature grows although waiting time for information is likely to increase. The concept of promoteurs is well worth keeping in mind and the emphasis placed on the collation of up-to-date costs in the mineral industry by the Mineral Study Group points sadly to one of our deficiencies.

UNITED STATES OF AMERICA

Documentation and analysis of the mineral industry in the United States of America is principally carried out in the Bureau of Mines, although some aspects are also covered by the United States Geological Survey. These are both very large organisations with a staff of 4,800 in the Bureau of Mines and about 12,000 in U.S.G.S., and only those parts of the organisations pertinent to the writer's investigation are featured in this report.


THE SECRETARY OF THE INTERIOR
THE UNDER SECRETARY
OFFICE FOR EQUAL OPPORTUNITY
JOB CORPS COORDINATION
OFFICE OF PROGRAM ANALYSIS
OIL IMPORTS APPEALS BOARD
OFFICE OF ECOLOGY
OFFICE OF THE SCIENCE ADVISER
OFFICE OF WATER RESOURCES RESEARCH
OFFICE OF INFORMATION
PROGRAM SUPPORT STAFF
BOARD OF CONTRACT APPEALS
ASSISTANT SECRETARY
ADMINISTRATION
OFFICE OF MANAGEMENT OPERATIONS
OFFICE OF SURVEY AND REVIEW
OFFICE OF BUDGET
OFFICE OF MANAGEMENT RESEARCH
OFFICE OF PERSONNEL MANAGEMENT
OFFICE OF LIBRARY SERVICES
ASSISTANT SECRETARY
FISH AND WILDLIFE AND PARKS
COMMISSIONER OF FISH AND WILDLIFE
BUREAU OF COMMERCIAL FISHERIES
BUREAU OF SPORT FISHERIES AND WILDLIFE
NATIONAL PARK SERVICE
ASSISTANT SECRETARY
MINERAL RESOURCES
OIL IMPORT ADMINISTRATION
OFFICE OF OIL AND GAS
OFFICE OF COAL RESEARCH
OFFICE OF MINERALS AND SOLID FUELS
GEOLOGICAL SURVEY
BUREAU OF MINES
ASSISTANT SECRETARY
PUBLIC LAND MANAGEMENT
BUREAU OF INDIAN AFFAIRS
BUREAU OF LAND MANAGEMENT
BUREAU OF OUTDOOR RECREATION
OFFICE OF TERRITORIES
ASSISTANT SECRETARY
WATER AND POWER DEVELOPMENT
DEFENSE ELECTRIC POWER ADMINISTRATION
BUREAU OF RECLAMATION
BONNEVILLE POWER ADMINISTRATION
SOUTHEASTERN POWER ADMINISTRATION
SOUTHWESTERN POWER ADMINISTRATION
ALASKA POWER ADMINISTRATION
ASSISTANT SECRETARY
WATER POLLUTION CONTROL
OFFICE OF SALINE WATER
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOLICITOR
OFFICE OF THE SOLICITOR

As a general background, both organisations belong to the U.S. Department of Interior, a mammoth Department headed by a Secretary and an Under-Secretary and with six major branches each headed by an Assistant Secretary; a broad organisation chart for the Department is shown in Figure 3. The branch monitoring the mineral industry is called Mineral Resources and consists of the U.S.G.S. and the Bureau of Mines as sister organisations plus four offices as follows:

Office of Oil Import Administration

Office of Oil and Gas

Office of Coal Research

Office of Minerals and Solid Fuels

As is well known by this time, the Australian Bureau of Mineral Resources, although assuming principally the roles of the U.S.G.S. as a national survey, includes some of the functions of the Bureau of Mines particularly in the Mineral Resources Branch; this report is therefore more concerned with the organisation and the techniques of the Bureau of Mines than those of the U.S.G.S.

BUREAU OF MINES

The broad organisation of the Bureau of Mines, divided into six major branches which are headed by Assistant Directors, is shown in Figure 4. Two branches of the Bureau of interest to B.M.R. are entitled Mineral Resources, Evaluation (formerly called "Development") and Mineral Research, the former dealing with documentation and analysis of the mineral industry and the latter mounting research in many aspects of mineral development; our Mineral Resources Branch covers documentation and analysis of the mineral industry but the branch has only minor commitments in research associated with the petroleum technology laboratory and with occasional research programmes arranged with outside organisations like AMDL and consequently enquiry at the Bureau of Mines was concentrated in the Mineral Resources Evaluation Branch.

Mineral Resources Evaluation is headquartered in Washington where most of the final collation of both statistics and analysis is carried out but also has offices in eight other centres throughout the U.S.A. and six of these have one or more "Field Offices" at mining centres. The largest of these regional centres is Denver where, in the Federal Centre, both the Bureau of Mines and U.S.G.S. have practiced decentralization. The Denver centre of the Bureau of Mines has four Field Offices additional to staff at Denver which deals with statistics and aspects of mineral analysis. Sections of the Mineral Research Branch and of other branches are located at Denver, and the total staff must exceed 1,000. The Western Administrative office of the Bureau of Mines at Denver provides administrative services for all activities west of the Mississippi River.

The Mineral Resources Evaluation Branch in Denver covers statistics, mining intelligence of the region and includes cost analysis and process evaluation groups which are part of Mineral Resources Evaluation headquartered in Washington.

Mineral Statistics

The statistical centre at Denver is one of eight area offices feeding data back to Washington and this centre provided the writer with information on the system of collecting mineral statistics in the U.S.A.

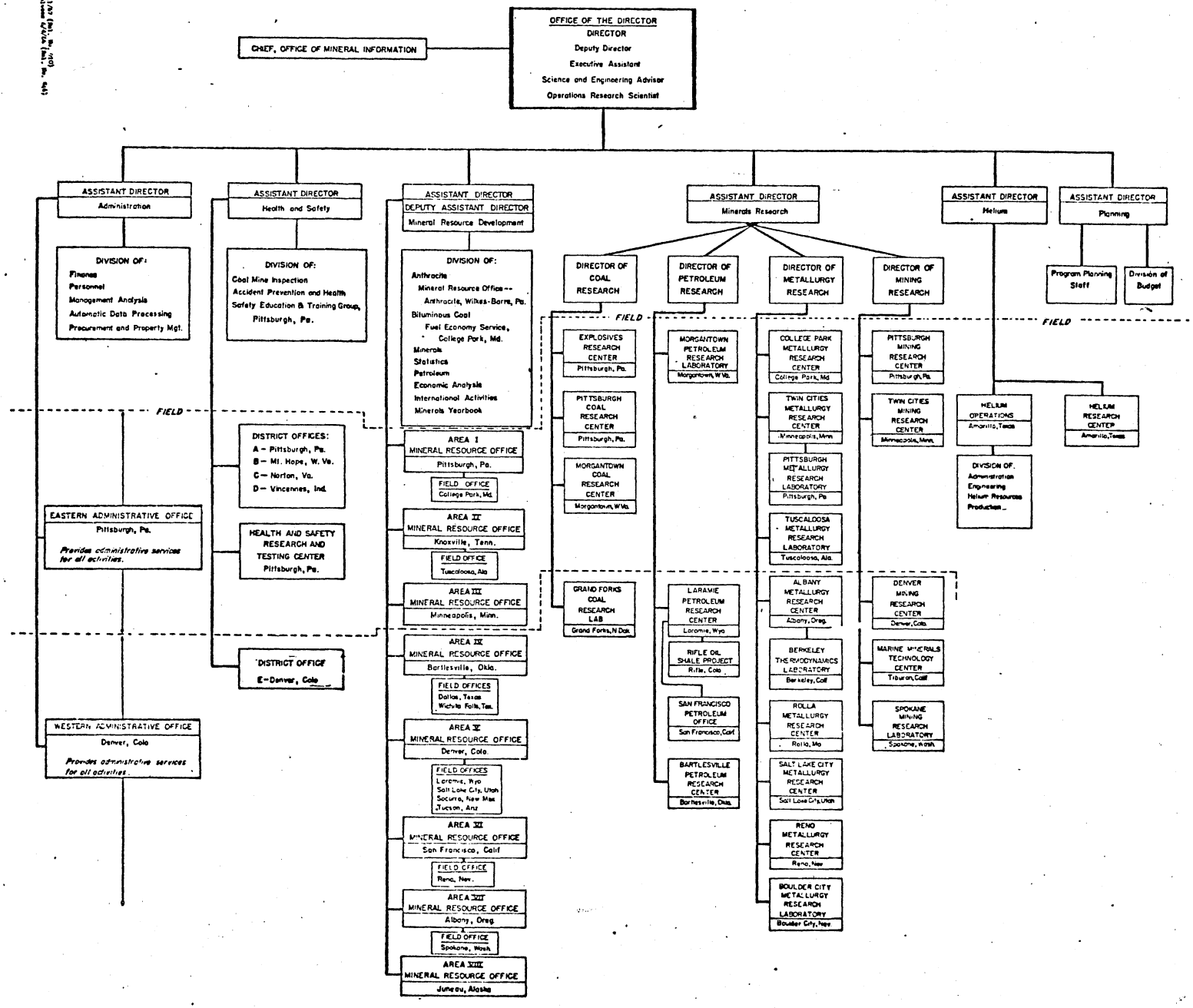
The pattern is complex and note-worthy because the Federal Government has no constitutional powers to collect statistics - presumably an example of shortcomings inherent in relatively old constitutions which have not been rectified in the light of modern requirements. However, some at least of the States have constitutional powers to collect mineral statistics so that the Federal system of collection has become a complex combination of voluntary contributions from industry and statutory collections by some States.

In practice the Bureau of Mines has based the Federal collection more on good-will than on State statutory powers and have designed sets of forms to induce uniform collection; the system has been worked out by bi-lateral agreements with many of the States to accommodate different conditions between States in regard to statutory powers, strength, efficiency and functions of geological surveys and Mines Departments and the importance or complexity of the local mineral industry. Agreements with States apparently fall into one of four principal types ranging from those in which the Bureau of Mines carries out the complete collection with no assistance from State powers to those with strong States where local organisations carry out the collection, with agreement on the forms used, and pass the data back to the Bureau of Mines.

These collections, collated in the regional centres of the Bureau of Mines, cover mineral production and a wide range of mining statistics, including some stocks, but consumption data is collected separately from the Washington office. Final collections are passed to the Bureau of the Budget and to the Bureau of Census for integration in national collections.

Copies of some of the forms used in collections are available but no analysis of these has yet been carried out. Confidentiality requirements are virtually set by the companies and strictly adhered to; they are much the same as our own in that totals are not normally published where less than three companies are involved or where two companies out of three make up 90% or more of the total figure.

ORGANIZATION CHART OF THE BUREAU OF MINES



Uranium statistics are collected by the Atomic Energy Commission and passed to the Bureau of Mines, Washington and fuels, including oil and gas, are normally collected by the States and similarly passed to Washington. Apparently the oil and gas companies play a major role, through their Associations, in the collecting of both statistics of the industry and petroleum reserves. This pattern works well both in U.S.A. and Canada because a number of companies are involved in each significant oil or gas field so that mis-calculations, in error or with purpose, are almost certain to be detected.

The remainder of the mineral commodities, some 60 to 70, are collected by a combination of States and Bureau of Mines as previously described, although the timing of collections is not the same for all mineral commodities. Nearly all of them feature in the calendar year census; about 25 commodities are reported on a monthly basis and less than 15 feature on quarterly or half-yearly collections. However, collections more frequent than annual feature production and not values, which are collected only in the annual census; estimates of value of production during the year are made by multiplying production by average monthly price.

Consumption statistics are collected from industry by the Bureau of Mines, Washington, on a voluntary system and with strict confidentiality requirements; few details were gathered on this collection which appears to be mainly annual but, as with us, consumption statistics and stocks present more difficulties than do production figures.

In general, questionnaires reach industry towards the end of the calendar year and statistics become available to Bureau offices in April or May with values about mid-year. These are the basis for the Year Book produced by the Bureau of Mines, previously in four volumes, and reduced to three covers in the 1966 edition. Titles of volumes are: 1. Metals and Minerals 2. Mineral Fuels 3. Area Reports - Domestic 4. Area Reports - International. In the new procedure, volumes 1 and 2 are combined under one cover.

The role played by regional centres like Denver in the Year Book is the collation of production figures for the region and the compilation of chapters for volume three dealing with the performance of the mining industry of the region. The commodity chapters in volumes 1 and 2 of the Year Book are written by commodity specialists in Washington with the assistance of some data supplied by regional centres. Chapters on the mining industry in the Denver region, for example, are sent to Washington at intervals of about two weeks beginning in May each year; they are edited in Washington and appear as pre-prints about three months after despatch. Pre-prints are available from about September onwards each year, but the three volumes of the Year Book are not normally available until about eighteen months after the end of the calendar year concerned. The system of pre-printing

regional and commodity chapters is therefore essential for the earlier release of information; much the same system is followed by Canada and is gradually being introduced in our own organisation.

However, apart from the comprehensive coverage by the Year Book, the U.S.A. system includes preliminary calendar year statistics for the mineral industry which are released by the Secretary of the Department of the Interior in early January each year, covering the calendar year just completed. These preliminary figures present the broad picture and are collected from industry on a volunteer basis by requests to companies and States returnable to Washington in November, so that preliminary figures can be issued on 2nd January. Summary sheets covering mineral commodities are issued also early in the year. Much the same system is used in Canada with a difference later discussed; the application of this idea to the Australian system would require a new approach to both States and industry but the possibility will receive consideration.

In terms of numbers the Statistical Group of Mineral Resources Evaluation probably approaches 200 out of a total staff of 750. The Statistical Group in Denver totals 21 statistical clerks and statistical assistants and the Statistical Division in Washington totals 100. The Washington division is run by very experienced statistical officers under Mr Abe Rothman; the main tasks of classifying and compiling mineral statistics is done by computer, and coding is designed to provide many collations by establishments, companies, States, countries, etc., and in relation to production, consumption, employment, etc.; however, details of these statistical methods and compilations lay beyond the field of present enquiry.

Analysis of the Mineral Industry

Mineral statistics and information on the performance of the mineral industry (mineral intelligence) provide the basic data for the Mineral Resources Evaluation Branch; another major function of the Branch is analysis, costing, and evaluation, mainly carried out in Washington, and these provide the most exciting developments from our point of view. The collection of statistics and of other basic data is, of course, by no means static as improved collections and more flexible computer analysis are continually sought, but more sophisticated analysis and evaluation are the most noteable trends in this Branch of the Bureau of Mines at the present time.

Indeed, it is noteable and encouraging to find re-organization, experimentation, and re-thinking so apparent in an old-established organization. On the other hand, such an environment is somewhat confusing for the visitor and it is apparent that the process of re-organization is not complete; the propensity of the American to experiment, but with willingness to change again and cut the losses if need be, has been shown in many fields and calls for the cautious approach of matching concepts and processes with results.

In these cases of new approaches to evaluation and analysis, some deficiencies in the system seem apparent, as will be noted in due course, but some results have already been produced; we can profit not by slavishly following procedures so much as adopting concepts and procedures to our own problems and environment.

The Assistant Director leading the Mineral Resources Evaluation Branch is Dr Vogely, from whom stems much of the insight and initiative evident in the Branch to-day - although his lieutenants Mr Zinner (Planning) and Dr Brooks (Mineral Economics) ably support and extend their chief's ideas. Dr Vogely is very impressive in many ways - a deformed man with virtually no legs but with the keenest of brains and with the courage and tenacity to over-ride the difficulties of his afflictions. He says the main functions of the Bureau of Mines is first the collection of basic information on the mineral industry and its analysis to delineate trends and problems for the guidance of both Government policy and industry and secondly, to tackle mining problems by research to guide and keep ahead of the mineral industry particularly in aspects of national importance. For information on research aspects of the Bureau of Mines, the reader is referred to Mr R.W.L. King's report on his visit to U.S.A. in 1968 (Records 1968/99).

The Washington establishment of Mineral Resources Evaluation is somewhat changed in grouping from that given in Figure 2 ; divisions relevant to this enquiry are entitled:

Division	Staff
Statistics	100
Mineral Study (Commodity Group)	40
Mineral Economics	20
International Activities	25
	185

These are assisted by other groups in area offices particularly at Denver where Process Evaluation and Cost Analysis groups will be referred to later. Some of the most interesting overall analysis is carried out by ad hoc team work rather than in any one section so that it seems logical to briefly describe the work of each group or division and lead up to the combination of their skills. The writer's comments and impressions and a synthesis of ideas of importance to B.M.R. are grouped in concluding sections.

Mineral Study

This division, numbering 40 professional officers with some supporting clerical assistance was a traditional commodity group providing specialist cover for about 80 mineral commodities for advice to both Government and industry and for the compilation of commodity chapters in the Year Book. However, recent re-organisation has brought a new look to the division, although the exercise is not complete and seems partly experimental. The division is still divided into four main groups on a commodity basis but in each group staff have been equally divided into two categories covering mineral intelligence and analysis. Details are as follows:

	Mineral Intelligence	Analysis	Total
Energy (coal, uranium, oil and gas)	8	8	16
Ferrous Metals	4	4	8
Non-Ferrous Metals	4	4	8
Non Metals and others	4	4	8
			40

Staff on mineral intelligence carry out the traditional functions of the commodity specialist in collecting data through liaison with the mineral industry; the analysts, although participating in the compilation of chapters and other records have a wider and less defined role in that they are responsible for delineating problem areas, analysing trends and carrying out projections for guidance of both Government and industry. The submission of work programmes for the Bureau of Mines, either in evaluation or in scientific research, may also result from their work.

In this concept, there is a hint of the French "prometeur", mentioned in the chapter on France, in that the analyst begins with the basic data and is free to apply his experience and ideas in dissecting problems and discerning trends.

No doubt this experiment is aimed at producing more searching results in commodity chapters and other records by ensuring that both efficient fact-finding and expert analysis are directed at all mineral commodities. It may be said that work in mineral intelligence and that of analysis calls for somewhat different training and approach and that some staff will achieve better results in one type of work than in the other; on the other hand a progression, resulting from experience, from mineral intelligence to analysis is not denied.

Current problems of this division will be referred to later but a management problem is obvious at present in that, rightly or wrongly, the re-organisation carries more than a hint of sorting sheep from goats; some of the staff obviously have this conviction but it is too early to look for results and, in any case, the situation is still fluid.

The important thing to recognise is that commodity work requires both expert collection and analysis and that the Bureau of Mines have sought re-organisation of the commodity group because commodity men may or may not have sufficient training, aptitude or interest to carry out both functions with full efficiency. Hence, the attempt to marry both skills and direct them at each mineral commodity alike; at least in theory this should provide more uniformly efficient coverage than does the system in which one man is responsible for all aspects of a mineral commodity.

International Activities

As the title suggests, this division provides mineral intelligence abroad and consists of 20 officers. Many if not most of these have served abroad as mineral attaches or in similar roles in the United States diplomatic or trade corps, and maintain contacts with countries of which they have some first-hand knowledge. The staff are divided into groups covering world regions although not all staff attached to a region would necessarily have field knowledge to assist them.

The grouping of this division is therefore based on geography not on commodities, and apparently the experiment to allocate staff to mineral intelligence or to analysis has not been extended to this group. The impression is that the main role of the group is mineral intelligence rather than analysis; the main channels of information are official publications from foreign countries, technical journals, newspapers, personal contacts and intelligence gathered by staff of United States delegations abroad. Mineral intelligence of foreign countries is, of course, of prime importance to a principally importing nation like the U.S.A., and the analysis of foreign mineral supplies features prominently in the Strategic Plan mentioned later.

Mineral Economics

This division has been re-named and re-organised but grew out of the division of "Economic Analysis", listed in Figure 2 and started in the early 1950's. Again, the role and procedures are largely experimental and the emphasis is on the application of economics to the performance and problems of the mineral industry.

The division is experimental on two counts. First, whereas other divisions are staffed by professionals with principally a technical background (mining, chemical or metallurgical engineers or economic geologists), this group of 25 includes 15 pure economists; the other 10 members are engineers or geologists with specific training in or bent for economics. This combination is admittedly experimental but considerable store is placed on the leavening of technical officers in the Division.

In the second place, the interests of the group extend beyond the traditional field of the primary mineral industry into aspects of secondary industry related to mineral trade which are normally the perogative of departments such as Trade. For example, the group have completed in-put and out-put studies for 48 mineral commodities, tracing the commodities from source to end-uses and analysing the part they play in the structure and performance of U.S. industry; in these and some other studies the basic statistics are supplied by the five-year census compiled by the Bureau of the Census for 1958, 1963 and 1967.

They have also attempted to analyse the results of some research programmes dealing with the mineral industry and for example, have reached the conclusion that research on the up-grading or beneficiation of manganese ores has not been productive and should be discontinued. They have also assisted in determining the value, and hence the potential, of oil shale projects.

The Division of Mineral Economics is informally divided into four working research areas. These work areas and some examples of the type of projects handled are as follows:

(i) Environmental Economics

- impact of surface coal mine regulation on employment and out-put
- multiple land use concepts and the mineral industry
- impact of Bureau programmes on employment and income

(ii) Industry and Regional Studies

- supply and demand for petroleum and natural gas liquids in the United States by States and regions 1960/65
- survey of the rare earth metals industry
- energy forecast model

(iii) Benefit-Cost Analysis

- valuation of mineral resources
- cost-benefit analysis of:
  - (i) oil shale industry
  - (ii) sodium chemicals
  - (iii) adverse effects of underground mining
- the petroleum industry expenditure statistics
- manual on measuring the benefits of Bureau research

(iv) Quantative Economics

- quantative economic analysis and long-run projections of the demand for steel
- a study of the long-run demand for phosphorus, potassium and nitrogen
- the process analysis of the coal, copper, oil and uranium mining industry of 1967.
- the inter-industry structure of the U.S. mining industry 1963 and 1967
- a quantative analysis of the demand for aluminium
- the production/function of by-product gold in the U.S.
- the comparison of 1958 and 1963 production, technology and current in-puts used in the U.S. oil and gas industry
- an economic analysis of the world's iron ore flows

In addition to these projects, arrangements can be made to farm special projects out to specialists either in industry or in the academic field; the following are examples of projects handled in this way during 1968:

- impact of changing technology on the coal mining of Southern Appalachia
- case studies of the impact of a shift from high to low sulphur coal
- planning for non-renewable mineral resources in urban suburban areas
- impact of mineral industry commodity and income flows on the U.S. balance of payment
- exploration as an economic process

Again there is a hint of the "promoteur" concept from France. The division is not tied to a definite programme; it is encouraged to look for those tasks and problems which appear amenable to their skills, and in this way help to define problems for other divisions of the Bureau of Mines or, as in the case of manganese research, to monitor and guide the work of other groups.

The reaction of other Departments, dealing with trade and secondary industries to this apparent "poaching" is of course, a matter of some interest, although the comments gathered on this occasion were one-sided only. Apparently the Mineral Economics Division maintains liaison with appropriate departments dealing with secondary industries and reports no serious problems in this regard; this could well stem from the fact that only part of the work of the division really transgresses the traditional limits of primary industry, that it is rather new and experimental, and that the results provided by a new combination of skills as yet leaves little room for criticism on the grounds of duplication or validity.

Although such a group can hardly be envisaged in our organisation in the near future, the results of this approach in the United States are well worth watching; they could provide us with a useful blueprint for the future and their approach at least emphasises the need for closer liaison with the Department of Trade and Industry than we have sought up to the present.

Cost Analysis Group

Although working as part of Mineral Resources Evaluation, this group functions in Denver and is mainly concerned with costs and the evaluation of mining and treatment projects, particularly those likely to be of national importance but of doubtful viability. Recent projects investigated have included gold mining and the production of petroleum from oil shale. Originally the staff of this group were mainly chemical engineers concentrating on processes but growth in recent years has enlarged and widened the range to include mining and other types of engineers.

The basic procedure in evaluating projects or ideas is to gather costs, produce flow sheets and arrive at the total cost of production; analysis of the project in terms of cost-benefit analyses, etc., follows; an alternative approach which is favoured by some American companies introduces variables in some of the critical factors in the project, from alternative mining methods or processes to cash flows, leading to a range of final results from profitable to unprofitable to be correlated with the variables assumed in the exercises. For these sophisticated exercises, the data originally on computer cards is transferred to tape and the analysis done by the computer complex at Denver which serves both the Bureau of Mines and the U.S.G.S.

The importance of collecting and estimating costs in the mining industry was emphasised by several groups within the Bureau of Mines as basic to much of their analytical work. The procedure in the collection of costs is much the same in U.S.A., Canada and France; some costs are obtained from mining companies, usually on a confidential basis, but companies are universally and understandably reluctant to release cost data. Engineers use their experience and initiative to estimate costs by keeping up-to-date with literature, by visiting mines where some of the critical factors such as type of machinery and labour force can be ascertained, by calling on manufacturers of machinery and by drawing on their mining experience to complete the exercise.

The group visited in the Bureau of Mines now require cost data for their own investigations rather than to satisfy requests from private enterprise or from other Governmental groups (as happens in the B.M.R.). Consequently, the cost analysis group does not feature a central cost card index, but seems to work with individual indices and files; but they would like an index, and now talk of a computer-based index in which costs could be readily up-graded.

Resources Inventory

Another group in Denver has been involved from time to time in establishing and up-dating resources inventories in which total reserves of selected metals are compiled in relation to assumed cut-off grades etc. Inventories for lead, zinc and copper were completed and published up to 1955, and have been to some degree up-dated since although apparently not published.

This work is done with various degrees of co-operation from mining companies; some provide the relevant data and others invite Bureau engineers to their mines and offices and make data available from which calculations or estimates can be made. Some of the data is made available on a confidential basis, of course, but this is little hinderance in compiling a publishable total inventory. Such an inventory is essential in the analysis of the potential of a nation's mining industry, and the data have been used by other groups in analysing and forecasting; the complete range of minerals included in inventory work was not established but is probably small in keeping with the very limited range of minerals in which domestic production in U.S.A. is really significant.

Bureau of Mines - Strategic Plan

The concept and execution of what the Bureau of Mines calls the strategic plan merits special attention and probably constitutes the most interesting and thought-provoking facet of mineral analysis found overseas. Strategic Planning is headed by Mr Paul Zinner, Assistant Director (Planning), who works closely with Dr Vogely and with the various groups in Mineral Resources Evaluation, but, in fact, has a staff of only four or five directly

attached to him. The strategic plan is a prime example of teamwork; Zinner's basic staff provide the continuity for the work and liaison with the many officers from other groups who are called upon to contribute their special skills or knowledge to completing, up-dating, or revising strategic plan documents.

The strategic plan seeks a means of identifying probable and possible changes in mineral supply-demand relationships which might have some significant impact on the economy and the wellbeing of the United States. The basic objective is to foresee and define events that threaten an adequate, dependable, timely and efficient flow of those materials which are essential to support national goals and to meet growing and changing industrial and social needs. The essential products form a pattern of guide-lines that suggest where efforts might be effectively applied to minimise the impact of such threats.

Strategic planning of this kind is not intended to produce a master plan to provide unchanging guidance; on the contrary, it is regarded as a dynamic process in which the plans and programmes are continually revised and up-dated to respond to anticipated changes in future situations. It would be hazardous to commit a significant amount of effort or resources to specify courses of action for very long periods, if such commitments did not yield promptly to accommodate changing circumstances. Great advantages can accrue from a procedure that provides sufficient lead-time for flexibility and immediate response to contingent possibilities. The procedures making up the plan do not readily provide a system of periodic publications, because the plan has no terminal point; however as long as the procedures are appropriately followed the plan does provide a new rationale for policy formation and programme planning. Moreover, it provides a continuing means of more clearly defining the really significant issues which demand decisions and the important problems which deserve solution.

A copy of the documentation making up the current strategic plan was generously provided by the Bureau of Mines on a restricted basis and copies are available in the Mineral Resources Branch. The strategic plan for the United States of America is, of course, orientated towards problems of world supply on which the nation is largely dependent; a strategic plan for Australia along similar basic lines would, of course, be export orientated, but the basic concepts are largely independent of the direction of outlook.

The basic documentations for the plan are called Commodity Statements, and have been completed for 81 mineral commodities. They are not comprehensive papers covering all aspects of a commodity but rather summaries tailored to the requirements of the strategic plan. Each statement summarises relevant data under the following headings:

Summary
Background
Operating Reserves
Industrial Patterns
Consumption Patterns
By-products and Co-products
Economic Factors
Technology
Outlook

Details of the types of material compiled in each of these sections need not be given here, but in general each section is brief and to the point and includes only those data directly bearing on the current and future situation. The outlook section is divided into:

Future demand	Time-price relationships
Future supply	Possible advances in technology,
Domestric supply	and Consequences

The summary presents a synthesis of the whole investigation.

These statements are not published because they are regarded as progress data for regular revision and not as ends in themselves. To provide some classification of reliability, the apparent reliability of data in each section of each statement is assessed to guide subsequent work on the plan, and it is interesting to note that at present between a third and a half of the commodities in the United States' statements lack adequate supply data; over half of them are deficient in demand data and 80% have deficiencies in information on reserves.

Forecasts up to the year 2000 are attempted in the statements, although the difficulties and lack of reliability in these exercises are well recognised. However, emphasis is placed on yearly revisions and the danger of using earlier and out-dated projections. An econometric model was not used in forecasting demand for the mineral commodities to as great an extent as it was used in energy projections. Forecasting demand for some 30% of the commodities has been based on end-use patterns; forecasts of most of the remainder have been based on other economic indicators such as GNP and population.

Due to data deficiencies in areas of data-environment, compatability, cost-price relationships, consumer industry uses and resources availability, the econometric models designed to forecast future commodity needs are presently unable to use significant commodity end-use relationships, consider the socio-economic impact of the resources, the supply potential or the susceptability of alternative resources. Demand forecasts based on population and economic indicators can be misleading if demand is not related to specific end-use of commodities.

Once the commodity statements have been compiled or revised the next procedure in the strategic plan is to analyse the date of the statements and to delineate areas where national problems lie or are likely to arise. This analysis has therefore the following purposes:

(i) to delineate merging issues

(ii) to delineate those problems that are critical to the national interest

(iii) to establish the impact of critical problems, degrees of urgency and critical time frames

(iv) to define alternative courses of action to resolve issues or to approach problems

(v) to set forth options and rationalise preferred courses of action

(vi) to maintain the products of these analyses in the form of a self-perpetuating strategic plan from which programme plans and appropriate advice may be drawn at appropriate intervals

The first step in this analysis is to digest the data provided by the statements and trace each mineral commodity through an idealised flow from discovery to ultimate disposal. This functional sequence is divided into nine sectors as follows:

(1) exploration

(2) resource definition

(3) reserve delineation

(4) development for exploitation

(5) extraction

(6) processing

(7) using

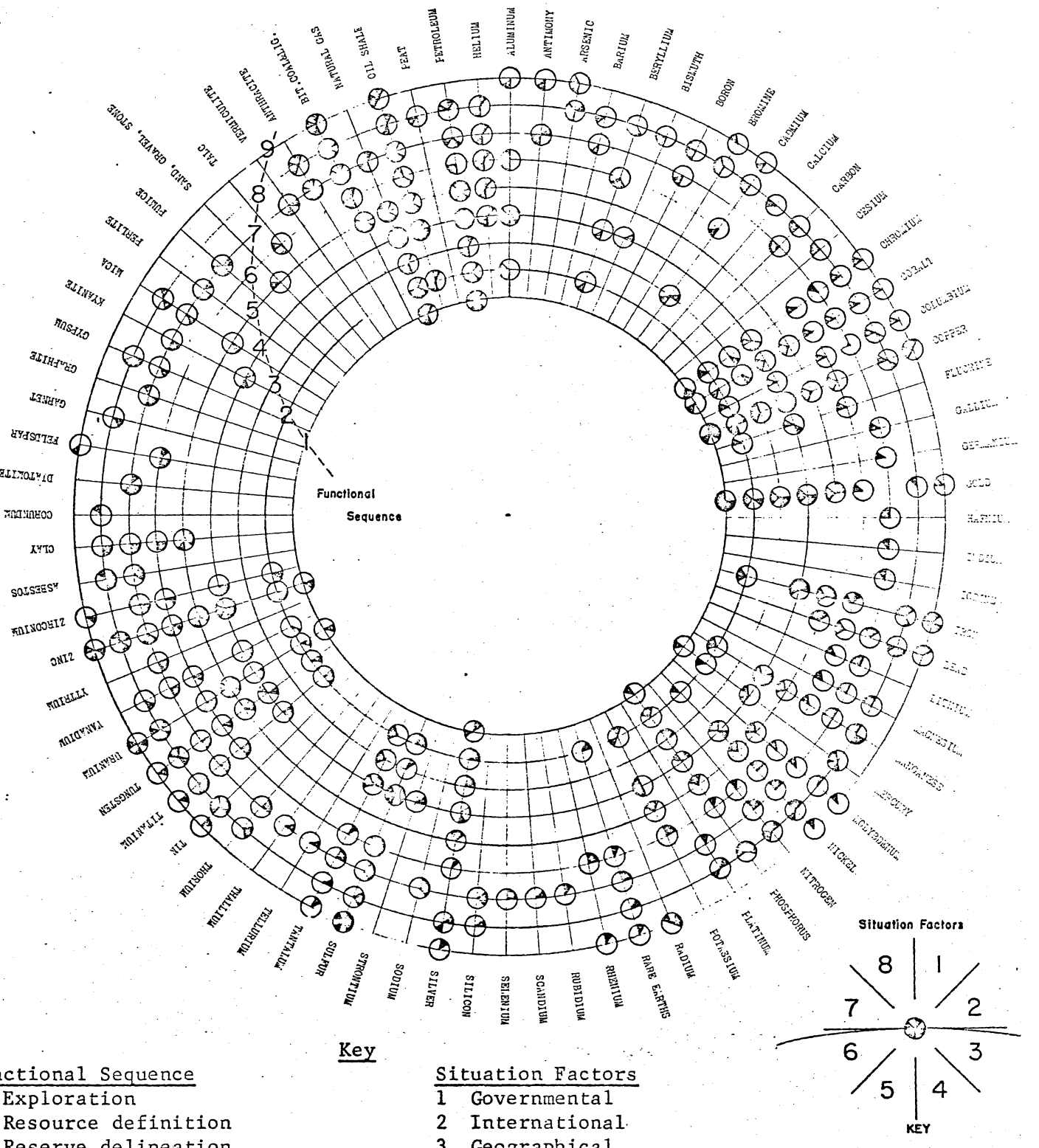
(8) extending uses

(9) re-using and disposal

The purpose of this first analysis is to identify those sectors of the sequence in which problems lie; to maintain objectivity of this exercise, the sectors and criteria of problems are strictly defined. The association of 81 mineral commodities with these nine sequences provides a minimum of 729 inter-reactions and those in which

Fig.

Figure 2--Second Examination. Situation Factors at Interactions in the Functional Sequence.



Key

Functional Sequence

1 Exploration
2 Resource definition
3 Reserve delineation
4 Development for exploitation
5 Extraction
6 Processing
7 Using
8 Extending uses
9 Reusing and disposal

Situation Factors

1 Governmental
2 International
3 Geographical
4 Physical
5 Technological
6 Source and Use Patterns
7 Environmental
8 Capital

problems lie are identified and marked on a chart. In a second analysis, key reactions obtained from the first analysis are weighed against a series of factors that define the nature of the problem or of the area in which it occurs. These factors are:

(1) Governmental

(2) International

(3) Geographical

(4) Physical

(5) Technological

(6) Source and Use Patterns

(7) Environmental

(8) Capital

Again, precise definitions are essential for objectivity and each interaction is noted with some detail.

The resultant distribution of problems is then shown diagrammatically on a circular chart (Figure 5) in which each mineral commodity is represented by a radial line transecting nine concentric circles; each circle represents one item of the functional sequence and problem areas delineated in the first analysis are indicated by a small circle on the point of intersection of the mineral line with the appropriate circle; further definition of the problem is shown by dividing the small circles into eight quadrants representing the eight situation factors of the second analysis and marking in black the quadrant involved.

The third analysis seeks to resolve these problem areas by introducing nine question categories which consolidate or group the problems or uncertainties indicated. The categories used in the U.S. plan are:

(a) the competitive position of domestic sources

(b) reliability of essential overseas supplies

(c) future end-use patterns

(d) technologic advances which may ultimately minimise the reliance on indigenous resources

(e) the degree to which demand for primary materials may be minimised by more effective use or re-use

(f) latent potential

(g) resource conflicts

(h) manpower capabilities

For example in the 1968 results of the strategic plan, 379 of all problems identified fell under the first three categories listed above and indicated that presently developed U.S. resources will find it increasingly difficult to compete commercially with newly developed, higher grade, lower cost and relatively abundant foreign sources. The technologic advances that have so effectively permitted high productivity, co-incident with a decreasing tenor of source material in the recent past, demand further augmentation and face a much greater challenge in the immediate future.

Following the delineation of problems, the analysis seeks alternative action to rectify or ameliorate problems under general headings of:

Maintaining	Extending
Ensuring	Implimenting
Accommodating	Resolving
Creating	Promoting

Following these procedures, the plan identifies national problems, seeks alternative action and crystallises the type of action to be suggested to Government or industry or both.

These concepts of a strategic plan and indeed the pattern of procedures are certainly applicable to the Australian scene, although categories and definitions will need change and adaptation to suit our export orientated mineral economy. The full relation of such a plan must of course await additional staff within the Mineral Economics and Mining Engineering sections, but the possibility of experimenting with such a plan but involving only a few critical minerals with the present staff is under consideration.

COMMODITY STUDIES IN THE U.S.G.S.

A feature of the U.S. system is that mineral commodities are studied both by the U.S.G.S. and the Bureau of Mines. Admittedly the emphasis is somewhat different in each case, but none-the-less dichotomy is apparent. About 42 geologists in the U.S.G.S. are listed as specialists on mineral commodities, 19 headquartered at Washington, 19 at Denver, and the remainder at Menlo Park Beltsville and Spokane. In theory, the U.S.G.S. commodity geologists concentrate on the geology of mineral occurrences and on ultimate resources, whereas the engineers of the Bureau of Mines concentrate on the economics of known deposits and reserves in the shorter term; however, the visitor becomes well aware of overlapping and the need for better liaison between the two organisations in this regard. This lack of liaison is largely the function of the size of the organisations and the distribution of specialists at different centres from Washington to Denver; but even at the same centre liaison appears infrequent. This matter is taken up in a later section, but at this stage it should be emphasised that B.M.R. officers interested

in mineral commodities must arrange to see the appropriate specialist from both the Bureau of Mines and the U.S.G.S. in seeking maximum information on the commodity concerned. A list of commodity geologists in the U.S.G.S. and their location in 1968 is provided in Appendix 1.

ADVICE TO GOVERNMENT

As far as the U.S.G.S. and the Bureau of Mines are concerned, the procedures followed in advising the Government on matters affecting the mineral industry in the U.S.A. seem much the same as our own. There are no policy groups as such in either organisation, and requests for information, advice, or comment are passed down from the Secretary of the Interior to the branch appropriate to the subject, and the Assistant Director passes to the appropriate sections or groups for action; the answers follow the same sequence in reverse. The Government uses a number of bodies and institutions outside normal Departments for comment and advice so that, for political or other reasons, the policies approved may or may not have the support of the Bureau of Mines.

Basic information for advice to Government is a combination of public or released data and confidential information gleaned mainly from mining or industrial concerns and principally from personal contacts; such information is zealously guarded, as it is with us, and the information itself is not passed upwards where there appears danger of it falling into unreliable political hands. Obviously analysis projects like the strategic plan form the basis of much advice and comment from the Bureau of Mines.

COMMENTS AND IMPRESSIONS

One would expect any organisation as large as the Bureau of Mines (4,800 staff) to present, at any one time, a fairly wide range of quality and endeavour, reflecting current leadership and personnel. Some differences in energy and performance seem apparent, but the overall impression is of a noteably high general level of competence and energy in the divisions visited.

The emphasis on analysis is striking, particularly in Washington, and is reflected in the growth of groups dealing with cost analysis, evaluation and strategic planning. In most groups, the need for regular and close liaison with industry is stressed and, as a corollary, the staff involved have a technical background and sufficient experience to win confidence in industry and to carry out effective mineral intelligence. The only group diverging from this pattern is the Division of Mineral Economics where more than half the staff are economists and where direct contact with industry seems minimal. However, this division is looking outward from the field of primary mineral industry and Paul Zinner, Assistant Director (Planning), referred to it as experimental and intimated that, in the experience of the Bureau, pure economists on their own have not been effective because of lack of technical

background. Another point made by many groups was the importance of the technical environment for the growth and functioning of groups dealing with facets of the mineral industry; each functions better in the technical atmosphere apart from the intra and inter-disciplinary liaison required by the work.

One would expect to find problems and some difficulties in any organisation and particularly in a very large one; some of these difficulties are worth noting here in no sense of criticism but because they provide lessons for growing organisations like the Bureau of Mineral Resources.

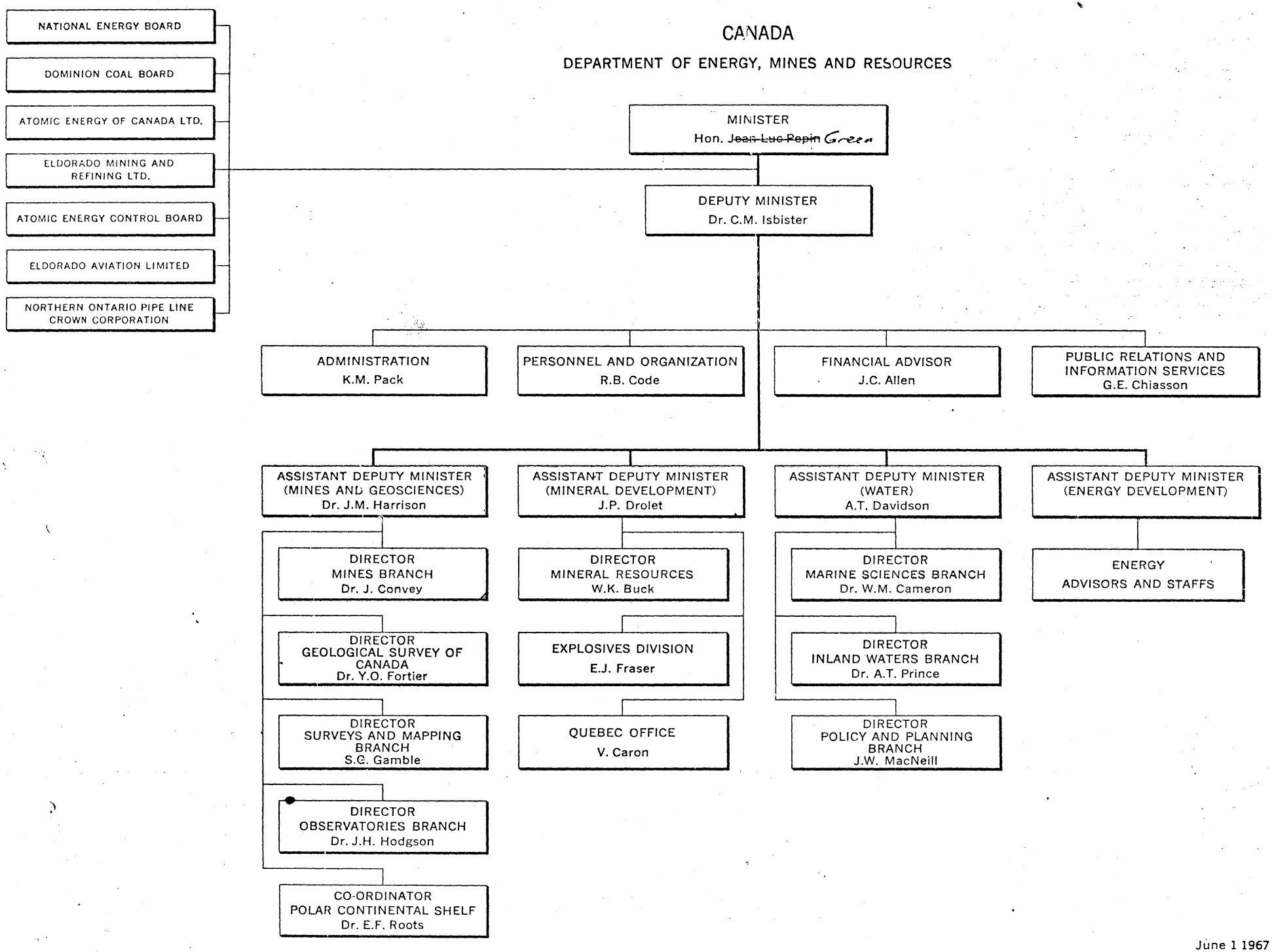
The first of these concerns the obvious need for closer liaison between staff of each group within the Bureau of Mines and particularly between personnel working in the same field in the Bureau of Mines and the U.S.G.S. Many of the seniors in both organisations talked about the problems of fragmentation of endeavour and indeed about whether the division of tasks between the two organisations is logical, although there are no ready or clear-cut answers to these problems. Obviously, size and physical separation present major difficulties in this regard, but staff of both organisations are well aware of these difficulties, and one is left wondering whether specific efforts to forge and maintain close liaison would not pay off handsomely. The point has already been made that enquiries on mineral commodities must track down commodity staff in both the Bureau of Mines and the U.S.G.S. to cover the field.

In a few places individual efforts are made to increase liaison; for example, one commodity man in Washington has a regular lunch with colleagues involved in his field - but in this instance, liaison was directed towards other Departments like Trade, rather than to technical colleagues.

The changing scene in Mineral Resources Evaluation in Washington presents samples of management difficulties. The division of commodity work into analysis and mineral intelligence has obviously brought some heartburn; the situation is still fluid and, no doubt, some better arrangements will eventuate. Another management problem lies in communications, in that the new look and purpose stemming from Dr Vogely is obviously not properly understood in some groups within the branch, even in Washington itself, where some staff have never had the opportunity to talking to Dr Vohely or imbibing his enthusiasm or purpose by means of lectures or seminars. Some of the staff in both the Bureau of Mines and U.S.G.S. envy smaller organisations like B.M.R. their readier lines of liaison - but B.M.R. has obvious deficiencies in both and particularly in communications; let us learn the lesson and improve this situation before we grow larger.

CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES



June 1 1967

SYNTHESIS

Documentation and analysis of the mineral industry carried out by the Bureau of Mines, although currently emphasising sophisticated analysis, is soundly developed to provide as much basic data as possible for analysis and interpretation. The system therefore, may be divided into two major sectors:-

Basic Data: statistics, mineral intelligence (domestic and overseas), resources, inventory, cost data, metallurgy and process intelligence.

Analysis: cost analysis, evaluation, economic studies (Division of Mineral Economics), strategic planning.

The combination of the mineral economics and mining engineering sections in B.M.R. potentially covers the same broad field as does the Mineral Resources Evaluation in the Bureau of Mines, although as presently developed, B.M.R. is deficient in the collection of basic data (cost data and resources inventory particularly), and with present staff is capable of providing analysis only on a restricted ad hoc basis.

However, it is a matter of some encouragement that the re-organisation already planned for the two sections includes groups to provide basic data on resources, costs and processes, to provide more comprehensive mineral intelligence and to initiate more sophisticated analysis. The application of ideas from overseas to our system is reserved for a final section of this record, but the system developed in the Bureau of Mines has helped to clarify sections of the re-organisation planned within the Bureau of Mineral Resources. Aspects particularly relevant to our purpose may be listed as follows:

(1) The collection of preliminary statistics from industry for early presentation at the end of each calendar year is worthy of study.

(2) The need for basic data on costs, processes, and resources inventories gains new emphasis.

(3) Sophisticated analysis must be built into the system but with flexibility and room for experimentation.

(4) Effective co-operation between analysis and mineral and other intelligence presents management problems which have to be solved.

(5) The officers most effective in documentation and analysis of the mineral industry are those with technical background and with experience, at least in their own sector of the industry. The use of pure economists as such calls for particular care.

(6) Groups working in these fields should operate in a technical environment for maximum effectiveness; the need for close contact with colleagues in associated technical fields and in industry is universally acknowledged, but particularly in larger organisations effective liaison and communication should be accepted as an important function of management.

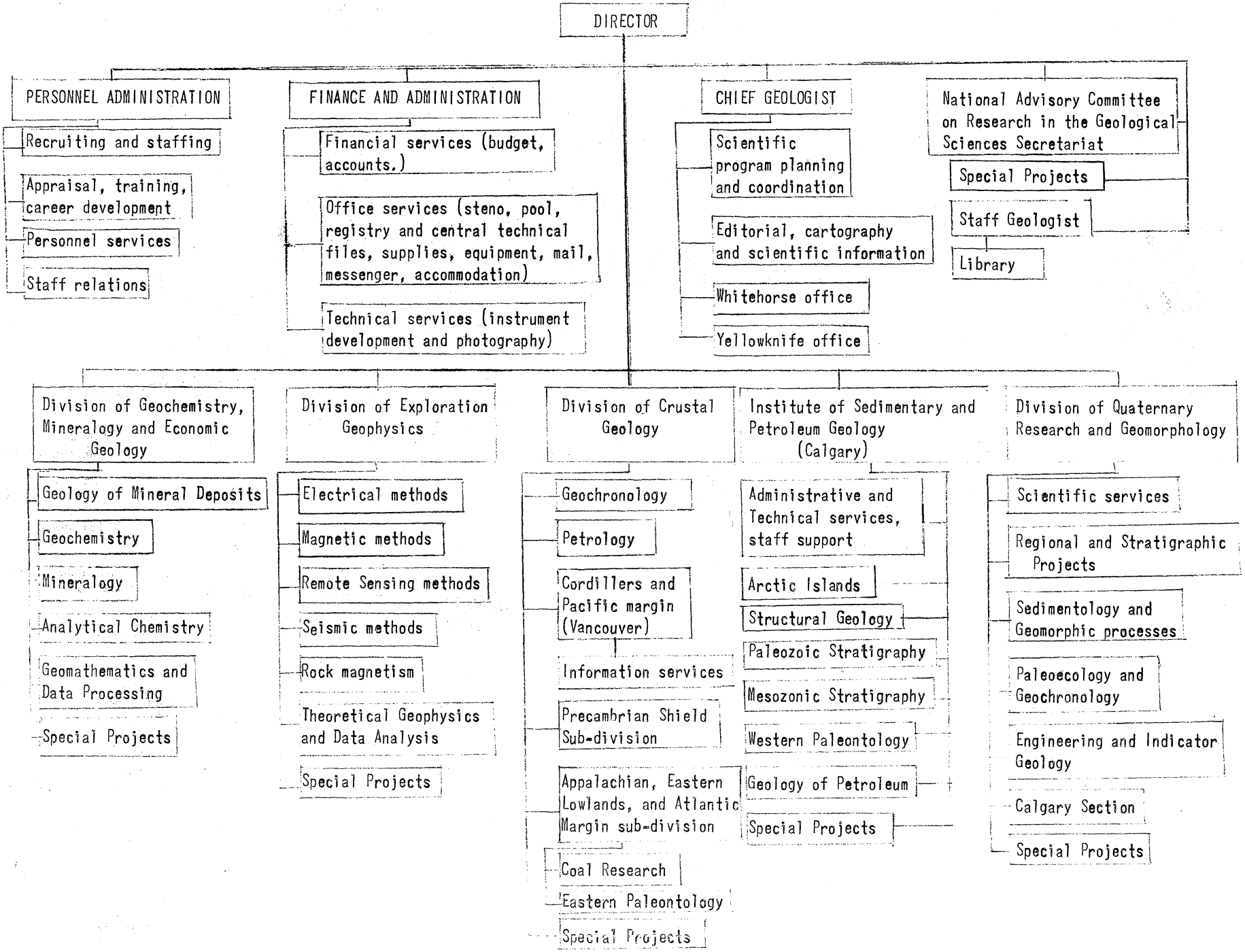
CANADA

Organisation of the Federal Government in Canada bearing on the mineral industry follows much the same line as in the United States of America. The department most concerned is the Department of Energy, Mines and Resources and the broad organisation is shown in Figure 1. Technical aspects of the Department are grouped mainly into four wings entitled: Mines and Geosciences, Mineral Development, Water, and Energy Development. The Geological Survey of Canada and the Mines Branch - the equivalent of the U.S.G.S. and the Bureau of Mines in U.S.A. are both branches within Mines and Geosciences.

However, the groups dealing specifically with the documentation of the mineral industry forming the Mineral Resources Branch have been split off from the Mines Branch with which they were previously associated and function as a branch of their own under a director, but working as part of Mineral Development. The Canadian Department of Energy, Mines and Resources has been re-organised in recent years and problems stemming from fragmentation and inadequate liaison between groups present worries here as in Washington.

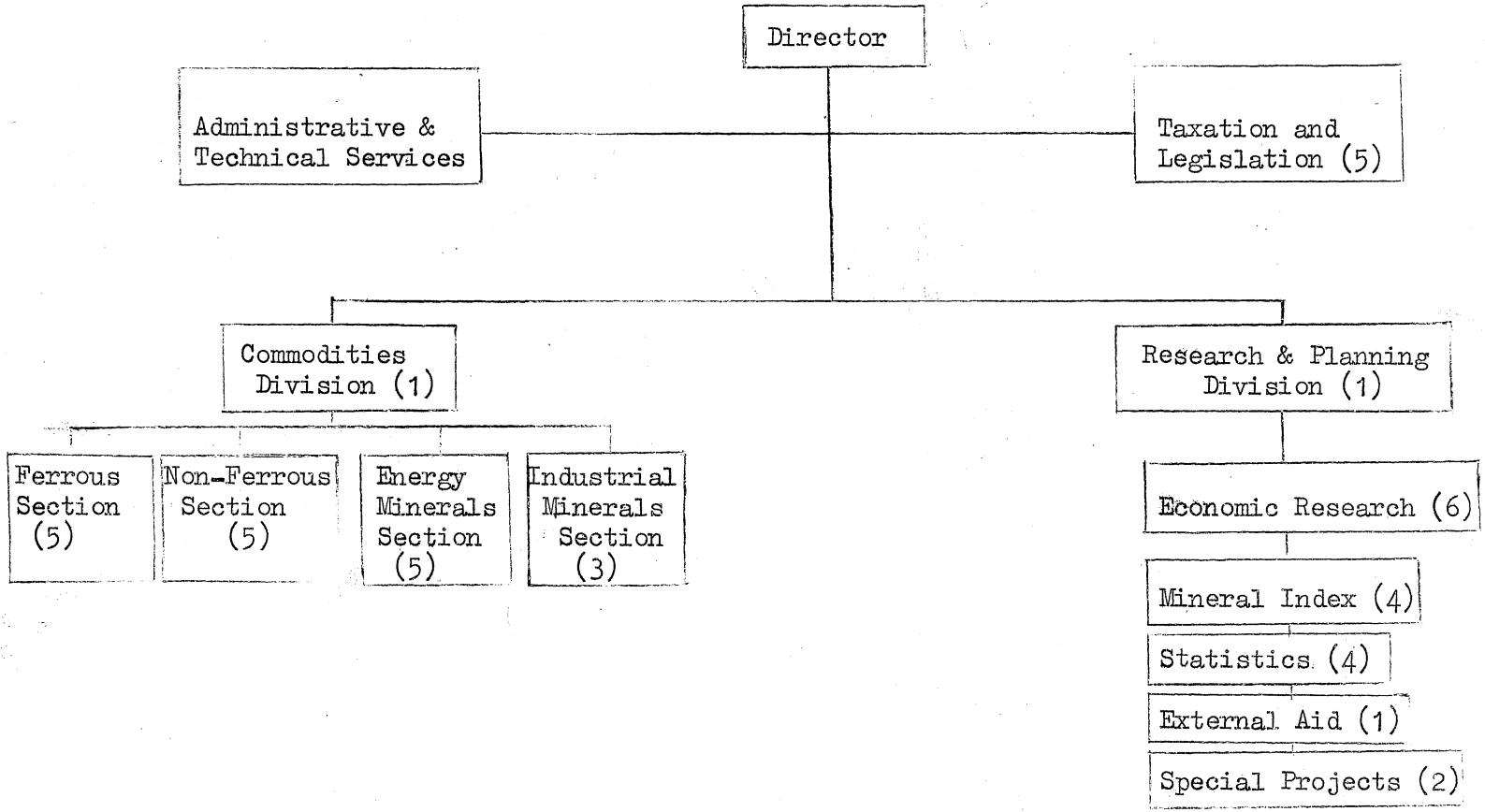
Like Australia, Canada is divided into largely autonomous territories called Provinces, of which there are ten, and the north-west territories which remain under Federal control. Each province has its own Mines Department and Geological Survey but the relationship between Federal and Provincial surveys appears to be on a different footing, more favourable to the Federal survey in Canada than in Australia, because the Federal agency is far older than the Provincial groups and benefits from the senior status this tradition confers. Jurisdiction over mineral resources lies with those provinces of Canada in which the resources are located, except for the two large northern territories and off-shore areas where jurisdiction lies with the Federal Government. The Federal Government has historically played a large and influential role in the development of mineral resources throughout the country.

GEOLOGICAL SURVEY OF CANADA



MINERAL RESOURCES BRANCH

OTTAWA



Total Staff - approximately 80 (50% Professional)

The mineral industry in Canada, as in the United States of America, has developed to the stage where the main functions of Geological Surveys and Mines Departments, apart from safety and administration, tend towards research rather than to prospecting and development. The Geological Survey has a group of about ten geologists dealing with some aspects of mineral commodities but otherwise does not assume importance in the present enquiry. The Mines Branch, apart from safety, etc. has much the same research function as in the U.S.A. with branches dealing with mineral processing, industrial minerals, chemical treatment, metallurgical processing and fuels; some aspects of work in the Mines Branch are mentioned in Mr King's account of his study tour in North America (Records 1968/99). Study of documentation and analysis of the mining industry in Canada can therefore be concentrated on the Mineral Resources Branch, directed by Mr W.K. Buck.

MINERAL RESOURCES BRANCH

This branch has an enviably long tradition, as it can be traced back to 1886 when a Mineral Resources Division was created within the Geological Survey of Canada to collect and publish mineral statistics and to examine areas of potential mineral production. In 1906 the Division was transferred to form the nucleus of the newly created Mines Branch and continued to carry out its original functions. The division remained within the Mines Branch until 1956 when it became an independent division and subsequently in 1968 an independent branch of similar status to the Mines Branch and the Geological Survey of Canada.

Throughout much of its long history the emphasis of the Mineral Resources Branch has been on mineral commodity analysis as an aid to mineral policy formulation and in the evaluation of mineral projects. At this point of time, the Mineral Resources Branch, among other responsibilities, conducts fundamental and applied resources - engineering - economic research and field investigations into non-renewable resources problems, policies and programmes on a regional, national, and international basis, and provides policy advice on the basis of its research investigations. As with the U.S. Bureau of Mines, it was not until the early 1950's that a degree of economic sophistication began to creep into the Branch. The degree of sophistication has increased during the present decade to the point where the Branch now has a small but discreet capability in the field of mineral economic research as well as a larger capability in the field of commodity and project analysis. There is but a small corp of mineral economists in Canada and the Mineral Resources Branch possesses the larger part of this body, and indeed plans to gradually extend its analytical staff.

The current organisation of the Mineral Resources Branch is shown in Figure 2; the Branch has a total of about 80 officers of whom approximately 50% are professional and these include about equal numbers of geologists and mining and other engineers. Most professional assistance is concentrated in the administrative and technical surveys, under the Director, but others are distributed amongst technical sections and in statistics to assist in the compilation and processing of data. Most interest lies in the two main technical divisions - Commodities, and Research and Planning - but also of interest is a section dealing with taxation and leigslation, staffed by 5 professionals, mainly mining engineers, which combines examination of taxation and other legislation with the monitoring of the Gold Subsidy Act.

Statistics

This is handled by a section of four people in the Research and Planning Division; the section will be extended to seven, but can remain small because, as in the Australian system and unlike that in U.S.A., responsibility for the collection of statistics in Canada lies mainly with the Dominion Bureau of Statistics which collects under statute. The basis of collection is the annual calendar year census, covering production, value and consumption, etc. of all mineral products. About nineteen to twenty minerals feature in monthly collections by the Dominion Bureau of Census, but apparently only lead and zinc are regularly collected on a quarterly basis. Stocks and scrap are not well covered and, as usual, close liaison with industry and the collection of some confidential figures are essential in the assessment of performance and potential within the mineral industry. Without detailed study it is not possible to really compare the effectiveness of statistical coverage in Canada and Australia but, as an impression, there appears little between the two systems apart from the collection of preliminary figures at the end of each calendar year.

The main collection of both production and consumption figures is called for at the end of the calendar year and the figures become available from March onwards (consumption from May or June) although census figures are not completed entirely until the end of the year. These collections include value, some costs, employment, etc. but a few items like refinery production are collected by the Mineral Resources Branch through the Provinces.

However, a collection of preliminary figures including quantities, shipments and f.o.b. values at the end of each calendar year, similar to the preliminary collections of U.S.A., features prominently in the early issue of chapters of the minerals Year Book and in the Year Book itself. These preliminary statistics are called for in November and collated in December each year to provide first a preliminary statement of the year's performance of the mineral industry, and secondly a basis for compiling chapters for the Year Book. The preliminary statement on the Canadian mining

industry for each calendar year is published in the February issue of the Canadian Mining Journal, following the close of the calendar year, and subsequently issued as an official bulletin.

Pre-printed commodity chapters of the Year Book appear at intervals during the second half of the year following the calendar year concerned and the complete Year Book early in the year following (as does our own), but many of the statistics for the year concerned are still provided by the preliminary rather than the full census for that year, and by estimates provided by companies to the Mineral Resources Branch. The full census figures become finally available about the end of the year following the census and are then used to correct the preliminary figures shown in the pre-prints and complete the statistics for the Year Book which is normally issued in March - about the same time as our own. A few of the figures for the last year in the Canadian Year Book are still preliminary rather than final but this is the exception rather than the rule, and in these cases the final figures would appear in the next set of pre-prints issued some months after the Year Book concerned. In any case there appears to be no real significant variation between preliminary and final figures which could detract from the value of the pre-prints. On our present system our own pre-prints will be timed to provide final figures in most cases although some blanks and estimations may be necessary.

Commodities Division

The Commodities Division is divided into four sections termed ferrous, non-ferrous, energy minerals and industrial minerals. Each section has five professional members, except industrial minerals which at present has three; clerical assistance increases the division to 25 to 30 members.

The work follows the traditional lines of commodity groups with a distribution of mineral commodities between the 15 to 20 professional staff to suit current importance in the Canadian mineral industry. Each section has a leader in charge, who is not officially responsible for any one mineral commodity and important commodities like uranium and thorium, iron ore, iron and steel, coal and coke, and petroleum each receive the full attention of one professional officer. Other commodities are grouped to give the remainder of the staff a reasonable work-load.

As close liaison with industry is deemed essential, commodity staff in general spend about six to eight weeks in the field each year. Commodity specialists provide monthly mineral summaries and are responsible for their regular chapters in the Year Book around the middle of the calendar year; work for these regular deadlines occupies a total of about three months each year, leaving about eight months (excluding leave, etc.) for commodity assessment and study, for writing papers, for team work in branch projects, and for attending to inquiries and requests for advice.

In this system, commodity men, currently equally divided between geologists and mining engineers, are responsible for collection of costs within their sectors and in this and other regards make contributions to evaluation work in other sections. All professional commodity staff must have a technical background and in most cases sufficient experience in the mineral industry to work effectively. Inexperienced graduates were not used in this work in the past but some senior officers feel that the section is now large enough to train a graduate with little experience but with encouraging potential. Resources inventories are not allocated to any particular section and, like costs, are mainly the responsibility of commodity specialists although files on resources and reserves are kept with the mineral index. Commodity specialists also handle overseas intelligence in their own commodities as in our own organisation.

Reserves of petroleum are collated by the section dealing with energy minerals, but as in U.S.A., the compilation of each field is prepared by the industry through the Petroleum Institute. The Energy Minerals Section is in a position to check where required, for instance by the Taxation Department or to calculate reserves for small fields where one company alone may operate. Reserves of both crude oil and natural gas are normally published under the category of "Proven plus Probable" or under the equivalent term "Recoverable".

Research and Planning

This division of five sections deals with economic research, mineral index, statistics, external aid and special projects. The statistical section has already been mentioned and basic information on the other sections is as follows:

Mineral Index

This has been a feature of the branch since 1918, although indexing has not been continuous, and there is still a back-log to be handled. Indexing has been continuous since 1959, at first by one or two people but by four officers since 1967. The four current indexers are all professional officers and are sufficient to keep abreast of current literature, reports, etc. but insufficient to reduce the back-log, which will require an additional two staff. Experience has shown that the use of non-professional staff is not efficient, and even vacation students are now not employed on this work. The index is basically similar to that admired in London, although the subjects concentrated on Canada, rather than foreign countries. With the London index in mind, the Canadian index was not examined in detail and more time was thus available for other sections.

External Aid

This section is presently run by two experienced geologists with wide knowledge of the Canadian aid programmes. The concept is that matters or questions concerning external aid are channeled to this section for on-forwarding to appropriate groups within the Department; in this way, replies and advice can be co-ordinated. However, the allocation of this function to the Mineral Resources Branch appears fortuitous and, indeed, could be handled to equal purpose in the Geological Survey.

Economic Research and Special Projects

In recent years emphasis on more sophisticated analysis, already noted in the U.S. Bureau of Mines, has been reflected in Canada and concentrated through the functions of the section of Economic Research, which currently includes six professionals which will be expanded to perhaps 12; present staff consist of a combination of engineers, geologists and economists, but like the planning group in U.S. Bureau of Mines, the section can call on other groups, particularly commodity specialists, to form a team in project work in which the Economic Research staff may provide the project manager. The Special Projects Section, consisting of two professionals, may be included here as these two officers apparently function as managers for some major projects.

The section has initiated and co-ordinated projects along two main lines - regional mineral development, dealing with the problems and potential of Provinces or territories, and mineral industry development dealing with Canada as a whole. It is interesting to note that an initial trial project on the assessment of mineral potential of Manitoba was so impressive as to induce requests from other provinces for similar services; the value of the section has been established in both Federal and Provincial quarters by the results of this and similar work.

The following details of branch studies, presumably co-ordinated by the Economic Research section, are taken from a paper by Keith Buck:

"These regional studies have involved the participation of all Sections and Divisions of the Branch. The studies constitute thorough examinations and analyses of the potential for future resource development; of the present and future position of producing companies in national and international mineral markets; of the economic effect of mineral land tenure systems on capital expenditures for exploration, development and production and their comparison with land tenure systems elsewhere; of the provincial organisation for minerals administration; and they also provide a forecast of the future of the province's mineral economy. One of the regional studies, for example, formed the basis of the mineral recommendations contained in a report of a provincial Royal Commission.

An economic assessment of a large medium grade lead-zinc project in a remote area of Canada and recommendations related thereto assisted the Federal Government in deciding on the types and amounts of infrastructure and other assistance that might be made available to achieve federal objectives for northern development. The economic analysis of the project included a scrutiny of all aspects of the company's preliminary feasibility study and its request for government assistance. Twenty-five basic processing-transportation combinations or alternatives, constituting departures from the assumptions contained in the company's feasibility study, were examined. For each of these basic alternatives, variations in four input parameters were considered; market price, power cost, royalty rates, and government assistance. A computer programme, re-designed for the project, was used to evaluate the expected company rate of return, government tax and royalty payments, and the degree of uncertainty for each variation of each alternative. The results were analysed to show benefit-cost relationships for each alternative from both the government and the company points of view. Comparisons were made of the processing to metal and toll smelting alternatives, transportation alternatives and the effect of price variations, power cost, royalty payments and various forms of government assistance in the project economics. The expected impacts of the development alternatives on foreign exchange, market conditions, employment and regional economic development were considered. The evaluation and analysis assisted the Federal Government in negotiating an appropriate assistance programme with the company. Subsequently, the same techniques were used in the evaluation of another major mineral project, also located in an isolated area, for which the promoters were requesting massive federal financial assistance.

The Branch recently made a study of the quantity of iron ore that can be expected to move through the St Lawrence Seaway and the effects that increases in Seaway tolls and Welland Canal charges might have on the competitiveness of Canadian iron ores in their major United States markets. The study encompassed a thorough examination and evaluation of: mine production costs; rail, stockpile and handling costs; the iron ore price structure at Great Lake receiving ports; the competitive position of alternative sources of iron ore in the steel markets of the Great Lakes area of Canada and the United States; the captive nature of iron ore sources available to the area; the future level of steel ingot production in the area; iron ore to steel ingot ratios over time; the effect of changing raw material and processing technology on steel costs; and production costs at consuming plants. The study was not only of immediate value relative to toll increase considerations but subsequently of value in examining the need for an increase in canal capacity.

Officers of the Branch comprised the research and operational staff of the Donald Enquiry into the Cape Breton coal problem. Research followed along three major lines: (1) An examination was made of past trends and the current status of the following key factors; capital expenditures in the mines, operating costs, productivity, wage trends, markets, annual production, and the cost of subsidies. (2) A costing was done of alternative future policies by simulating such policies over a fifteen year period. The key inputs into the simulation models were: number of mines operating, annual production, operating costs, labour force, sales price and tonnage purchased by each major customer or customer grouping. (3) A study was also made of the social implications of alternative future policies by the simulation of the characteristics of coal mine labour force under the different policies, over the same fifteen year period. The key inputs were: the present structure of the labour force broken down by marital status, and the number in each age group, by year; the past and expected future trends in voluntary resignations; the labour force required under alternative future policies; and the application of mortality rates. The key outputs were a projected labour force balance over the fifteen year period showing either an excess of labour available over that required or a shortage and hence a need for new entrants. The need for quantitative guidelines for policy formulation was obvious, hence the attempt to project the costs of alternative policies in a situation of many unknowns. The analysis led to the recommendations contained in the Donald Report, which recommendations were accepted by the Government. The culmination was the creation of the Cape Breton Development Corporation and the adoption of a programme for Cape Breton Island which marks the commencement of a new and interesting approach to the problems of a declining mining community. The analytical techniques used in the Cape Breton study were subsequently employed, in simplified form, in the analysis of the problems of the Minto Coalfield. The Minto Coalfield study also led subsequently to a federal-provincial agreement for the rationalization of that coal-field's mineral industry".

Projections used in Branch projects have been based mainly on population trends but the section is experimenting with other models. It is note-worthy that these mineral analysis and evaluation projects in Canada are staffed in the same way as in the U.S. Bureau of Mines which probably provided the model. The formation of ad hoc teams is certainly an effective way of combining the talent appropriate to the project, although effective and smooth operation obviously depends on sympathetic liaison between sections and divisions, very effective programming and a strong development of team spirit in the branch as a whole. Judging by results, Keith Buck and his officers are to be congratulated for forging and maintaining this effective liaison. The organisation of the Mineral Resources Branch and of the Economic Research section in particular is by no means static. Experience in analytical projects is resulting in re-organisation

and expansion of the Economic Research Section to develop three groups, one dealing with regional resource development based on Provinces and territories, a second to cover mineral industry development Canada-wide and including short and long range forecasting, transport, manpower and productivity, and a third devoted to international trade and mineral industries abroad. It is assumed that special projects might be absorbed into the re-organised Economic Research section.

SYNTHESIS

Documentation and analysis of the mineral industry practiced by the Department of Energy, Mines and Resources is of special interest because it includes emphasis on sophisticated analysis developed in an organisation more comparable to our own in numbers than is the Bureau of Mines in U.S.A. There is little doubt that the U.S. Bureau of Mines has been used as a general guide to Canadian development, and that the models presented by both bodies can guide our own re-organisation.

Apart from pre-prints of chapters in the Year Book and possibly the collection of preliminary figures, there is not much of significance in statistics in Canada and, in any case, statistical collections once established are rarely flexible.

Commodity work in Canada follows the traditional pattern and emphasises to us the need for additional staff to allow individual attention for mineral commodities of major importance such as iron and steel, coal, lead and zinc, aluminium, and copper. The collection of costs and of mineral reserves and resources are also emphasised, but in this model are attached to commodity intelligence rather than the functions of separate groups.

Again, the mineral index is emphasised as an asset to be built into the organisation before its growth makes the task well neigh impracticable.

The introduction of sophisticated mineral analysis by developing a small group, currently six to eight in number, is also of special interest; this small group with special interest and expertise in analysis is used to guide and contribute to projects for which appropriate teams or contributors are arranged among the staff of other divisions. In early projects, emphasis has fallen on the development of regions (in co-operation with other authorities) rather on nation-wide problems although these have not been excluded; such regional studies may well be the most profitable early contribution that a mineral analysis group can provide in a developing country.

Canadian experience confirms that documentation and analysis of the mineral industry requires:

(1) officers with sound technical background and with experience in, and liaison with, the mining industry.

(2) a gradual introduction of pure economists in special sections as sophisticated analysis progresses.

(3) non-technical support which may extend to as much as half the total staff.

The essentially technical environment desirable for such work is also confirmed, but the problems of fragmentation and of associated inadequate liaison as organisations grow and diversify are found in Canada as in U.S.A.

CONCLUSIONS

The conclusions from these studies in four countries provide some guidelines for the conduct and expansion of activities within the Mineral Resources Branch and are grouped below under broad work areas. Although most of the helpful ideas stem from organisations in North America, some aspects of staffing and practice in France and in the United Kingdom usefully confirmed patterns found in U.S.A. and Canada.

Mineral Statistics

Systems of statistical collections tend to be fairly inflexible in any country; any radical change becomes a long-term project involving discussion and agreement between public organisations and probably including private enterprise. Judging by this recent and inevitably cursory examination, our own system compares favourably with those of the countries visited; all show degrees of deficiencies in the data dealing with costs, stocks, consumption, and prices and these deficiencies emphasise the need for the collection of confidential data from industry for the better understanding of industrial performance and to enhance the accuracy of analysis and projection. The practice of producing pre-prints of chapters to allow early dissemination of information on the mineral industry is already under way in B.M.R. but the collection of preliminary statistics from industry at the end of each year to provide early distribution of the approximate performance in that year needs serious consideration as our mining industry grows in importance.

The concern of all countries in standardising on calendar year statistics in the mining industry (and indeed in all industrial statistics in the countries visited) endorses our recent stand against the proposed fiscal year timing for mineral statistics in Australia and increases the suspicion that our intergrated census based on the fiscal year is a mistake we will regret unless quarterly or half-yearly collections are sufficiently improved and extended to provide adequate statistics for both calendar and fiscal year periods.

Commodity Studies

These continue to be the real basis of mineral economics with emphasis on study in greater depth and in continual close liaison with industry. Within commodity or mineral intelligence groups there is unanimous agreement that the work requires professionals with sufficient experience in fields of industry to make them critical collectors of information whom industry itself can accept as experienced and responsible officers.

Study in depth is primarily applied to those minerals critical to the country concerned; each of these important minerals or mineral groups are allocated to one or possibly two officers who therefore have time to study all aspects of production and consumption in both field and office. On this basis we should aim to allocate one man full-time to each of the following minerals or mineral groups - aluminium, lead-zinc, iron and steel, energy minerals, copper and nickel, fertilizer minerals, beach sand minerals and construction materials; other minerals of less current importance to Australia should be appropriately grouped and covered by the remainder of the commodity staff.

Indexing

The rapidly growing volume of data from literature and from other sources makes some type of storage and retrieval system essential for efficient work; the larger the organisation the more difficult and cumbersome becomes the task of providing this service. It is vital that a system be designed and initiated for the Mineral Economics and Mining Engineering Sections of the Mineral Resources Branch to increase efficiency at the present staffing level and before the sections are expanded. Emphasis should be placed on simplicity and immediate retrieval and, at this stage of development, the model of the United Kingdom index seems obviously appropriate - a relatively simple card index adapted to include information of mineral deposits, reserves, costs, metallurgy, mining, finding, and treatment methods, uses, companies and organisations involved, etc. Such an index has already been designed but experience in both Canada and the United Kingdom indicates that a bare minimum of two professional indexers with desired assistance will be required to index current data; unfortunately, the back-log of previous data cannot be practically considered in this index because of staff requirements, but this realistic approach emphasises the importance of obtaining staff and commencing the project as soon as possible.

Costs

Conern with the collection of cost data in North America and France in particular emphasises that the performance and potential of the mineral industry cannot be properly analysed without basic knowledge of the many costs involved. In these countries which are more advanced than our own, costs are required particularly to carry out feasibility studies at various levels of detail, to explore the potential of marginal deposits or of new alternative processes; in our case a better understanding of costs is required to carry out similar projects but also to provide some general information for new or small companies whose interest in mining development in Australia needs to be encouraged; in this regard recent publications of transport costs in Canada by the Mineral Resources Branch provides a useful example of this service.

The collection of cost data follows an established pattern - a combination of information from literature (via the index), some data from industry, normally confidential, plus intelligent estimates from engineers based on visits to mines, plants and manufacturers of equipment. The collection of costs may be assigned to a small group as a full-time task, may be regarded as one of the many tasks of a group investigating specific projects by feasibility study or may be distributed on a continuous basis amongst a number of appropriate officers as in the B.R.G.M. Within a relatively small branch, costs might best be collected by a number of officers as opportunity offers but co-ordinated by one officer or by a small group having the specific responsibility for the collection, storage and retrieval of cost information.

Mineral Resources Inventory

Like costs, data on treatment processes, etc. the mineral resources inventory provides one of the essential parameters in some analyses of national potential; national inventories have been completed for essential indigenous minerals in some countries, particularly in the U.S.A., and are overdue in Australia. Again the pattern is established in that although the inventory can be started from literature, it is made as comprehensive as possible by seeking confidential data from mining companies and by inspection of company properties and records. The task appears principally one for a small group of mining engineers, although co-ordinated assistance from other officers in line with their experience and opportunities would no doubt be helpful. Principal elements of the inventory would refer to location, type of deposit, mineralogy, quantities and grades in the various categories of reserves and characteristics of mining and treatment.

Analysis of the Mineral Industry

The salient purpose of documenting the mineral industry is to provide proper bases for analysing trends and performance and for investigating alternative future courses as a guide to national and company planning. All of the aspects already underlined in these conclusions bear on the field of mineral analysis which may range from examination of features affecting mineral production or consumption to specific feasibility studies, to mineral production and consumption projections or to the strategic mineral planning currently practiced by the U.S. Bureau of Mines.

Mineral analyses may be considered in two broad fields. In one field analyses are based on mineral commodities and include problems and projects of nation-wide interest such as mineral processing or other aspects of mineral development; in the other field, analyses are based on the regional or geographical approach and deal with the mining problems or potential of specific areas in which mining needs to be considered with other aspects of industrial or primary development.

Analysis in both of these fields are urgently required in Australia. The present staff of the Mineral Economics and Mining Engineering Sections cannot adequately document the mining industry let alone analyse the results, and the proposed re-organisation, which is not discussed in any detail in this report, is designed to rectify these deficiencies. Our current examination of mineral processing of titanium, tin and salt and of the application of econometrics with the future demand for zinc are, of course, exercises in mineral analysis but these projects can only be handled on a part-time basis with present staffing levels. In particular the concept of the U.S. strategic plan for minerals needs to be adapted to the Australian export-orientated environment so that our problems and potential can be delineated to provide a better basis for national planning.

Analytical practices have become more sophisticated and ambitious since the early 1950's, and no growing country with orientation toward mining like Canada or Australia can afford to leave the development and application of analytical techniques to other countries which are, to varying degrees their competitors, following a course best suited to their own national interests.

New skills in analysis based on econometrics and/or computers have been established and others remain experimental; but the salient point is that groups like our Mineral Resources Branch must be sufficiently expanded to adequately cover both documentation of the mining industry and the analysis to which documentation should lead.

There are a number of models which could be followed in introducing and extending analysis of the mineral industry, but it is important that any effective system will be based on the introduction or the inducing of the skills, temperament and approach required and the fostering of very close team-work not only within the Mineral Resources group but, as required, with other branches and Departments.

Perhaps the most practical way of introducing and extending mineral analysis in the Mineral Resources Branch would be by way of a new specialist group within the Mineral Economics section; however, the group would be designed to operate not so much as an entity but rather to provide the nuclei for teams appropriate to the problem to which the specialist would contribute analytical skills and experience. By this means commodity officers or members of other sections can develop their skills and approaches and thus find their own forté in teamwork.

Staffing and Management Problems

Performance in the countries visited highlights management problems in three broad fields - liaison with associated groups, communications and the introduction and injection of new skills and approaches. Overseas mineral industry groups all agree that the work needs to be carried out in the professional environment, be it within a Bureau of Mines or Geological Survey, and that as size increases the problems of adequate liaison become more severe. Groups dealing with the mineral industry need to be identified with other geologists and mining engineers so that location is important, but beyond that, the establishment and continuance of close liaison between groups with some common interests becomes a firm responsibility of management. For example, it is inevitable and desirable that, with growth, a geological branch dealing principally with the performance and potential of the mineral industry should both develop commodity specialists concentrating on their particular fields; but the divorce between the two groups of commodity specialists as seen in the United States is not inevitable, although it can readily develop. Liaison between such groups must be fostered to ensure communication and to widen the knowledge on both sides. This, as well as the problems of communication - applying to dissemination of programmes, planning, new ideas and information - must be accepted as a challenge to the management skills of all section leaders.

In reference to the third field of management problems, the introduction of new approaches and skills carried the danger of a loss of perspective in which new skills of analysis are given pride of place above the older skills of effective mineral intelligence and common sense analysis. Such a development mitigates against dissemination of new skills and against the congenial blending of new and old in an effective team approach - again a call on management at several levels.

Summary of Guidelines

These conclusions indicate a number of useful guidelines in promoting more effective documentation and analysis of the mineral industry by the Mineral Resources Branch:

(1) Calendar year mineral statistics should be improved by more comprehensive quarterly or half-yearly collections.

(2) An effective mineral industry index needs to be established.

(3) Additional commodity staff with professional training and experience are needed to extend commodity studies in depth.

(4) Continuous and close liaison with the mineral industry and with other branches of the B.M.R. is most necessary.

(5) Sub-professional or clerical staff should be increased to support and allow optimum use of professional staff.

(6) Injection of analytical skills is needed with additional staff to provide analysis as well as basic data on costs, resources inventory, etc.

(7) Continued location of Mineral Resources Branch in the scientific environment of B.M.R.

(8) Close attention to the management problems of liaison, communication, and the introduction of new skills.

APPENDIX 1

U.S. GEOLOGICAL SURVEY

Commodity Geologists

Commodity		Location of geologist
Aluminous refractories	Espenshade, G.H.	Washington, D.C.
Anhydrite, gypsum	Withington, C.	Washington, D.C.
Barite	Brobst, D.A.	Denver
Bauxite, clays	Patterson, S.H.	Beltsville
Beryllium	Griffitts, W.R.	Denver
Bismuth		
Carbonate rocks	Ericksen, Geo. E.	Washington, D.C.
Chromite	Thayer, T.P.	Washington, D.C.
Coal	Landis, E.R.	Denver
Cobalt	Vhay, J.S.	Spokane
Copper	Kinkel, A. and Kirkemo, H.	Washington, D.C.
Cryolite	Van Alstine, R.E.	Washington, D.C.
Fluorite, cryolite	Van Alstine, R.E.	Washington, D.C.
Geothermal Energy	White, Donald	Menlo Park
Gold, bismuth, arsenic		
Gypsum, anhydrite	Withington, C.	Washington, D.C.
Helium	Pierce, Art	Denver
Iron	Klemic, H.	Washington, D.C.
Lead, zinc, silver	Kiilsgaard, T., Heyl, A.	Washington, D.C.
Lightweight aggregates	Bush, A.	Denver
Manganese	Dorr, J.	Washington, D.C.
Mercury	Bailey, E.H.	Menlo Park
Molybdenum	King, R.U.	Denver
Monazite	Overstreet, W.C.	Washington, D.C.
Nickel, platinum	Cornwall, H.R.	Menlo Park
Niobium, tantalum	Parker, R.	Denver
Oil shale	Duncan, D.C.	Washington, D.C.
Pegmatite minerals	Lesure, F.G.	Washington, D.C.
Petroleum	Schweinfurth, S.	Washington, D.C.
Phosphate	Cathcart, J.	Denver
Platinum and nickel	Cornwall, H.R.	Menlo Park
Potash	Raup, Omer	Denver
Rare Earths	Adams, Jack	Denver
Rhenium	King, R.U.	Denver
Salines	Smith, G.I.	Menlo Park
Selenium, tellurium	Davidson, D.F.	Denver
Silica, quartz crystals	Carter, W.D.	Washington, D.C.
Sulfur, sour gas	Bodenlos, A.	Washington, D.C.
Tantalum, niobium	Parker, R.	Denver
Tar sands	Roberts, A.E.	Denver
Thorium	Staatz, M.	Denver
Tin	Sainsbury, C.	Denver
Titanium	Herz, N.	Washington, D.C.
Trace metals	Weeks, R.A.	Washington, D.C.
Tungsten	Hobbs, S.W.	Denver
Uranium	Butler, A.	Denver
Vanadium	Fischer, R.P.	Denver

APPENDIX 2

ITINERARY

Date	City
28th September, 1968	lv. Canberra
	arr. Sydney
28th September, 1968	lv. Sydney
" " "	arr. San Francisco
1st October, 1968	lv. San Francisco
	arr. San Diego
3rd October, 1968	lv. San Diego
	arr. Denver
6th October, 1968	lv. Denver
	arr. Chicago
7th October, 1968	lv. Chicago
	arr. New York
9th October, 1968	lv. New York
	arr. Washington
15th October, 1968	lv. Washington
	arr. Boston
17th October, 1968	lv. Boston
	arr. Montreal
17th October, 1968	lv. Montreal
	arr. Ottawa
23rd October, 1968	lv. Ottawa
	arr. Montreal
23rd October, 1968	lv. Montreal
	arr. Halifax
25th October, 1968	lv. Halifax
	arr. Montreal
25th October, 1968	lv. Montreal
26th October, 1968	arr. London
2nd November, 1968	lv. London
	arr. Paris
6th November, 1968	lv. Paris
	arr. Rome

ITINERARY (Cont.)

Date	City
6th November, 1968	lv. Rome
7th November, 1968	arr. Hong Kong
8th November, 1968	lv. Hong Kong
9th November, 1968	arr. Sydney
9th November, 1968	lv. Sydney
	arr. Canberra