139

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COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

Records 1964/139

SAMPLE REGISTRATION, INFORMATION STORAGE AND RETRIEVAL SYSTEM, GEOLOGICAL BRANCH BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

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by

B.P. Walpole, A.D. Haldane, A.L.Mather
and W.R. Morgan.

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INTRODUCTION

The Geological Branch of the Bureau has reached the stage where existing information storage and retrieval systems are inadequate, and a new system based on modern practice has had to be instituted. At the time of writing, (September, 1964), parts of the new system had been operating on a trial basis for about four weeks. The trial period will probably continue for a further four months by which time it is hoped that most of the unforeseen requirements will have been located and the system adjusted to meet the needs of the Branch, it is hoped, for some years to come.

This report summarizes the main aspects of the new system, in its present form, and is intended for both information and instruction in its operation. Coding of information for punching is treated in detail. It is recognized that some changes may need to be made to the system as new problems are identified or some aspects are found to require modification; as these become evident, the procedures will be reviewed.

The main problem in designing an information storage and retrieval system for a geological organization is the diversity of the information and the proliferation of non-exclusive specialist and routine work areas. Thus any one sample could conceivably be examined by macro and micro palaeontologists, chemists, mineralogists, petrologists, and for radioactive age determination; and there are many other possible combinations. A workable system therefore needs to be adequately cross-indexed and must take into account sample handling, movement, final registration (Museum) and reporting requirements as well as data storage and retrieval. It must also take into account the diversity of sample types and locations; and the fact that one specialist work area may handle a very much larger volume of samples than another - for example geochemical samples can and do run into many thousands per annum, samples for mineragraphic examination may only amount to a few hundred.

We could find no comparable organization with a suitable system which could be copied or modified as a whole. We did, however, find useful parts of other systems which we copied or modified - e.g. the U.S.G.S. coding of igneous rock textures, and sample significance. We could not locate a suitable consultant to design and arrange the whole system for us; but we found Mr. B. Eggington of I.B.M. most useful and generous with technical advice on data storage and retrieval.

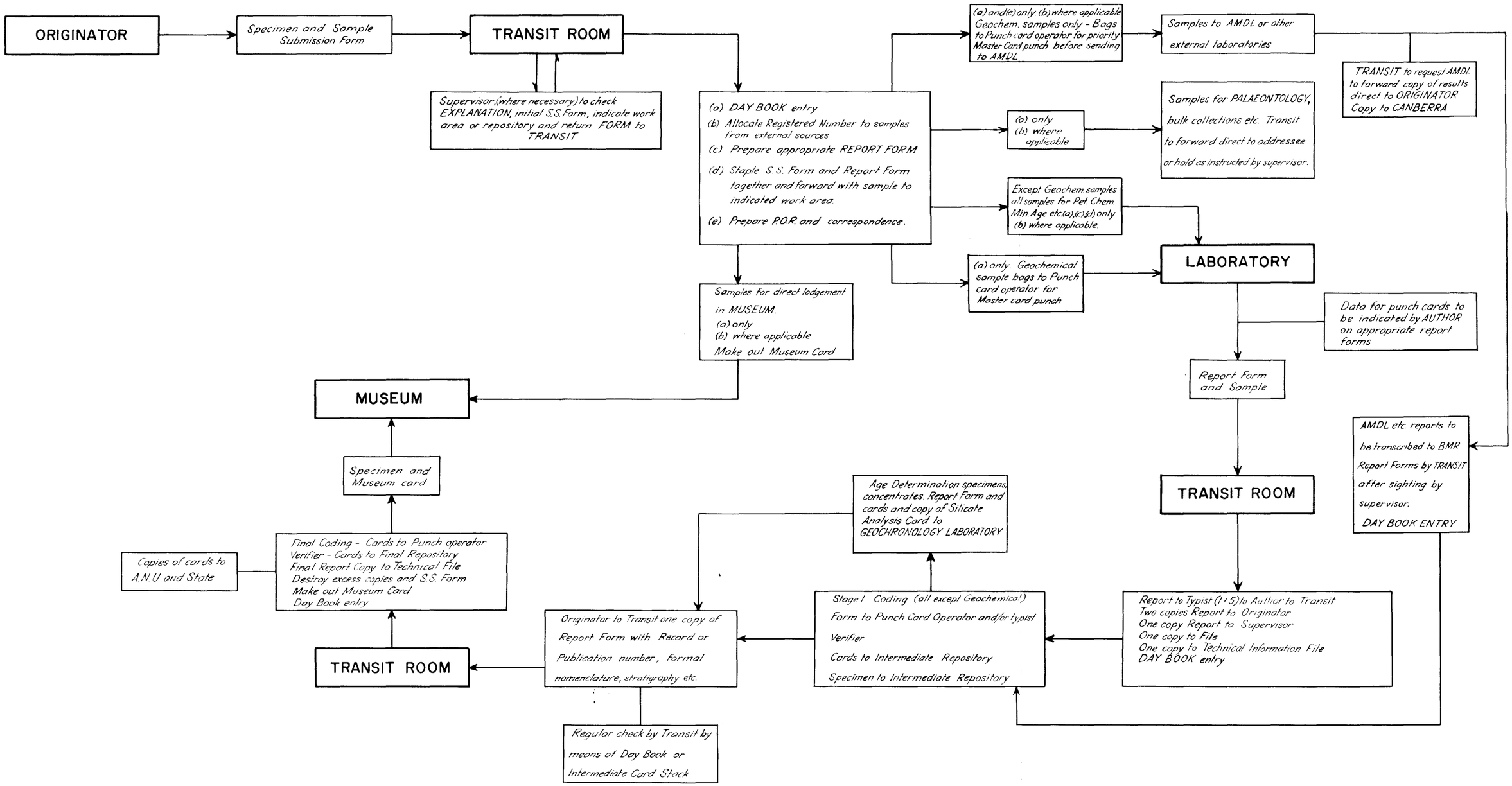
A further problem was the necessity to learn the jargon associated with data storage and retrieval systems. This is also a basic requirement for any scientist who hopes to use and get the most out of such systems - he does not need to be a trained programmer, but he does need to know what such a system can and cannot do. Training classes run by I.B.M. were most useful in this regard and were attended by a number of Bureau officers.

Recognizing that there is no short cut to data storage and retrieval for a geological organization, it is still of the utmost importance to have a system which can be operated largely by non professionals, and which does not require more effort at the input end than there is value in the output. Whether the present design has achieved this can only be determined by studying the system in operation.

Fig. 1

FLOW SHEET FOR GEOLOGICAL SPECIMENS, GEOCHEMICAL SAMPLES ETC.

Geological Branch, Bureau of Mineral Resources, Geology and Geophysics



Bureau of Mineral Resources, Geology and Geophysics

Day Book entry

SAMPLE SUBMISSION FORM

Originator..... Field Party..... Date..../../.....

Field No..... Batch No..... No. of samples.....

Point No.....Photo..... Run..... Survey set.....Lat..... Long.....

General location.....

Explanation .....

.....

.....

Registered Number Year Prefix Serial No Fraction

Sample Co ordinates. Zone *Military or Metric grid E N Other grid E* W N* S

For Mil. grid calculation Two points on base line

Point A *Military or Metric grid E N Other grid E* W N* S

Point B *Military or Metric grid E N Other grid E* W N* S

State..... 1:250,000 Sheet No..... 1:50,000 Sheet No.....

Sample depth..... R.L. Collar..... Interval..... Inclination..... Azimuth..... M/T *

Rock unit (Name)..... Rank.....

Age: Era..... Period..... Epoch..... Stage.....

Sample significance..... Source..... A.V.M.....

Supervisors Initials..... Date Recd. (Transit)...../../..... Date Dispatched (to work area)...../../.....

Work area or Repository

Sed. Pet.	Pet.	Min.	Chem.	Phos.	Eng.	Water	Pal. macro	Pal. micro	Palyn.	Age	Paleo mag.	Pet. Ex.	Pet. Tech.	AMDL	Mus.	Geophys. Branch			Hold

Remarks.....

.....

* Delete that not applicable

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Fig. 2

SUBMISSION OF SAMPLES

Figure 1 is a flow sheet for all samples entering the Geological Branch and their progress to and through different work areas to final repository in the Museum. Allowance has been made for recording samples destroyed in processing or split into two or more samples. The Flow Sheet is incomplete as all work areas (e g palaeontology) do not, as yet, use 80 column punched cards.

To meet the requirements of handling, registration, control and reporting a new Sample Submission Form has been designed (Fig. 2) and this will be used by all persons submitting samples for examination or storage in the Museum. After a trial period and any necessary modifications which may result, the form will be printed and bound in stiff covered books of 100 original and duplicate sheets.

INSTRUCTIONS FOR USE OF THE SAMPLE SUBMISSION FORM

The form is arranged in three main parts. The upper part is mainly general information to be used by the field party or originator and by the Transit Room. The central part - Registered No. to A.V.M. - is information which is recorded on the punched crads, and as such must be filled in legibly and correctly. The lower part is for sample control. With the exception of the 1:50,000 map reference, sample significance, source and A.V.M. the submitter is not expected to code any of the information on the submission form. This will be done in the Transit Room. Explanation of each of the headings are given below:

Originator and Field Party: These can be the same depending on circumstances. A field party submitting samples need not fill in "Originator" which is for use by individuals only.

Date: Refers to the date of despatch of sample to the Transit Room.

Day Book Entry(See Fig. 4): On receipt at the Transit Room, each sample or batch of samples is entered into the Day Book and given an Entry number which is sequential. This is for use by the Transit Room and will allow a quick reference back from the Sample Submission Form to the Day Book if a sample should go astray.

Field No: This is for the Party's or Originator's own use - it will NOT be recorded on the punched cards. Field numbers will be given however, to age determination samples and registered numbers (see p. 3) will only be given by Transit Room manager after the samples have been passed as suitable for age determination. When bulk collections (e.g. palaeontological) identified by field numbers only are forwarded through the Transit Room, the "Explanation" can be used to instruct the Transit Room and the box labelled "Hold" marked.

Batch No.: This is for control purposes and is for use mainly when large numbers of samples (e.g. geochemical samples) are regularly forwarded. It can be used by party leaders other than those engaged on geochemical work if they so desire. The year and prefix number (see p. 3) should be used for this purpose e.g. 6512, Batch 2 and should be clearly written on the outside of sample boxes.

No. of Samples: This is to be filled in in every case, whether single samples or batches and is for control purposes. Range of field or registered numbers in the batch should be indicated.

Point No., Photo, Run, Survey Set, Latitude, Longitude, General Location:

This information is for the party's or originator's use only for all samples originating from Australia or Papua New Guinea. It is NOT recorded on the punched cards and, as such, is not required for registration purposes.

For Oceanographic and Antarctica samples, latitude and longitude are the only means of recording locality information. The procedure for this is given in the chapter on Sample Location (see page 4).

Explanation:

The Explanation must be a clear and concise statement of what the submitter requires to be done with the sample and for what reason. Supervisors are required to check this aspect. Samples submitted without adequate explanation will be returned to the originator or field party or held by Transit until the party's return to Canberra. Officers submitting samples should recognize that not only does work on them require time and money and should therefore be of some purpose, but also that an adequate explanation of the reason for submitting a sample is of considerable assistance to the specialist who examines the sample.

Registered Number:

The Registered Number will now be allocated by the Originator or Field Party to all samples submitted for examination or storage in the Museum.

It is an eight digit number of which the first two digits represent the year in which the sample is collected (e.g. this year would be indicated by 64).

The second two digits constitute a prefix which will be allocated to each field party or individual collector and which will be obtainable from the Transit Room manager. This prefix will characterise all samples collected in a specific area (e.g. a 1:250,000 Sheet) or for a special project where collecting is scattered (e.g. the age determination programme). If the party or project carries on into the following year or is expected to be continued in the near future, the same prefix number would be retained for that project. Where more than one geochemical sampling grid is to be used in any one area, (e.g. Rum Jungle, Tennant Creek) a prefix number will be allocated for each grid.

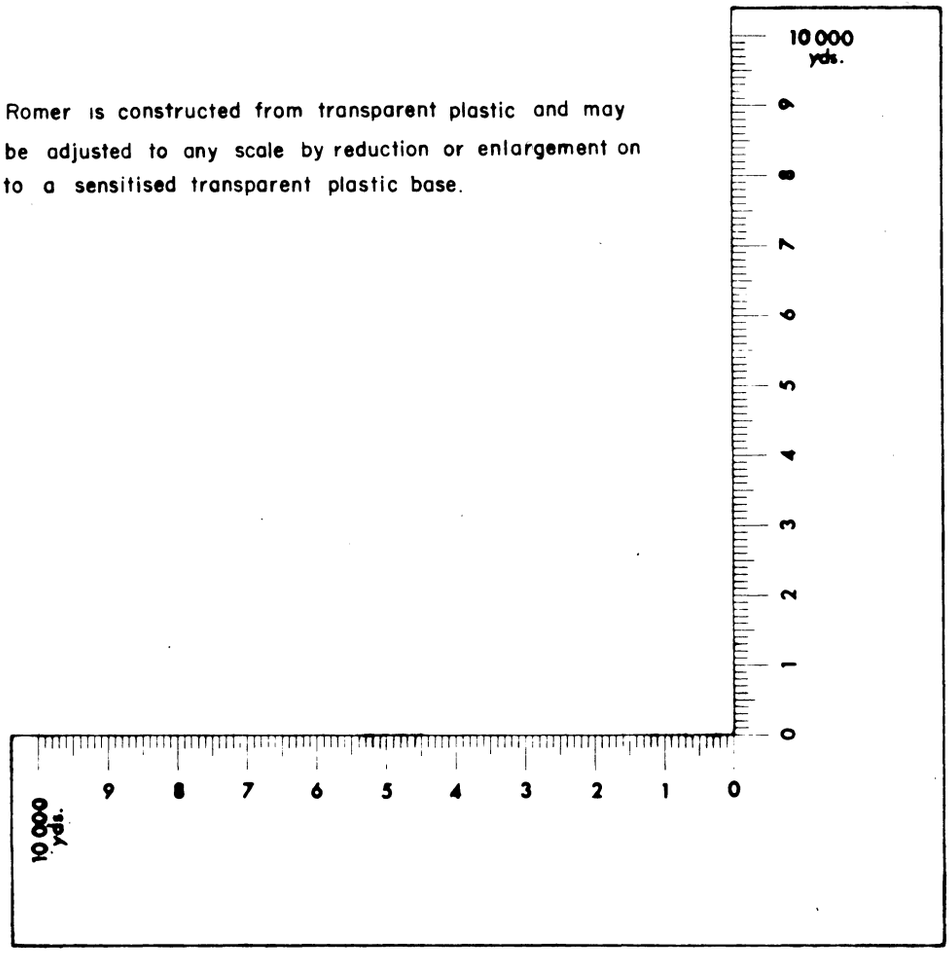
The next four digits are the Serial Number which provides for a maximum of 9999 samples for each prefix and year. Should this number be exceeded (e.g. geochemical sampling programmes), a second prefix will be allocated.

Where only a few samples are being collected the Serial Number may be abbreviated for writing on the sample e.g. 64120005 may be written on the sample as 6412/5. The prefix number should not be abbreviated. No abbreviation should be made on the Sample Submission Form, on which the Registered and Serial Numbers must always be entered in full.

All age determination samples will be given registered numbers (GA prefix) only after they have been passed as suitable. The registered number will be given in the Transit Room. Samples registered with R prefix during 1964 and before will retain this number on the punched cards.

The Fraction Number is not to be filled in by submitter. It is provided for laboratory use where a sample is separated into a number of different fractions (e.g. fossils, minerals, size fractions etc.).

Romer is constructed from transparent plastic and may be adjusted to any scale by reduction or enlargement on to a sensitised transparent plastic base.



Romer used for the rapid determination of military grid coordinates

ENTRY Nº	PRIORITY	SHORT DESCRIPTION	REGISTRATION NUMBER	FILE			ORIGINATOR	GENERAL LOCATION	DATE		WORK AREA	NO. OF SAMPLES	DATE REPORT FORMS		SAMPLE DISPOSAL
				PARTY	GEN.	TECH.			REC'D.	DISPATCH			REC'D	TYPED	

The Day Book is cross indexed. Each project is listed sequentially at back of book with all Day Book entries entered against each project.

FIG. 4 SPECIMEN PAGE OF DAY BOOK

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M(PI)/21

Grid Reference - Sample Location:

All samples will in future be located by means of the Australian Grid system or, in the case of the Territory of Papua - New Guinea, by the U.T.M. Grid system. (In a few years time the U.T.M. Grid system will also be used in Australia. The punched card design allows for a change over to be made without disrupting the general card layout).

For each sample the Zone should be specified. In the case of the Australian Grid they are numbered from 1 to 8. Here 0 should be placed in the first Zone box and the Zone digit in the second box. For Papua and New Guinea the zones are numbered from 54 to 56, and both boxes should be used. Where a mine or other arbitrary grid is used, insert only the figures 09 in the zone box (the figure 09 is a card code which identifies the fact that an arbitrary or other grid is being used).

In the location of geological samples on Military or Metric grids easting and northing co-ordinates should be given as fully as possible for each sample. 13 digits provide for location of samples to the nearest yard (6 digits easting followed by 7 digits northing) but it is of course unnecessary to use all digits in all cases - location at this accuracy would only be desired for closely spaced sampling grids where analytical results are to be plotted by means of an automatic data plotter. In many cases where petrological specimens are being collected it may be necessary to locate samples only to the nearest 100 yds. or so. In such cases the last boxes in each of the easting and northing group should be filled in progressively with zeros (e.g. a four figure easting and a five figure northing would be:

| 2 | 3 | 2 | 6 | 0 | 0 |

| 1 | 8 | 2 | 6 | 5 | 0 | 0 |

Care should be taken not to omit the first digit of the northing. This is usually indicated in very small type in the margin. If the northing only goes to six digits a zero should be placed in the first northing box.

Geologists should make sure that, before leaving for the field, the military grid has been superimposed on transparent photoscale compilation maps covering their field area. The co-ordinates of any point plotted on an aerial photograph may then be located by laying the maps on the photograph. Reading of the grid coordinates can be greatly facilitated by the use of a Romer, (fig. 3), a transparent L shaped scale graduated along the two ordinates of the scale. These Romers can be provided by the drawing office and should match the scale of the photoscale compilations. If photoscale compilations are not available, geologists should locate samples on topographic maps on which the Australian grid has been superimposed. Where samples are being collected on grids not aligned with military grid ordinates, the position of two points on the base line should be given in terms of the arbitrary and military coordinates. (If the grid is properly surveyed, the surveyor can be requested to provide this information). From these data the military grid references may be obtained for all other points on the grid. Geologists are reminded that the origin and selected points on a surveyed base line should be marked by star pickets set in concrete. It should also be noted that all grids not aligned with military or metric grids should have a false origin well outside the grid so that all coordinates may be given as eastings and northings and in terms of feet. This will greatly facilitate future computations and automatic plotting of results.

For oceanographic and Antarctic samples, the location should be given as geographical coordinates. Latitude should be recorded as a six digit number (four decimal places) in the Easting boxes and Longitude as a seven digit number (four decimal places) in the Northing boxes. Both should be decimalised in terms of degrees (see Inman's Nautical Tables

With oceanographic samples the Marine Province should be indicated in the Zone boxes as follows:-

AB Great Australian Bight	CP Coral Sea Platform	NR Naturalist Ridge
AS Arafura Sea	CS Coral Sea	PO Pacific Ocean
BR Barrier Reef	GC Gulf of Carpentaria	TM Timor Sea
BS Bass Strait	IO Indian Ocean	TS Tasman Sea

For Antarctic samples the appropriate U.T.M. (Universal Transverse Mercator) zone should be indicated.

The locality reference is designed for a number of requirements and it will be understood that not all the boxes and lines for the locality reference need to be filled in by every sample submitter. Leave blank those which do not concern you.

Please remember that in giving a military grid reference the Easting is given first and the Northing second.

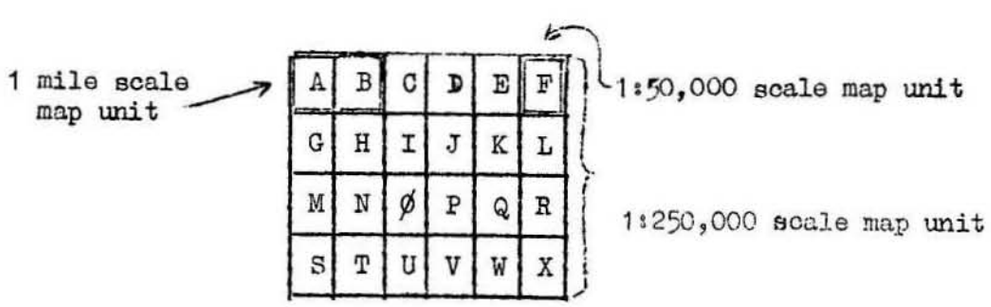
State

The State or Territory should be indicated. This includes A.C.T., N.T., T.P.N.G., Island Territories and Antarctica.

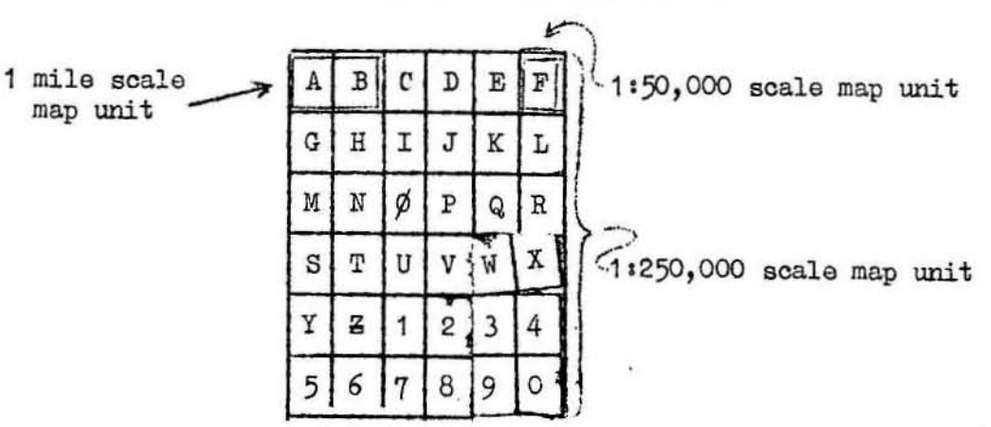
1:250,000 Map Reference: A map number such as SD 55/13 (Cooktown) is coded by omitting the prefix 'S' and the oblique stroke, thus becoming D5513. SE 55/1 would become E 5501.

1 Mile or 1:50,000 Map Reference

The procedure to be adopted for coding of 1 mile and 1:50,000 map areas within 4 mile or 1:250,000 scale maps in the Australian Index is shown diagrammatically below.



Coding of 1 mile and 1:50,000 map areas within 4 mile or 1:250,000 scale maps in the Papua - New Guinea Index is shown below



With the old and current map index System each 4 mile or 1.250,000 Sheet was divided into twelve 1-mile sheets. In the next year or two the 1:250,000 scale map unit will be divided into 1:100,000 Sheets and also subdivided into twenty-four 1:50,000 scale map units. In Papua-New Guinea there are thirty-six 1:50,000 scale map units per 1:250,000 map unit.

The coding system illustrated above indicates the code letters that would be used for all 1:50,000 maps in a 1:250,000 map unit. Pairs of these units, e.g. A + B, etc., represents a 1-mile scale map at present in use. Thus when giving a sample location on a one-mile map, the 1:50,000 map code letter or digit used will depend on whether the sample is on the west or east half of the one-mile map. If on the western half A is used, if on the eastern half B and so on.

For the present, 1:100,000 scale maps are not included in the rock indexing scheme.

Sample Depth, R.L. Collar, Interval, Inclination, Azimuth.

These are for use when submitting drill core, sludge cuttings or fluids for examination and are self-explanatory. Where hole is vertical, use 90°. If the RL of the collar is not known, leave this space blank. A True or Magnetic Aximuth should be indicated by crossing out the T or M - whichever is not applicable.

NOTE : Aximuth and Inclination refer only to readings taken at the collar of the hole. The problem of bearings etc. in drifting holes is still under study and has not yet been solved.

Allowance has been made in the card layout for registering samples by the Rock Unit Name, thus allowing information on any particular rock unit to be extracted. It is necessary therefore that the formal name only be recorded. Do NOT use informal names on the original sample submission form. Allowance has been made in the system for formal nomenclature to be added before final registration (see flow sheet). The party or originator can, if they so desire, keep a record of their own informal nomenclature on the duplicate copy which they retain.

Where other stratigraphic information listed is not known, the spaces should be left blank. The broader terminology, e.g. Palaeozoic, can be used if the details are not known.

The stratigraphic information will not be punched on the cards until final registration i.e. when the completed report form is returned to the Transit Room by the field party or originator. Its inclusion on the Sample Submission Form is for guidance of specialists examining specimens.

In the case of samples going direct to the Museum, no report form is made out. In such cases, the Transit Room will use the information on stratigraphy given on the Sample Submission Form for final registration.

Doubtful information such as "(?) Palaeozoic" is not acceptable. If you do not know, leave the space blank.

Era and Period, Epoch and Stage.

Era and Period, as given below are not used as strictly defined and are designed for ease in sorting only. They cannot be extended indefinitely without use of alpha coding (which we wish to avoid where possible) and some licence has been taken with the terminology.

Use only one "Period" and one "Era". The choice of which one to use is left with the sample submitter.

In sorting punched cards it is useful to be able to sort on general as well as detailed information - therefore if both Era and Period are known both should be filled in.

ERAS used for the punched cards are as follows:

Quaternary
Tertiary
Cainozoic
Mesozoic
Palaeozoic
Upper Palaeozoic (Devonian, Carboniferous Permian)
Lower Palaeozoic (Cambrian, Ordovician, Silurian)
Proterozoic
Precambrian

PERIODS used are:

Recent	Cretaceous	Devonian
Pleistocene	Jurassic	Siluro-Devonian
Pliocene	Triassic	Silurian
Miocene	Permo-Triassic	Ordovician
Oligocene	Permian	Cambrian
Eocene	Permo-Carboniferous	Sub Cambrian
Palaeocene	Carboniferous	Upper Proterozoic
		Middle Proterozoic
		Lower Proterozoic
		Archaean

Epoch is Lower, Middle, and Upper. It refers to Period, and not to Era. The reason for restricting its meaning to Period is to avoid ambiguities in the sorting and selection of punched cards.

Stage refers to the palaeontologically defined divisions within the Periods. For example, stages with the Cretaceous are Neocomian, Aptian, Albian, Cenomanian, Turonian, Senonian, and Maestrichtian.

Sample Significance - Source and A.V.M. are items on the Sample Submission Form which the submitter is required to fill in in code. Instructions for coding will be printed in each book of forms. Until this is done reference should be made to this Record for instructions.

Sample Significance

This relates the method of sampling a specimen to the rock body or deposit from which it was obtained.

Typical of rockmass or deposit	Typical of a particular part of a rock-mass or deposit	Relationship to rockmass or deposit not known	
B	K	S	Single specimen selected for a particular purpose.*
C	L	T	Other single specimen.
D	M	U	Composite specimen, fractions combined quantitatively proportional to some rock characteristic.
E	N	V	Composite, fractions combined intuitively.
F	Ø	W	Composite, fractions combined in taking (channel sample).
G	P	X	composite in nature (drill cuttings).

Examples of coding:

(a) A specimen which is typical of a rockmass (B to G) and which is purposefully selected (B,K,S) is coded B.

(b) A composite specimen, fractions combined quantitatively proportional to some rock characteristic (D, M, U), and typical of a particular part of a rock mass (e.g. a facies in a sedimentary bed, or a chilled margin of an igneous intrusion), i.e. K to P, is coded M.

* It is not necessary to specify the particular purpose for coding.

Source and A.V.M.

Source implies how and where a specimen was collected - e.g. if it comes from an outcrop or diamond drill hole, or a tailings dump. Source is coded in conjunction with A.V.M. which, broadly speaking, gives an idea of the kind of material that was collected - e.g. rock, soil, water, etc. (metaphorically - Animal, Vegetable or Mineral). The code to be used is the capital letter shown in brackets on the left of each example. (It is not necessary to use the brackets in filling in the form).

Source

(A) Outcrop (natural exposure).

(B) Artificial exposure (quarry, road cutting and soils).

(C) Floater (loose block or boulder on surface that is composed of material similar to the underlying rock).

(D) Erratic (A transported floater that is different from the underlying rock).

(E) Mine

(F) Volcanic exhalation product. Refers to gas, water, or sublimate obtained from a volcano (see A.V.M.); it does not refer to lavas or pyroclastic rocks.

(G) Surface seepage (of water, oil).

(H) Stream sample (of water, sediment, etc.).

(I) Lake sample (of water, sediment, etc.).

(J) Marine sample (of water, sediment, etc.).

(K) Beach sample (sand, detrital concentrate, etc.).

(L) Auger sample.

(M) Bore, well, diamond drill hole.

(N) Core cuttings.

(O) Smelter.

(P) Refinery.

(Q) Extra-terrestrial.

(R) Mine dump (untreated).

(S) Tailings.

(Z) Miscellaneous.

A.V.M.

(A) Rock.

(B) Weathered rock.

(C) Sand.

(D) Detrital concentrate (obtained by panning).

(E) Magnetic fraction of detrital concentrate.

(F) Sediment sample (from stream, lake, etc. - see source).

(G) Soil.

(H) Encrustation.

(I) Sublimate (from volcanic action).

(J) Water (from stream, volcano, sea).

(K) Oil (from seepage, well, etc.).

(L) Tar.

(M) Gas (from well, volcano).

(N) Ore.

(P) Mineralized rock.

The remaining items on the Sample Submission Form do not concern the submitter except where he is aware in advance of the work area or destination of the sample.

Supervisors are required to check the work area or repository nominated, or indicate this if necessary.

The Remarks column is for the Supervisor's use.

REPORT FORMS

Examples of the Report Forms are shown in figs. 5 to 19. To date Report Forms have been designed only for those work areas which have adopted the 80 column card system. Others will be designed for other work areas in due course.

Supervisors are to check the main work area or areas nominated on the Sample Submission Form or fill in this information themselves if it is not provided by the originator. Other work areas can be added by the laboratories if required. The Transit Room Manager will make up the report form(s) for the work area(s) nominated, as described on pages 16 to 64.

In the case of geochemical samples, the Sample Submission Form and the locality reference section of the Report Form for each individual sample is combined on the printed sample bag (fig.20). The procedure for these samples is shown on the Flow Diagram. The Report Form used is the normal Chemistry Form. (see Fig. 10.).

The Report Forms have two uses:- they are a means of recording and distributing the information to which they refer - e.g., chemical, petrological, etc.; and they are a convenient means of summarizing and presenting information in a form suitable for recording on punched cards - in other words, they are punched card schedules. They are coloured according to the work areas they refer to as follows:

Petrology - green
Mineralogy - yellow
Chemistry - white
Age-determination-pink

The colours are the same as those on the Group Master cards.

The responsibility for filling in and coding the information on the report forms is outlined below:

Petrology has one Report Form. On the front side (Fig.5) the punched card information is coded in the numbered boxes; each box represents a column on a punched card. On the reverse side (Fig.6), the detailed petrographic description is written.

On the front of the form, the Transit Room Manager fills in and codes all the information from the top of the form down to the line containing "Source" and "A.V.M."

The petrologist fills in the information on the rest of the form, but does not code. This is coded by the Transit Room Manager when the form is returned to him.

The petrographic description on the reverse side of the form is filled in by the petrologist.

Age-Determination has two Report Forms one carries the Master Card and Reference Card information, and the other, the Detail Card information.

(1) Master Card Information. To be found on the front of the first report form (Fig. 16). The Transit Room Manager fills in and codes all information from the top of the form to the line containing "Source" and "AVM". The geologist fills in, but does not code, the remaining information; this is coded by the Transit Room Manager.

(2) Reference Card Information, i.e. Petrographic Description, General Geology, and References, are filled in on the reverse side (Fig. 17) of the first report form by the geologist.

(3) Detail Cards Information. (Fig. 18 and 19) Here, information referring to the mineral to be analysed, and the analytical data, are to be inserted. The information is filled in and coded by the following:-

(a) Boxes 1 to 11 - Transit Room Manager

(b) The section headed "B.M.R. Laboratory" by the B.M.R. mineral separation technician.

(c) The section headed "Geochronology Laboratory", to be filled in by the A.N.U. mineral separation technician, and to be coded by the Transit Room Manager.

(d) The analytical information for the Potassium/Argon, Rubidium/Strontium, and Lead Isotope methods, to be completed by the analyst.

It should be noted that if more than one mineral from the same sample is to be analysed, then a different Analytical Report Form for each mineral has to be filled in.

Mineralogy has two Report Forms; one carries the Master Card Reference Card information, and the other, Detailed Information.

1. Master Card Information (Fig. 7) All basic data are coded and added to Report Form by the Transit Room Manager.

2. Reference Card Information (Fig.8) The heading, Originator's name, and sample number are completed by the Transit Room Manager.

The description and conclusions are completed by the mineragrapher.

3. Detailed Information (Fig.9) The first four lines are completed by the Transit Room Manager. The mineragrapher fills in the remainder, but does not code; this is to be done by the Transit Room Manager.

Chemistryhas two Report Forms, one for the Master Punched Card, the other for the analytical details.

1. Master Card Report Form(Fig.10). The main body of the form is divided into 80 vertical columns, each one representing an equivalent column on a punched card. It is also divided into thirty-two horizontal rows, each row representing a particular punched card. The style of this form differs from those of petrology, mineralogy, and age-determination because it has to cater for large numbers of specimens for which there is repetitive information - e.g., for samples collected from a grid survey within one 1:250,000 Sheet area, the map number is the same for all specimens.

On this form, repetitive information is to be filled in on the horizon line marked "Constant Data". Thereafter,in the horizontal rows below, it need not be marked. Information that is unique to each specimen - e.g., specimen numbers, grid references, etc., are to be marked in the

Fig. 5

PETROLOGY REPORT FORM [1]

Sequence No. [2] Date Recd.....

Originator ..... Date../../...

Point No..... Photo..... Run ..... Survey Set.....

Year [3 4] Project [5 6] Serial No [7 8 9 10] Fraction No [11]

Zone [12 13] * Mil grid E [14 15 16 17 18 19] N [20 21 22 23 24 25 26]
Metric grid

Foreign Col..... [27 28] State..... [29] 1:250,000 Sheet [30 31 32 33 34] 1:50,000 Sheet [35]

STRATIGRAPHY

Rock unit Name ..... [36 37 38 39] Rank..... [40]

Age: Era..... [41] Period..... [42] M.Y..... [43]

Epoch ..... [44] Stage..... [45 46]

GENERAL

Significance ..... [47]

Source..... [48] AVM..... [49]

Report Ref: Type..... [50] Number.... [51 52 53 54 55]

SAMPLE INFORMATION

Sample type..... [56] General Description ..... [57]

Name..... [58 59 60]

Mineral Qualifier..... [61 62 63]

Texture ..... [64]

Alteration..... [65]

IGNEOUS

Mode of Occurence ..... [66]

METAMORPHIC

Metamorphic facies..... [66]

Type of metamorphism..... [67]

Original material..... [68]

Type of metasomatism..... [69]

SEDIMENTARY

Porosity / Grains: Matrix ratio (1 or 2) ..... [66]

Permeability / Grain angularity (1 or 2) ..... [67]

Cement or matrix..... [68]

Structure ..... [69]

Summary description

* Delete that not applicable

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Fig. 6.

PETROGRAPHIC DESCRIPTION

Registered No. . . . . .

Rock name

Petrologist . . . . . Date...../...../.....

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Fig. 7.

MINERALOGY REPORT FORM

1 ☐ Sequence No. 2 ☐ Date Recd ../../..

Originator ..... Date ../../...

Point No. ..... Photo ..... Run ..... Survey Set .....

Year 3 4 ☐☐ Project 5 6 ☐☐ Serial No 7 8 9 10 ☐☐☐☐ Fraction No 11 ☐

Zone 12 13 ☐☐ * Mil grid / Metric grid E 14 15 16 17 18 19 ☐☐☐☐☐☐ N 20 21 22 23 24 25 26 ☐☐☐☐☐☐☐

Foreign Col. ..... 27 28 ☐☐ State ..... 29 ☐ 1:250,000 Sheet 30 31 32 33 34 ☐☐☐☐☐ 1:50,000 Sheet 35 ☐

STRATIGRAPHY

Rock unit Name ..... 36 37 38 39 ☐☐☐☐ Rank ..... 40 ☐

Age: Era ..... 41 ☐ Period ..... 42 ☐ M.Y. ..... 43 ☐

Epoch ..... 44 ☐ Stage ..... 45 46 ☐☐

GENERAL

Significance ..... 47 ☐

Source ..... 48 ☐ AVM ..... 49 ☐

Report Ref: Type ..... 50 ☐ Number ... 51 52 53 54 55 ☐☐☐☐☐

SAMPLE INFORMATION ; Type ..... 56 ☐

Mine or Prospect Name ..... 58 59 60 61 62 ☐☐☐☐☐

Azimuth ..... 63 64 65 ☐☐☐ Inclination ..... 66 67 ☐☐

Surface to top of Interval ..... 68 69 70 71 72 ☐☐☐☐☐ Interval ..... 73 74 75 ☐☐☐

Reduced level ..... 76 77 78 79 ☐☐☐☐

* Delete that not applicable

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Fig.8

MINERALOGY REPORT FORM..... [1] Sequence No. [2] Date Recd.....

Originator.....Date../../..

Point No..... Photo..... Run.....Survey Set.....

Year [3][4] Project [5][6] Serial No. [7][8][9][10] Fraction No. [11]

Ore minerals identified .....

Conclusions .....

Mineralogist..... Date../.../.....

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Fig.9.

MINERALOGY REPORT FORM

1 ☐ Sequence No. 2 ☐ Date Recd. . /. . /. .

Originator . . . . . Date../. ./. . .

Point No. . . . . Photo . . . . . Run . . . . Survey Set . . . . . .

Year 3 4 ☐☐ Project 5 6 ☐☐ Serial No. 7 8 9 10 ☐☐☐☐ Fraction No. 11 ☐

SAMPLE INFORMATION

Number of ore minerals . . . . . 12 ☐

COMPOSITION

Major metal . . . . . 13 ☐ Minor metal . . . . . 14 ☐ Other significant metal . . . . . 15 ☐

Major non–metal . . . . . 16 ☐ Minor non–metal . . . . . 17 ☐

Other significant non–metal . . . . . 18 ☐

CLASSIFICATION

Mineral name . . . . . 19 20 21 22 23 ☐☐☐☐☐ Mineral deposit . . . . . 24 ☐

Genetic classification . . . . . 25 ☐ Deposit form . . . . . 26 ☐

DESCRIPTION

PRIMARY TEXTURES & STRUCTURES

Habit or form . . . . . 27 ☐ Zoning or banding . . . . . 28 ☐

SECONDARY TEXTURES & STRUCTURES

Supergene alteration . . . . . 29 ☐ Tectonic deformation . . . . . 30 ☐

Replacement structures . . . . . 31 ☐

GENERAL

Paragenetic sequence . . . . . 32 ☐ Other work areas . . . . . 33 ☐

SOILS

Undifferentiated type . . . . . 34 ☐ Pedalfer . . . . . 35 ☐

Pedacol . . . . . 36 ☐

Parent: igneous . . . . . 37 ☐ Parent: metamorphic . . . . . 38 ☐

Parent: Sedimentary . . . . . 39 ☐

Soil horizon . . . . . 40 ☐ Topography . . . . . 41 ☐

Rainfall . . . . . 42 ☐ Soil components . . . . . 43 ☐

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Fig. 10

Date ....

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

CHEMISTRY REPORT FORM

Group Master

Originator .....

Field Party .....

Batch No ..... Sheet ..... of .....

Analytical Method .....

CONSTANT DATA
PUNCH IN EVERY CARD

CARD CODE	SEQUENCE No	REGISTERED NUMBER: YEAR	PREFIX	SERIAL No	FRACTION	GRID REFERENCE: ZONE	EASTING	NORTHING	FOREIGN	STATE	1:250,000 SHEET No.: LATITUDE	ZONE	1:50,000 SHEET: SHEET No	1:50,000 SHEET	STRATIGRAPHY: ROCK UNIT: NAME	RANK	AGE: ERA	PERIOD	M.Y.	EPOCH	STAGE	SIGNIFICANCE	SOURCE	A.V.M.	REPORT REFERENCE: STYLE	REPORT No	SAMPLE TYPE	SAMPLE DESC	SAMPLE INFORMATION	DEPTH: SURFACE TO TOP OF INTERVAL	WIDTH OF INTERVAL	FRACTION	pH	CONTAMINATION
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Date .....

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

CHEMISTRY REPORT FORM

Metals — 1.

Originator .....

Field Party .....

Batch No ..... Sheet ..... of .....

Analytical Method .....

CONSTANT DATA
PUNCH IN EVERY CARD

All results are expressed as percent of the air-dried sample.
For each element the 1st, 2nd and 3rd columns give the digital value, the 4th column indicates the position of the decimal point. (See code manual)

CARD CODE	No SEQUENCE	REGISTERED NUMBER			FRACTION	Ag	As	Be	Bi	Cd	Co	Cu	Mo	Ni	Pb	Sb	Se	Sn	Te	V	Zn	ANALYST			
		YEAR	PREFIX	SERIAL Nº																					
1	2	3 4	5	6 7 8 9 10	11	12 13 14 15	16 17 18 19	20 21 22 23	24 25 26 27	28 29 30 31	32 33 34 35	36 37 38 39	40 41 42 43	44 45 46 47	48 49 50 51	52 53 54 55	56 57 58 59	60 61 62 63	64 65 66 67	68 69 70 71	72 73 74 75	76	77	78	79 80

Bureau of Mineral Resources, Geology & Geophysics.

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Fig. 11

Date ....

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

CHEMISTRY REPORT FORM

Metals – 2.

Originator ....

Field Party ....

Batch No .... Sheet .... of ....

Analytical Method ....

CONSTANT DATA
PUNCH IN EVERY CARD

All results are expressed as percent of the air-dried sample.
For each element the 1st, 2nd and 3rd columns give the digital value, the 4th column indicates the position of the decimal point. (See code manual)

CARD CODE	SEQUENCE No	REGISTERED No. YEAR	PREFIX	SERIAL No.	FRACTION	Al	Ba	Ca	Cr	Fe	Ga	Hg	K	Li	Mn	Mg	Na	Rb	Si	Sr	Ti	ANALYST		
1	2	3 4	5 6	7 8 9 10	11	12 13 14 15	16 17 18 19	20 21 22 23	24 25 26 27	28 29 30 31	32 33 34 35	36 37 38 39	40 41 42 43	44 45 46 47	48 49 50 51	52 53 54 55	56 57 58 59	60 61 62 63	64 65 66 67	68 69 70 71	72 73 74 75	76 77	78 79 80	

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Fig. 12

Date .....

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CHEMISTRY REPORT FORM

Metals — 3

Originator .....

Field Party .....

Batch No ..... Sheet ..... of .....

Analytical Method .....

CONSTANT DATA
PUNCH IN EVERY CARD

-	CARD CODE	SEQUENCE No	REGISTERED No. YEAR	PREFIX	SERIAL No.				FRACTION	Au	Cs	Ge	Hf	In	La	Nb	Pd	Pt	Sc	Ta	Tl	U	W	Y	Zr	ANALYST			
										All results are expressed as percent of the air-dried sample. For each element the 1st, 2nd and 3rd columns give the digital value, the 4th column indicates the position of the decimal point. (See code manual)																		
1	2	3	4	5	6	7	8	9	10	11	12 13 14 15	16 17 18 19	20 21 22 23	24 25 26 27	28 29 30 31	32 33 34 35	36 37 38 39	40 41 42 43	44 45 46 47	48 49 50 51	52 53 54 55	56 57 58 59	60 61 62 63	64 65 66 67	68 69 70 71	72 73 74 75	76 77	78 79	80

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Fig.13

Date .....

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CHEMISTRY REPORT FORM

Non-Metals and Radicals

Originator .....

Field Party .....

Batch No ..... Sheet ..... of .....

Analytical Method .....

CONSTANT DATA
PUNCH IN EVERY CARD

CARD CODE	SEQUENCE No	REGISTERED No.			FRACTION	All results are expressed as percent of the air-dried sample. For each element or radical the 1st, 2nd and 3rd columns give the digital value, the 4th column indicates the position of the decimal point. (See code manual)																			
		YEAR	PREFIX	SERIAL No.		B	Br	C	Cl	CO_3	F	I	NO_3	P	S	SO_4		INSOLUBLE RESIDUE	LOSS ON IGNITION	$H_2O(+)$	$H_2O(-)$	ANALYST	
1	2	3 4	5 6	7 8 9 10	11	12 13 14 15	16 17 18 19 20	21 22 23	24 25 26 27	28 29 30 31	32 33 34 35	36 37 38 39	40 41 42 43 44	45 46 47	48 49 50 51	52 53 54 55	56 57 58 59	60 61 62 63	64 65 66 67	68 69 70 71	72 73 74 75	76	77 78 79 80	

Fig. 14

Date .....

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CHEMISTRY REPORT FORM

Silicate Analysis

Originator .....

Field Party .....

Batch No ..... Sheet ..... of .....

Analytical Method .....

CONSTANT DATA
PUNCH IN EVERY CARD

CARD CODE	SEQUENCE No	REGISTERED NUMBER: YEAR	PREFIX	SERIAL Nº	FRACTION	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	$H_2O(+)$	$H_2O(-)$	CO_2	TOTAL	ROCK OR MINERAL NAME	ANALYST	ANAL. METHOD	
1	2	3 4	5	6 7 8 9 10	11	12 13 14 15	16 17 18 19	20 21 22 23	24 25 26 27	28 29 30 31	32 33 34 35	36 37 38 39	40 41 42 43	44 45 46	47 48 49 50 51	52 53 54 55	56 57 58 59	60 61 62 63	64 65 66 67	68 69 70 71 72	73 74 75 76 77	78 79	80	

All results are expressed as percent of the air-dried sample
The decimal point is located between the 2nd and 3rd columns for each constituent and between the 3rd and 4th for TOTAL

Fig. 15

Fig. 16

AGE DETERMINATION REPORT FORM

1 ☐ Sequence No. 2 ☐ Date Recd .....

Originator ..... Date ../../.... Field No. .....

Point No. ..... Photo ..... Run ..... Survey Set .....

Year 3 4 ☐☐ Project 5 6 ☐☐ Serial No. 7 8 9 10 ☐☐☐☐ Fraction No. 11 ☐

Zone 12 13 ☐☐ • Mil grid / Metric grid E 14 15 16 17 18 19 ☐☐☐☐☐☐ N 20 21 22 23 24 25 26 ☐☐☐☐☐☐☐

Foreign Col ..... 27 28 ☐☐ State ..... 29 ☐ 1:250,000 Sheet 30 31 32 33 34 ☐☐☐☐☐ 1:50,000 Sheet 35 ☐

STRATIGRAPHY

Rock unit Name ..... 36 37 38 39 ☐☐☐☐ Rank ..... 40 ☐

Age: Era ..... 41 ☐ Period ..... 42 ☐ M.Y. ..... 43 ☐

Epoch ..... 44 ☐ Stage ..... 45 46 ☐☐

GENERAL

Significance ..... 47 ☐

Source ..... 48 ☐ AVM ..... 49 ☐

Report Ref: Type ..... 50 ☐ Number 51 52 53 54 55 ☐☐☐☐☐

SAMPLE INFORMATION

Sample type ..... 56 ☐ General Description ..... 57 ☐

Name ..... 58 59 60 ☐☐☐

Mineral Qualifier ..... 61 62 63 ☐☐☐

Texture ..... 64 ☐

Alteration ..... 65 ☐

IGNEOUS

Mode of Occurrence ..... 66 ☐

METAMORPHIC

Metamorphic facies ..... 66 ☐

67 Sample : Deferred ..... ☐ Rejected ..... ☐ To laboratory ..... ☐ Age determined ..... ☐ 67

68 Petrography available ..... ☐ Slide cut ..... ☐ Chem. analysis ..... ☐ 68

METHOD INDEX

K/Ar ..... 69 70 71 72 ☐☐☐☐

Rb/Sr ..... 73 74 75 76 ☐☐☐☐

Lead isotope ..... 77 78 ☐☐

Other ..... 79 ☐

* Delete that not applicable

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Fig.17.

PETROGRAPHIC DESCRIPTION

Name . . . . . .

Described by . . . . . Date../../...

GENERAL GEOLOGY

Supplied by Date / /

REFERENCES

Supplied by Date / /

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Fig.18

AGE DETERMINATION REPORT FORM. [1] ANALYTICAL RESULTS Sequence No. [2]

Year [3 4] Project [5 6] Serial No. [7 8 9 10] Fraction No. [11]

Field No. .....

BMR LABORATORY

Mineral..... Concentrate available..... Grain size..... Purity.....

Remarks.....

Prepared by..... Date../../.....

Forwarded by..... Date../../.....

GEOCHRONOLOGY LABORATORY

Mineral.... [12 13 14 15] Concentrate available..... [16] Grain size... [17 18 19] Purity... [20 21]

POTASSIUM / ARGON METHOD [22]

Replicate analyses [23] Decay constants; $\lambda\beta$ [24 25 26] $\times 10^{-10-1}$ y; λK [27 28 29] $\times 10^{-10-1}$ y; K abund [30 31 32] $\times 10^{-4}$ g/g K

%K [33 34 35 36 37] Ar^{40} atm [38 39 40] $^{40}Ar^{*}/^{40}K$ [41 42 43 44 45] calculated **Age** [46 47 48 49] x10y; Age sig. [50]

Remarks.....

%K [51 52 53 54 55] Ar^{40} atm. [56 57 58] $^{40}Ar^{*}/^{40}K$ [59 60 61 62 63] **calculated age** [64 65 66 67] $\times 10^{6}$y; Age sig. [68]

Remarks.....

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Fig. 19

RUBIDIUM — STRONTIUM METHOD [22]

Replicate analyses [23] Constants: $\lambda\ Rb^{87}$ [24 25 26] $\times 10^{-11} y^{-1}$; Rb^{85}/Rb^{87} [27 28 29 30] Sr^{88}/Sr^{86} [31 32 33 34 35]

Common Sr [36 37 38 39 40 41 42] Total Rb [43 44 45 46 47 48 49] Rb^{87}/Sr^{86} [50 51 52 53 54]

Sr^{87}/Sr^{86} Initial Ratio [55 56 57 58 59] Sr^{87}/Sr^{86} Present Ratio [60 61 62 63 64 65]

Calculated age [66 67 68 69 70] $\times 10^4 y$ Related specimens [71] Age significance [72]

Remarks . . . . . .

LEAD ISOTOPE METHOD [22]

CARD 1

Replicate analyses [23] Related samples [24] Decay constants

U^{238} [25 26 27] $\times 10^{-10} y^{-1}$ U^{235} [28 29 30] $\times 10^{-10} y^{-1}$

Th [31 32 33] $\times 10^{-11} y^{-1}$ U^{238}/U^{235} [34 35 36]

Observed Isotopic ratios: Pb^{204}/Pb^{206} [37 38 39 40 41 42] Pb^{206} [43 44 45 46 47 48]

Pb^{207}/Pb^{206} [49 50 51 52 53 54] Pb^{208}/Pb^{206} [55 56 57 58 59 60]

Concentrations U [61 62 63 64 65 66] Th [67 68 69 70 71 72] Pb [73 74 75 76 77 78]

CARD 2

RADIOGENIC LEAD

Calculated ages: Pb^{206}/U^{238} [24 25 26 27] Pb^{207}/U^{235} [28 29 30 31] Pb^{207}/Pb^{206} [32 33 34 35]

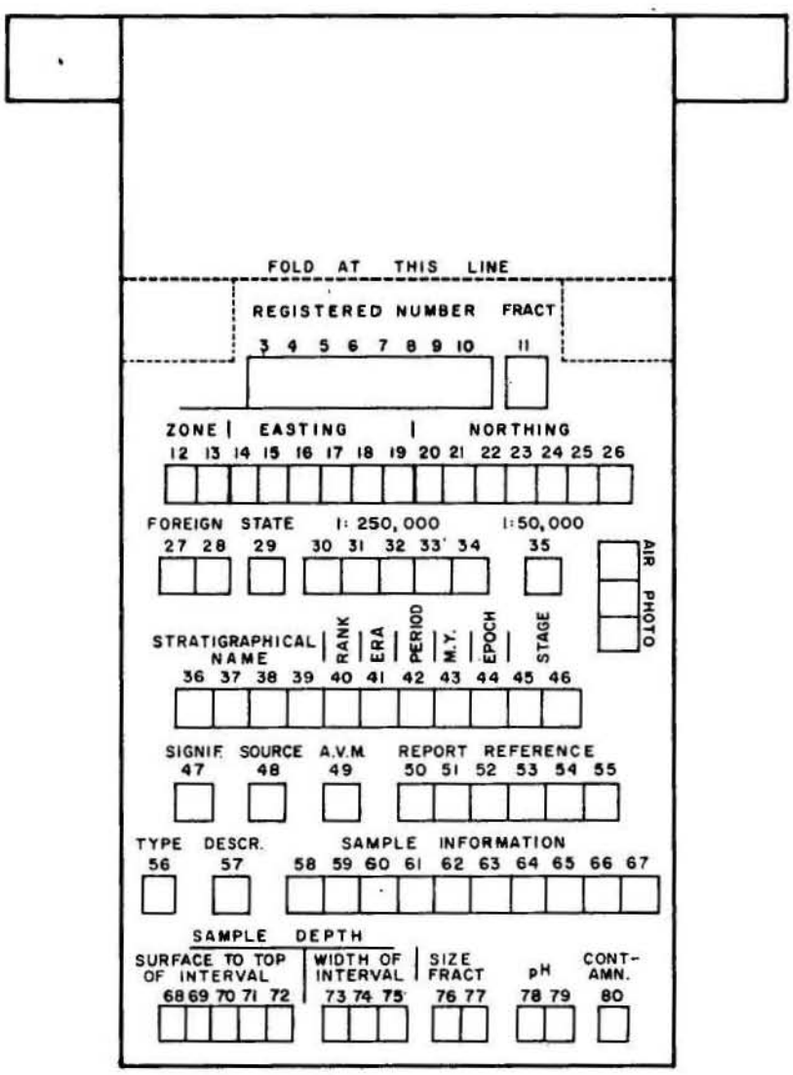
Pb /Th [36 37 38 39] True age [40 41 42 43 44] Meta. age [45 46 47 48 49]

COMMON LEAD

Parent rock U/Pb [50 51 52 53] Th/U [54 55 56 57]

Model age [58 59 60 61 62] Remobilization age [63 64 65 66 67] T_o [68 69 70]

Remarks . . . . . .



Geochemical Sample Submission and combined Report Form printed on geochemical sample bags.
NOTE Analytical information is contained on the Chemistry Report Form.

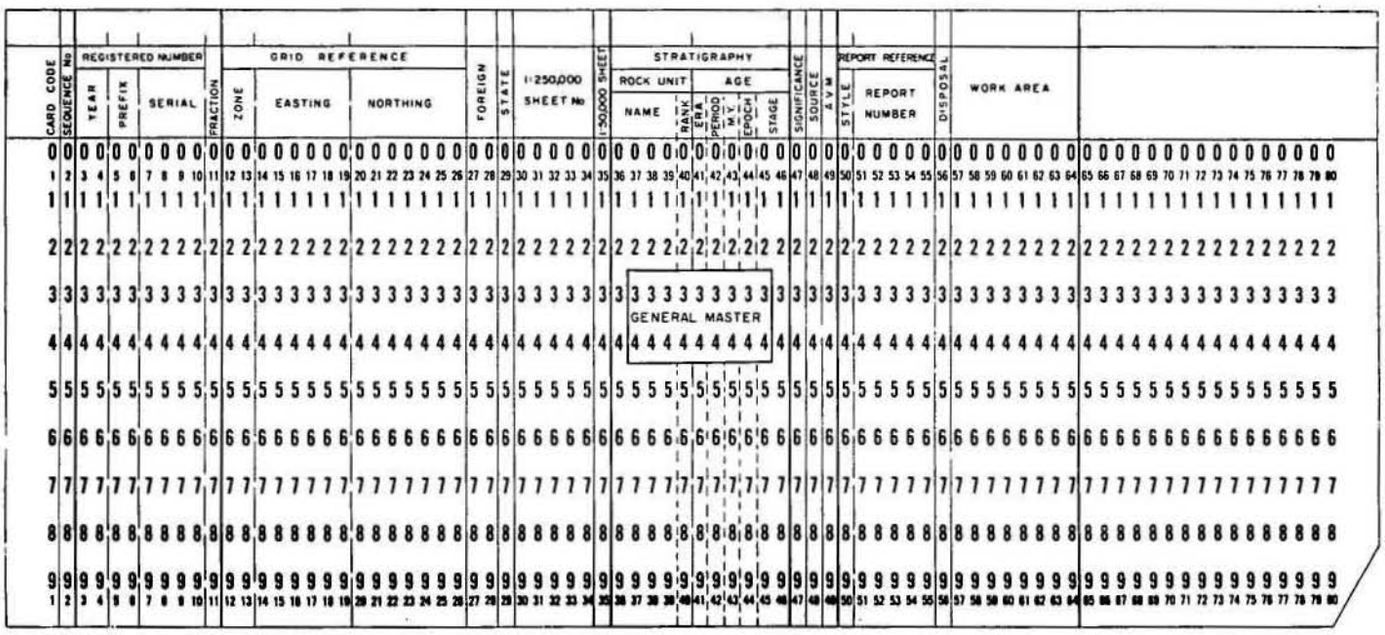


Fig. 21

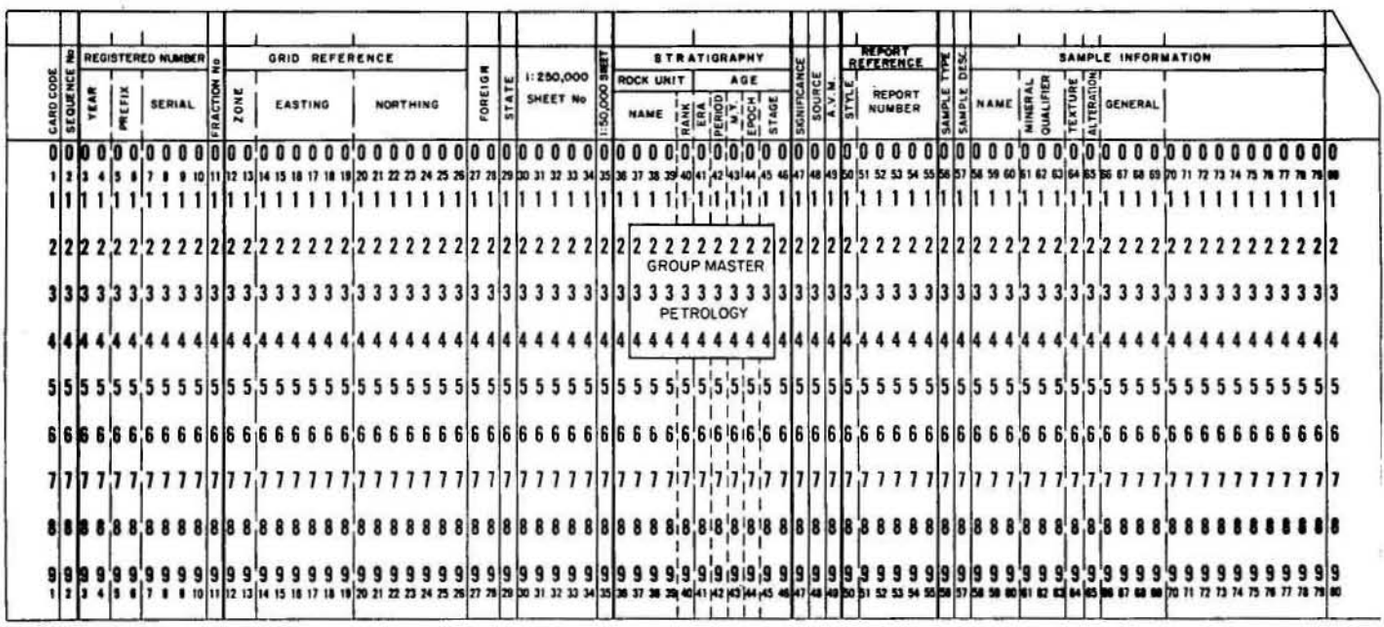


Fig. 22

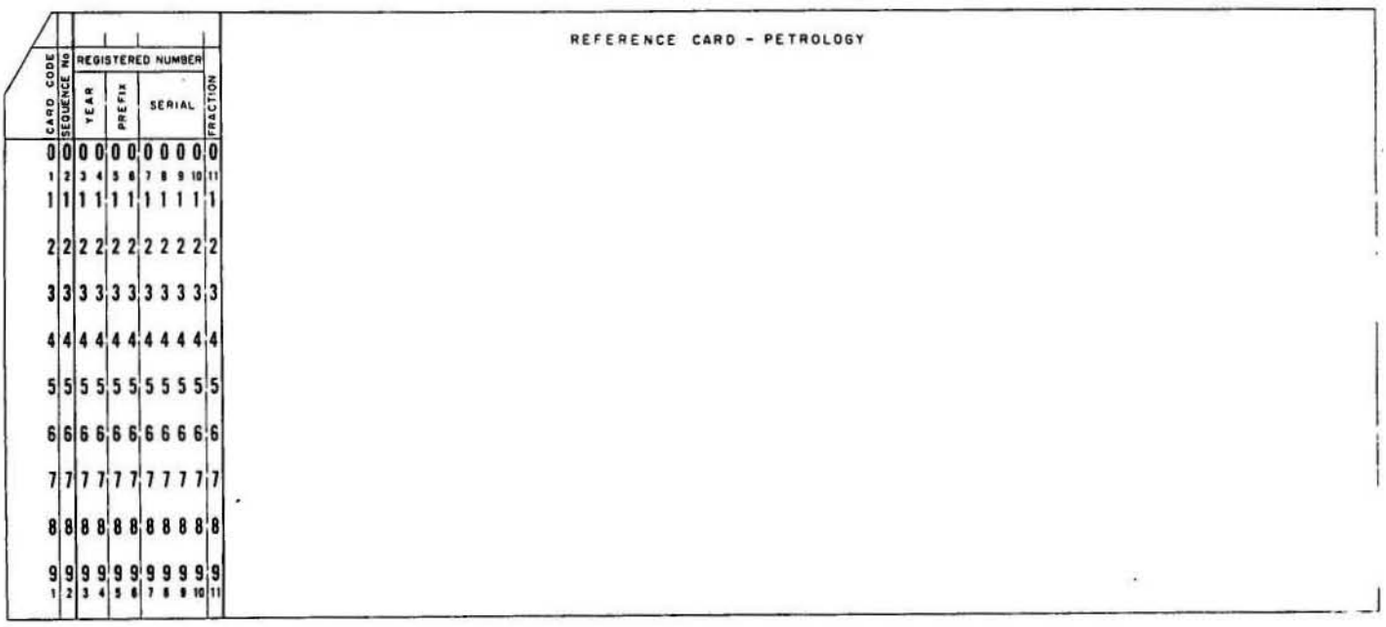


Fig. 23

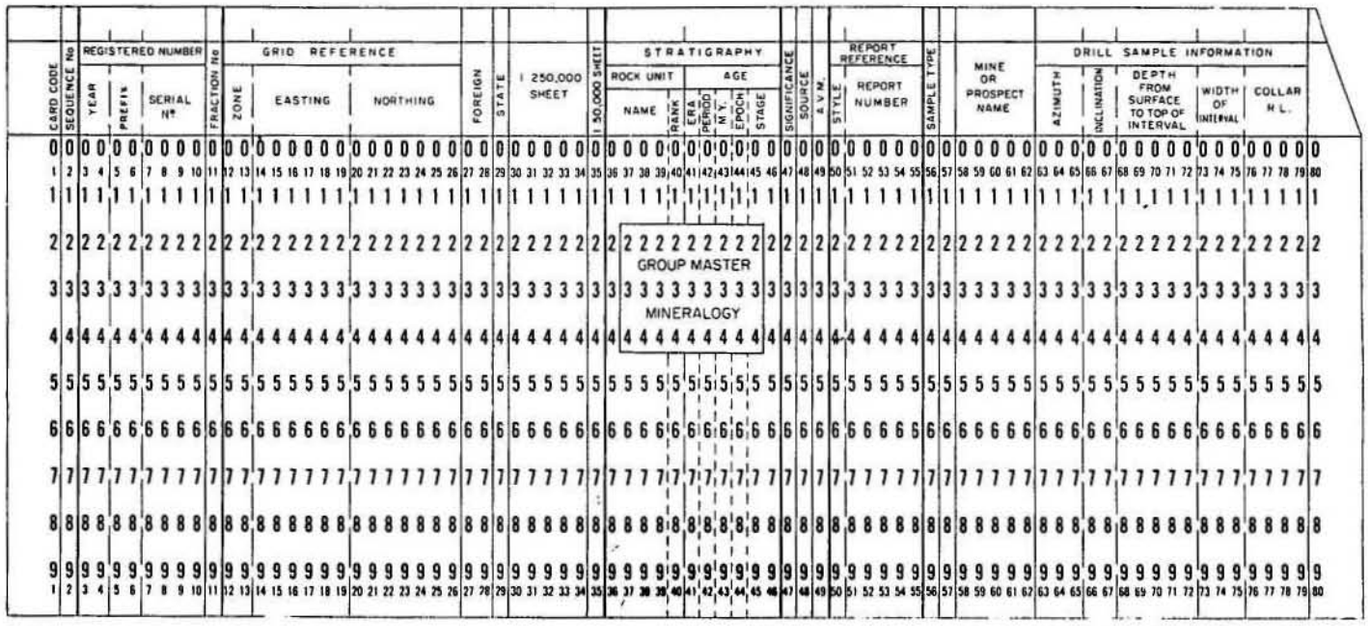


Fig. 24

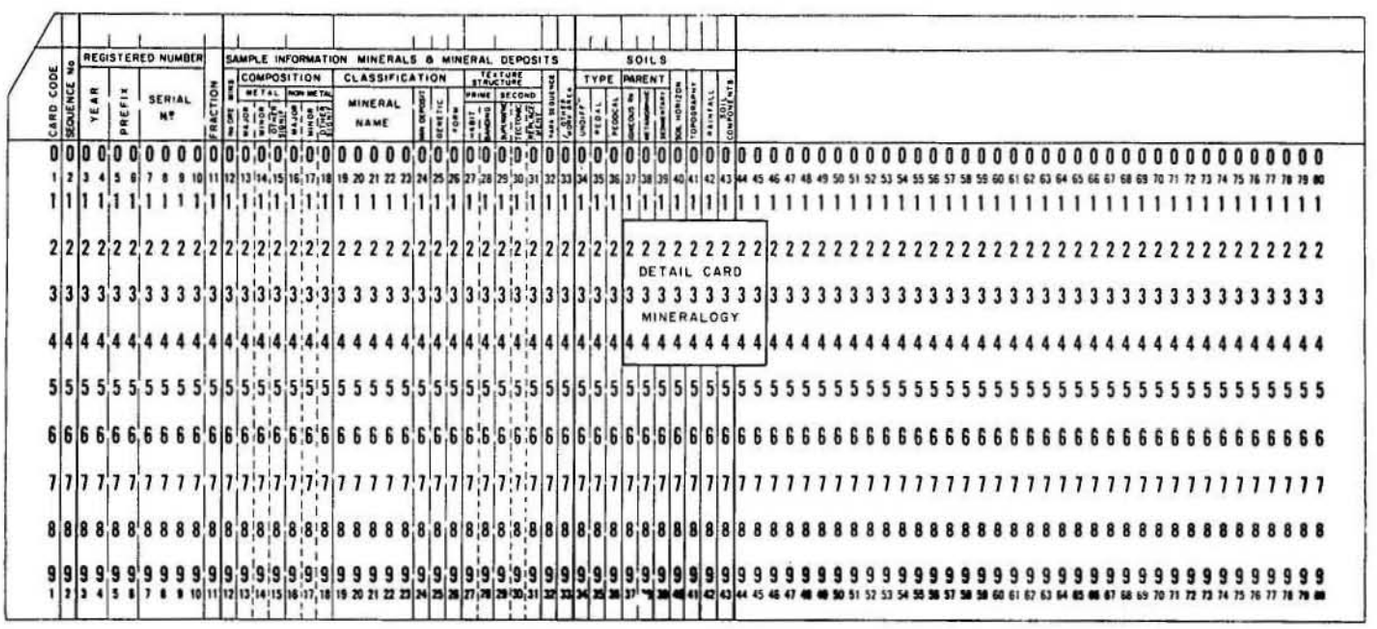


Fig. 25

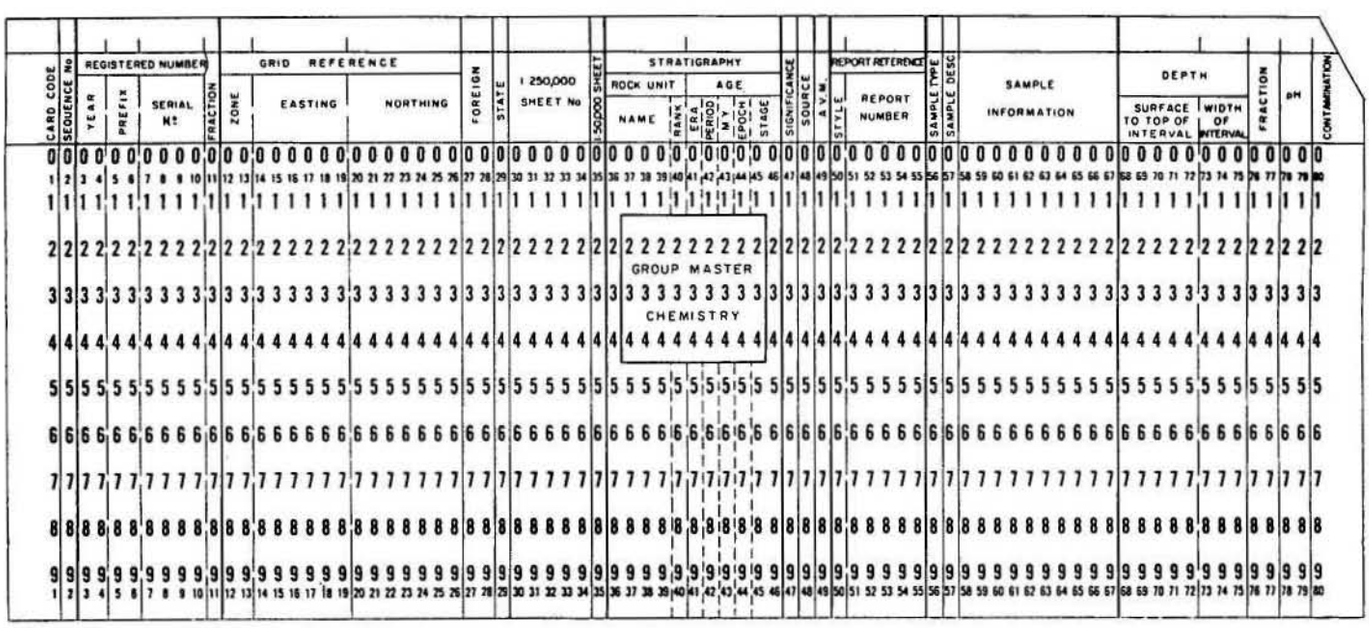


Fig. 26

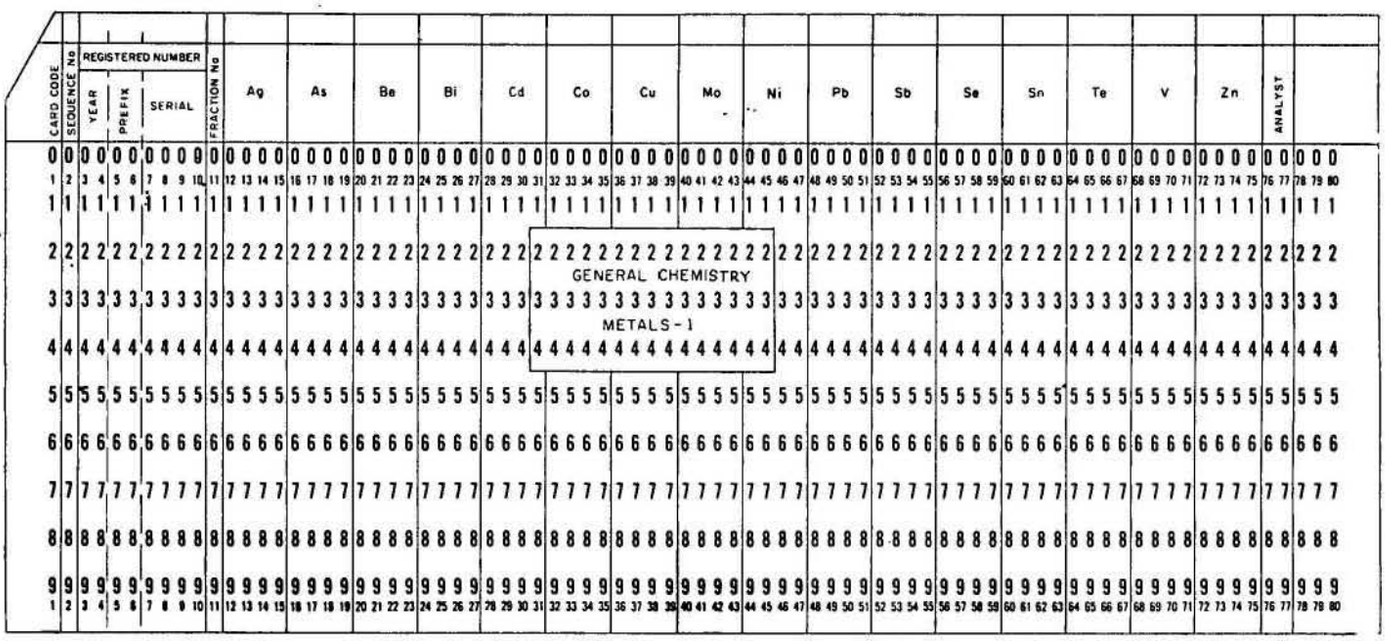


Fig. 27

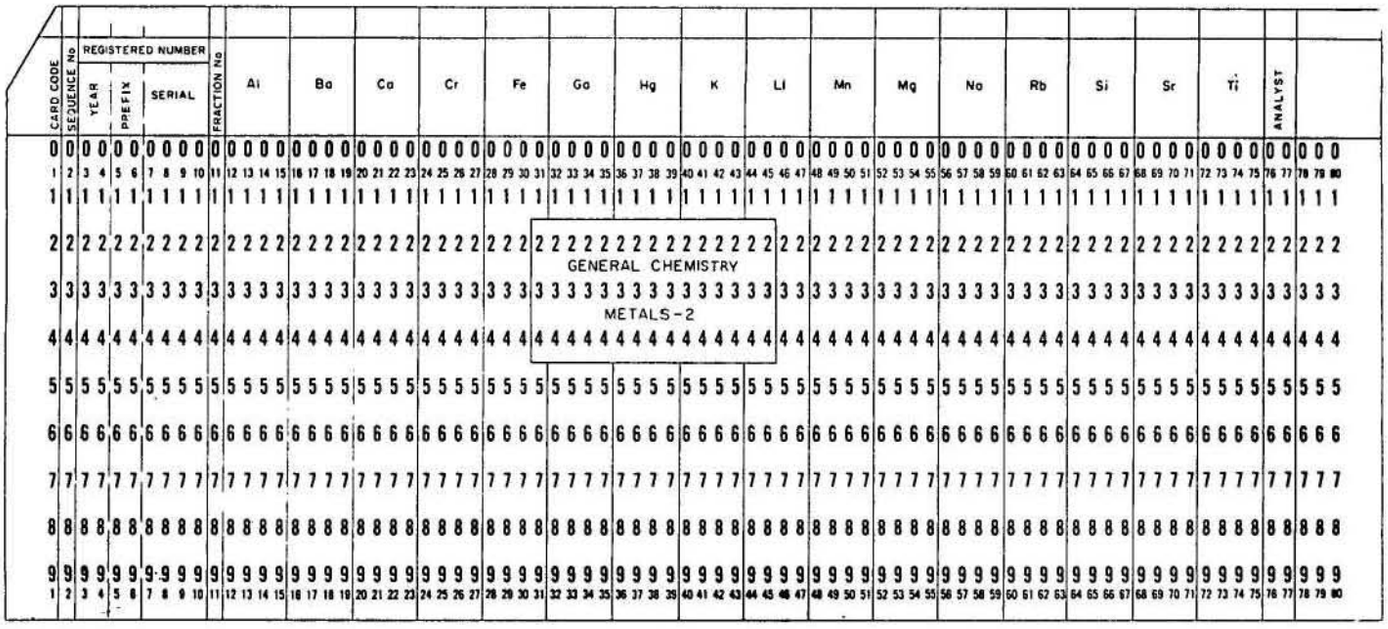


Fig. 28

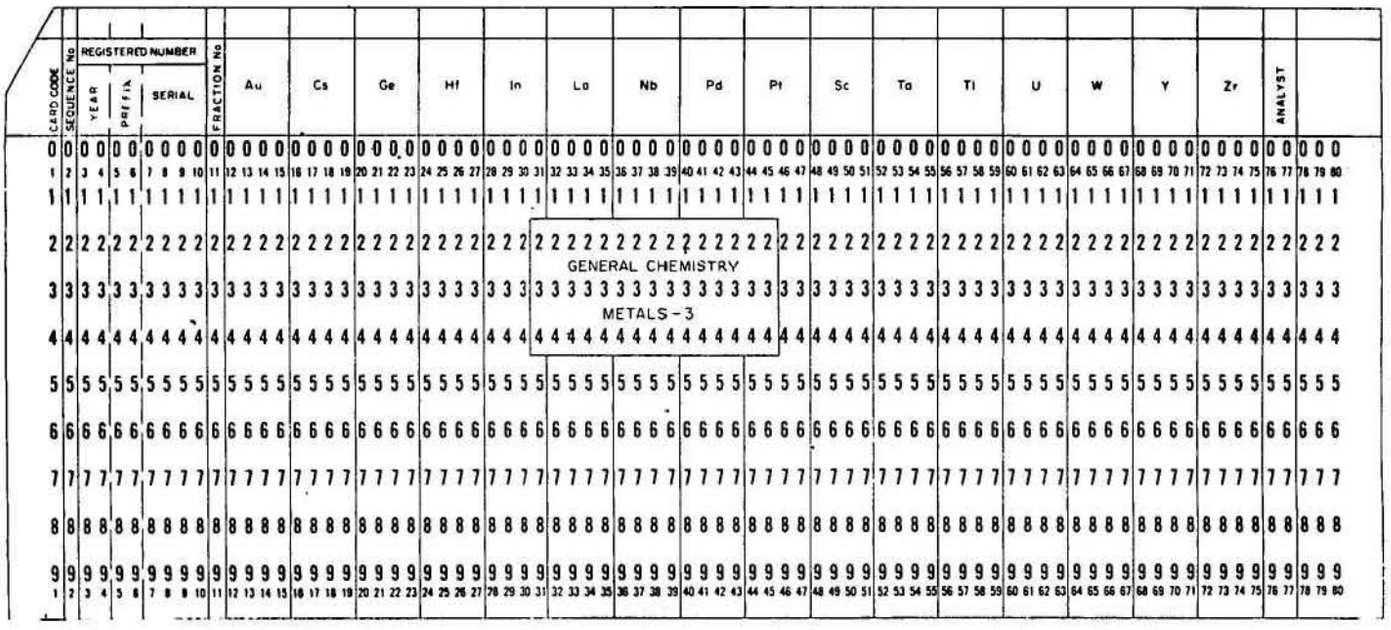


Fig. 29

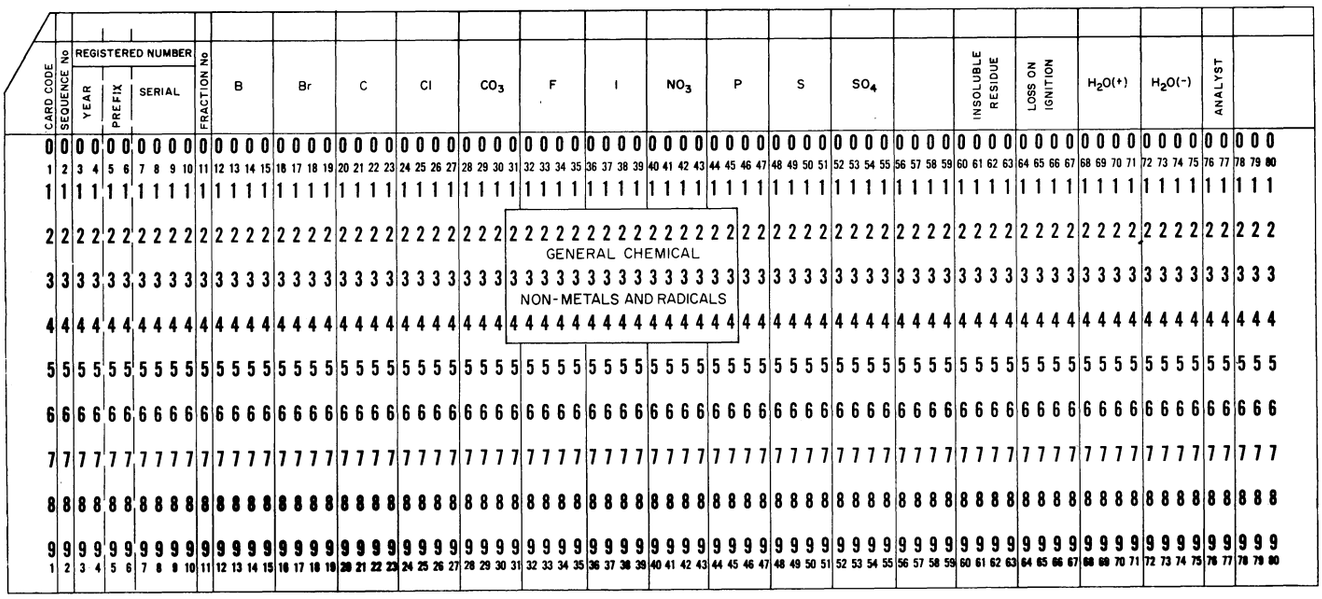


Fig.30

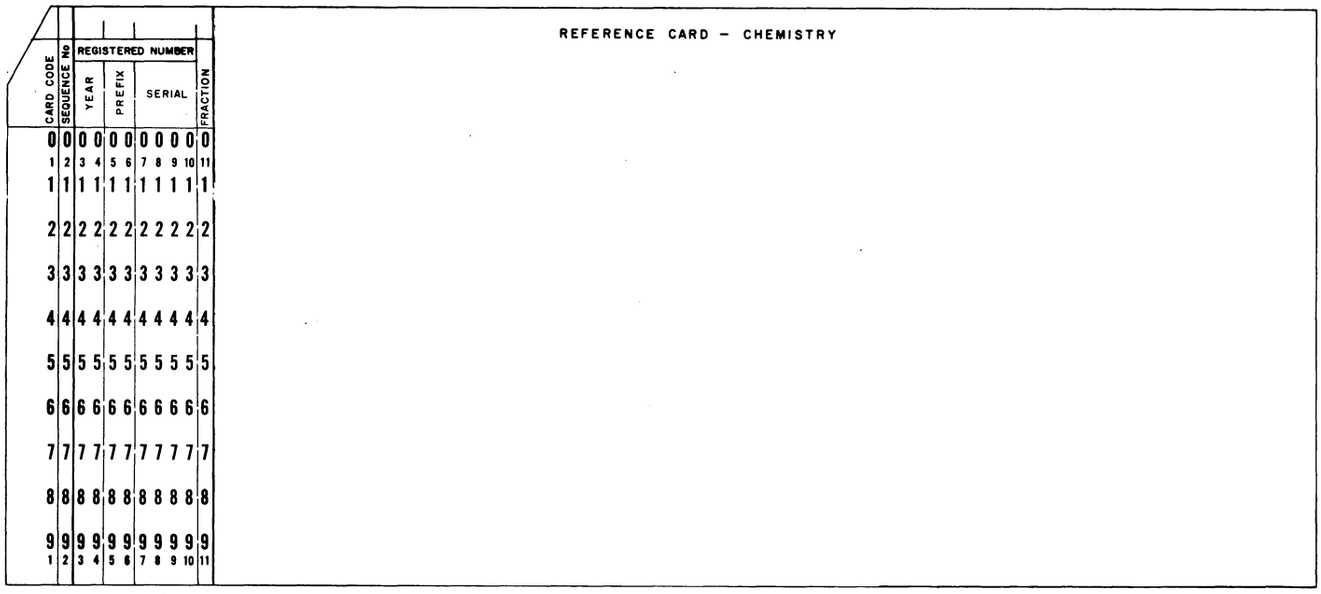


Fig. 31

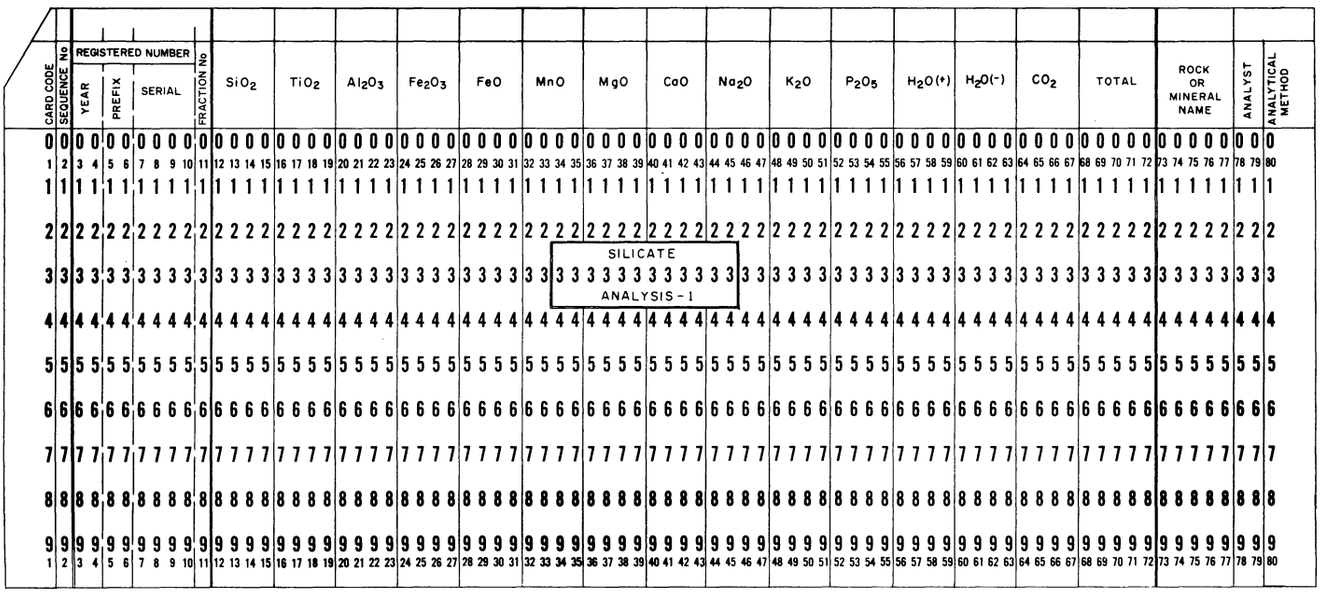


Fig 32

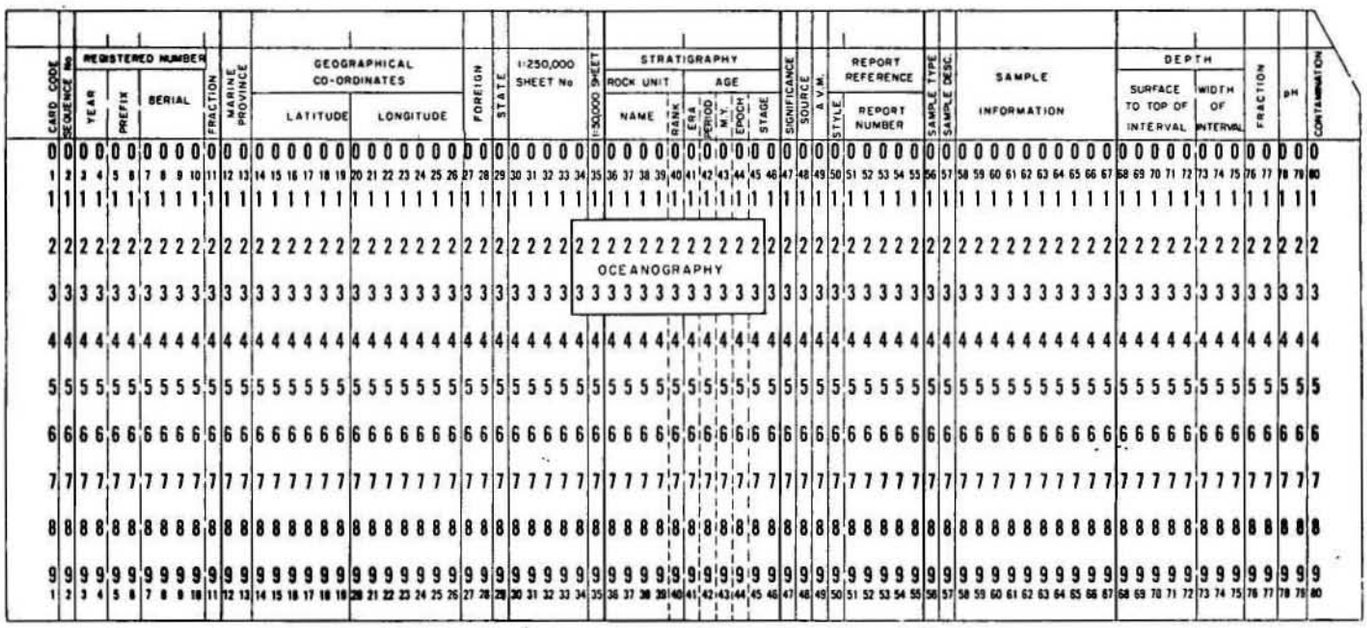


Fig.33

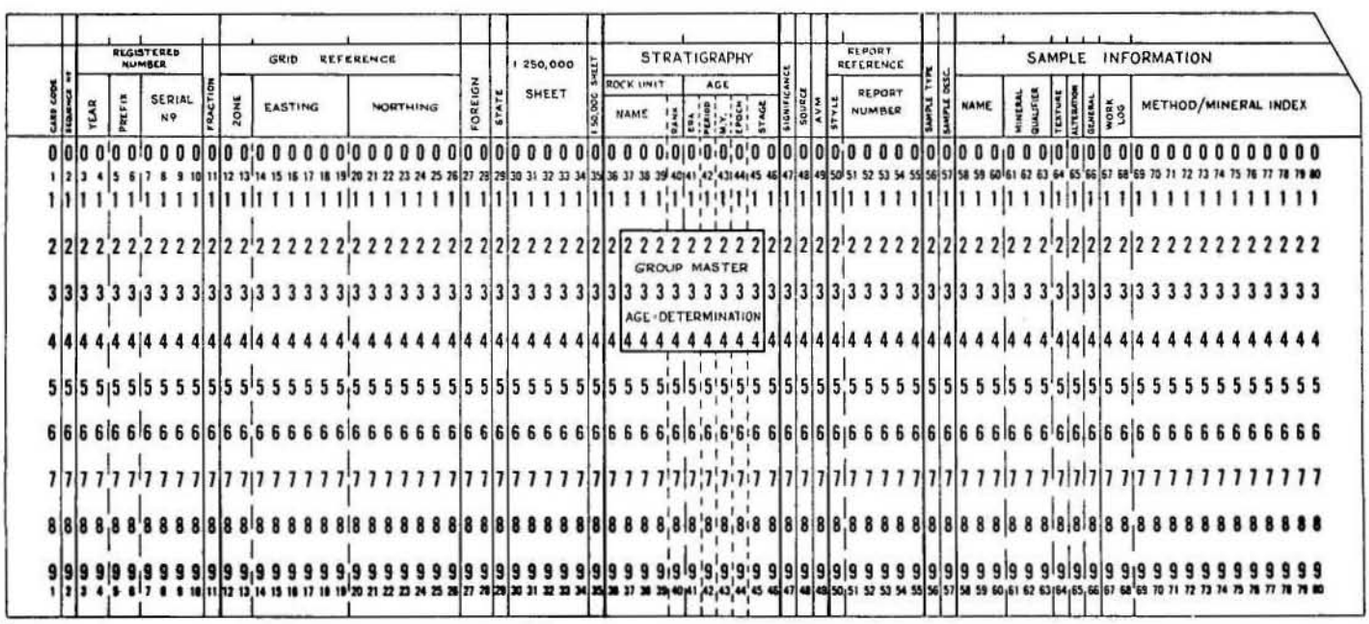


Fig.34

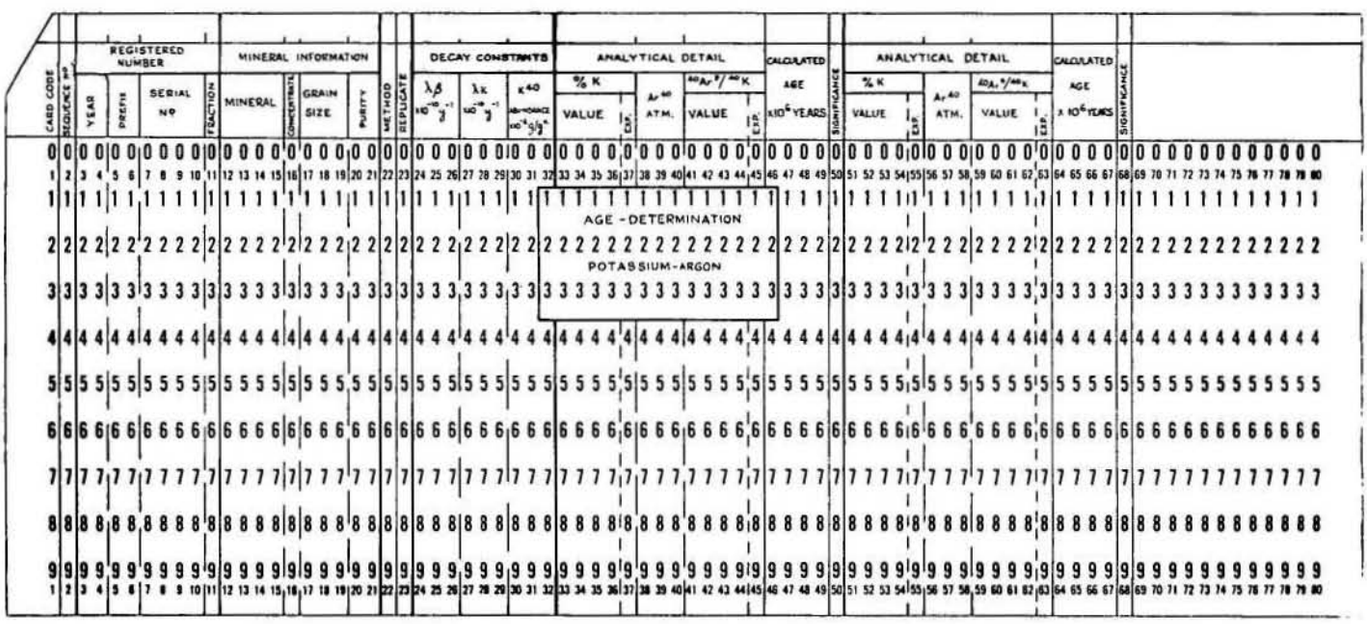


Fig. 35

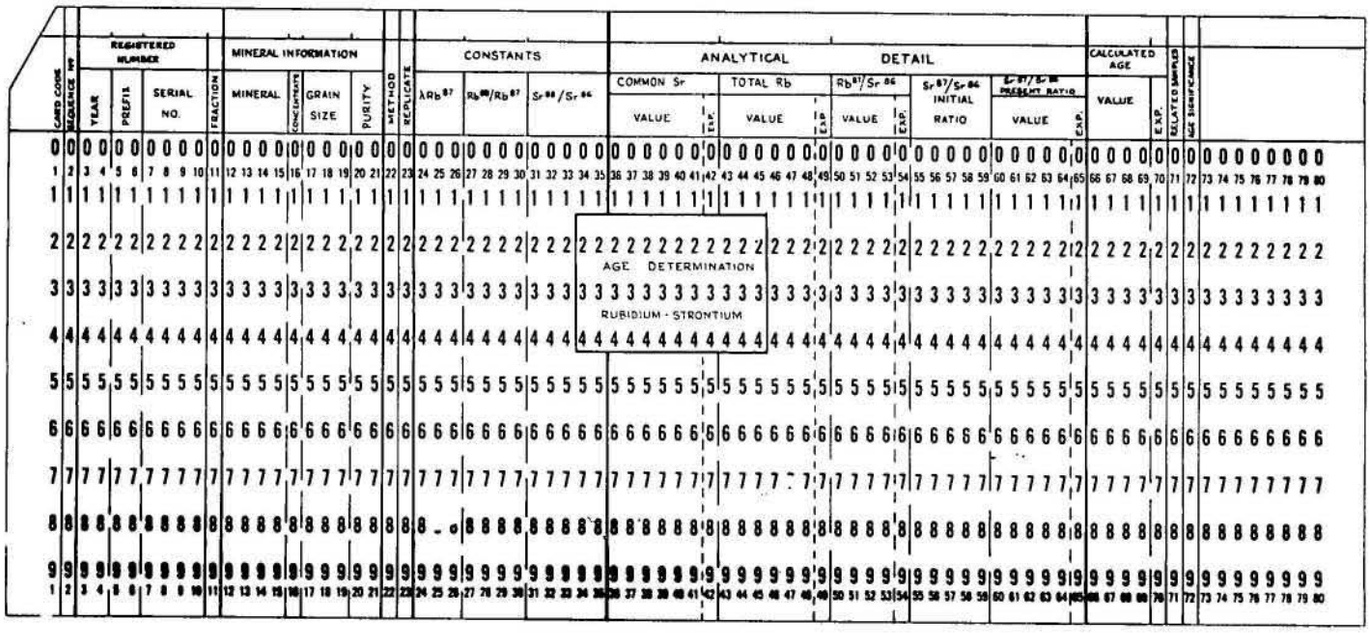


Fig. 36

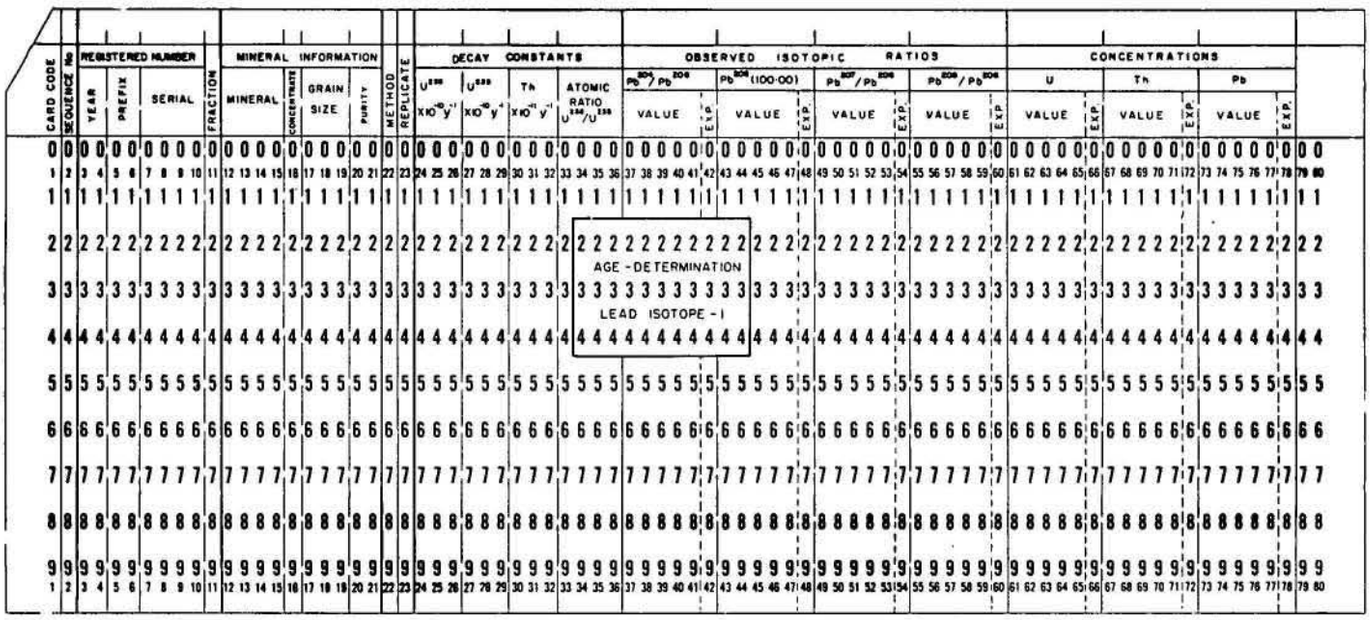


Fig. 37

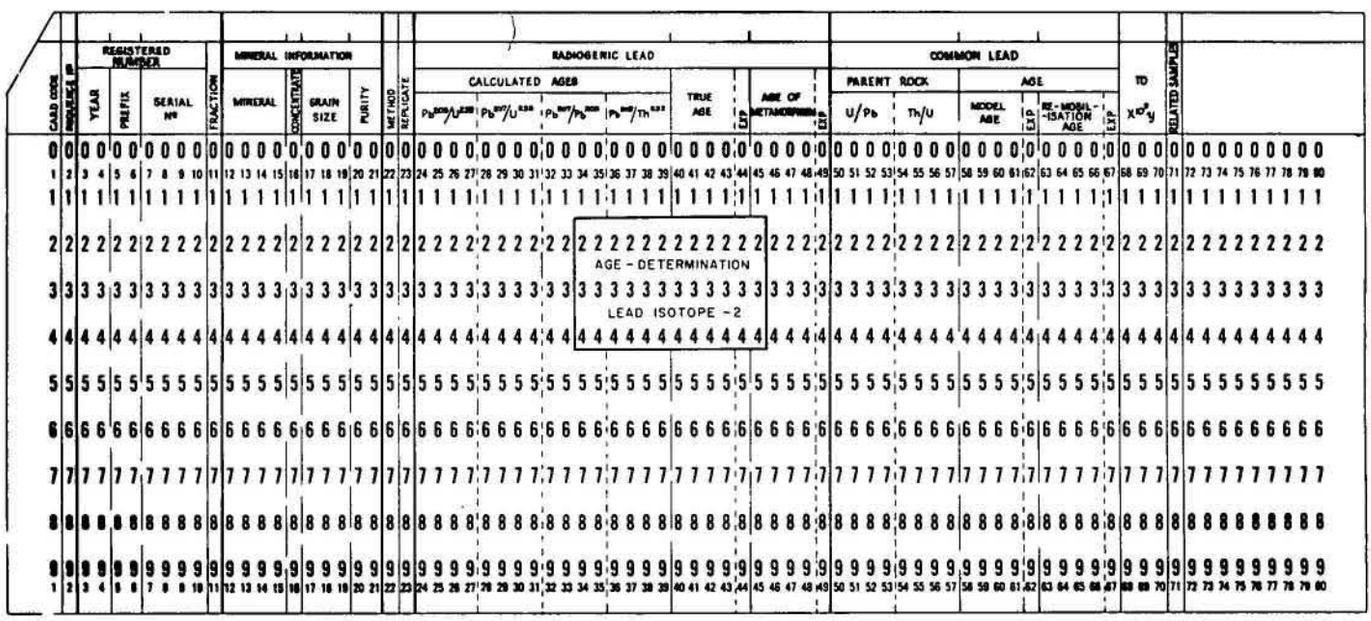


Fig. 38

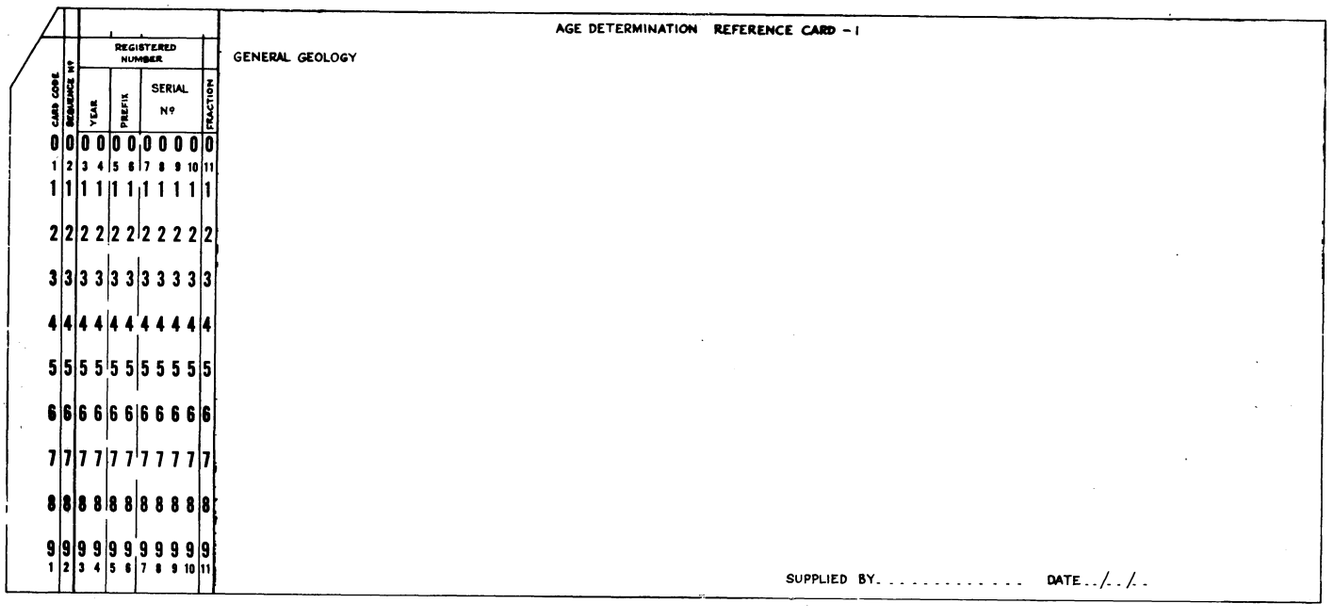


Fig 39

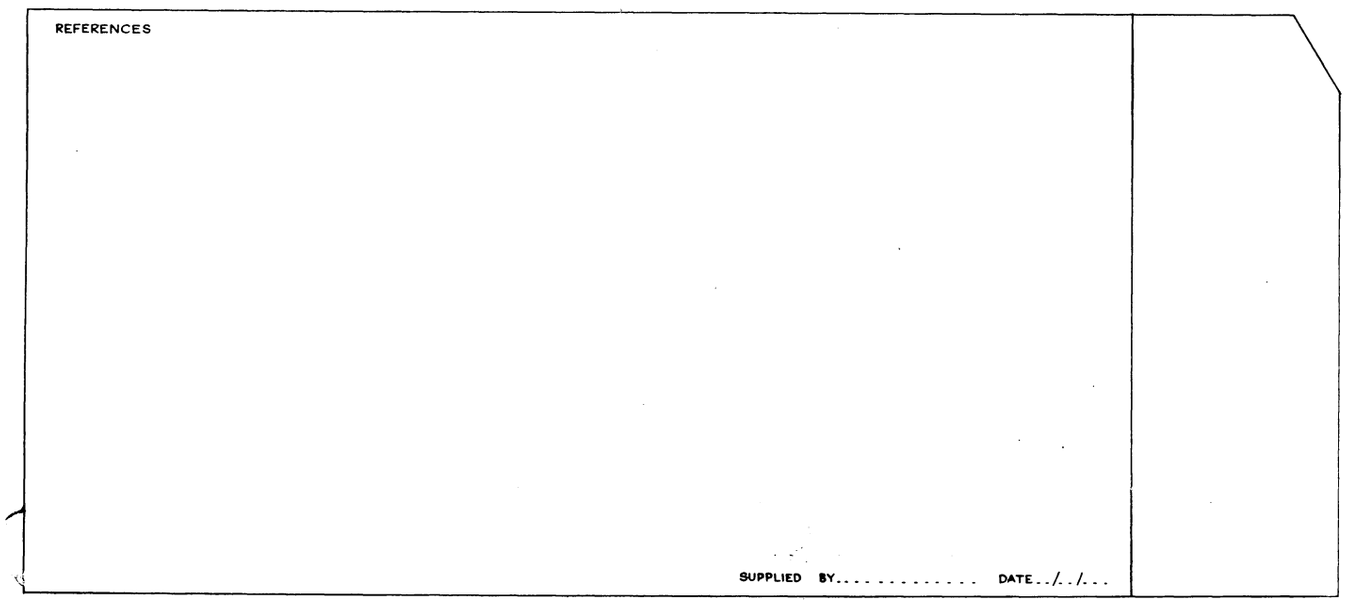


Fig 40

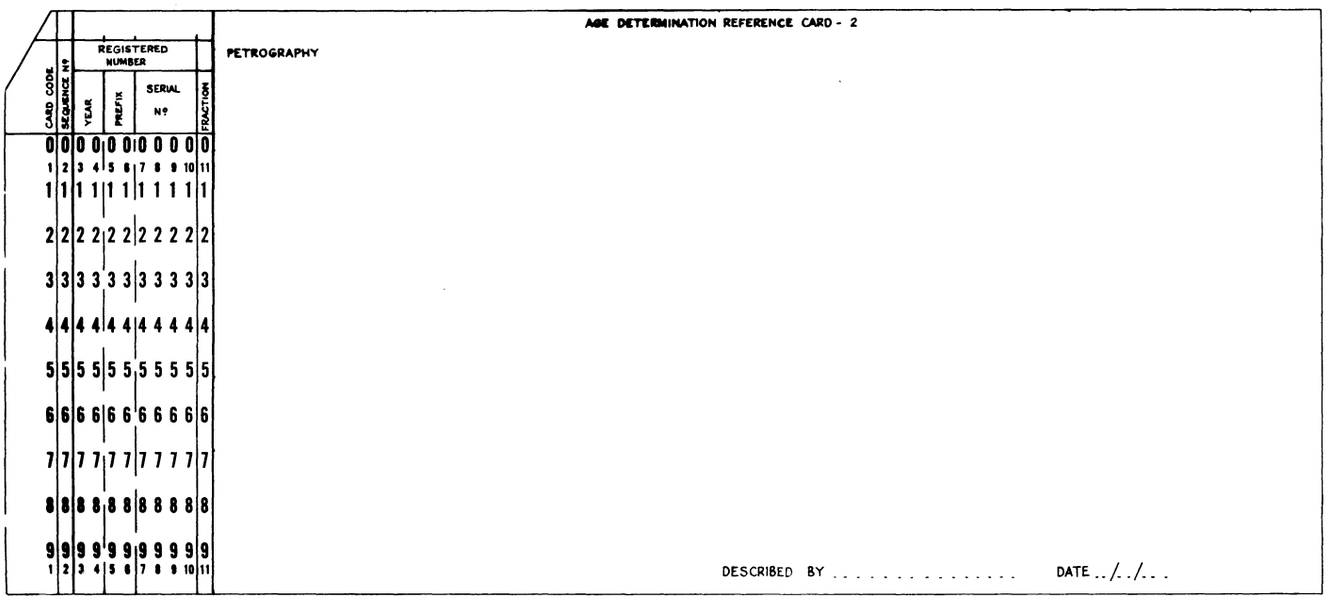


Fig. 41

rows below the Constant Data line, one row for each specimen.

The Master Card Report Form is to be filled in and coded by the Transit Room Manager.

2. Analytical Detail Report Forms (Figs. 11 to 15). Like the Master Card form, they are divided vertically into columns representing the 80 punched card columns; and horizontal rows, representing individual punched cards. The top horizontal row is for Constant Data, and those below for the changing data. Columns 1 to 11 are coded by the Transit-Room Manager; the remainder are coded by the chemist concerned.

Report Forms are distributed as shown on the Flow diagram, one copy being returned to the Transit Room by the originator after insertion of the formal nomenclature and Record, Report or Bulletin number.

Officers submitting samples for examination are reminded that it is their responsibility to see that their second copy of the Report Form is completed and returned to the Transit Room. Final card punching cannot be completed until this is done.

A check on forms not returned is provided by the Day Book.

THE PUNCHED CARD SYSTEM

Requirements for coding of information by the officer submitting samples and by Authors of reports have been previously outlined. All other coding is the responsibility of the Transit Room. Geologists will not have access to the card stack as such and the retrieval of data will be made, on request, by the Transit Room (or possibly by a Central Records or Data Processing Section if such becomes established in the future). All officers should, however, familiarize themselves with the card design and the type of information the cards contain in order that questions can be asked within the limits of the system (see fig. 43).

Any sample received by the Bureau could be the subject of one or more of a variety of examinations under a number of distinct but not mutually exclusive scientific disciplines. For example, a specimen submitted for a petrological examination to determine its rock name is a simple case. A more complex example would be a detailed petrological description and modal analysis, full silicate analysis, trace element analysis and age-determination. There are many other possible combinations. Accordingly provision must be made to record a large amount of diverse analytical information of varying detail.

The system adopted makes use of four main types of punched card - General Master, Group Master, Detail and Reference cards. These are illustrated in Figs. 21 to 41 and the general arrangement is shown schematically in Fig. 42.

The General Master (Fig. 21) forms the basis of a library of information on all specimens or samples held by the Geological Branch, (it can be extended to cover other Branches) and gives, against each registered specimen or sample number, details of locality, stratigraphy, specimen data, relevant report and a feature called "work area". The work area field has an important function in collecting together and correlating in broad terms the type of work that has been done on any given sample, or group of samples. For example it will show whether a sample initially submitted for mineralogical examination only was also analysed chemically. It also forms a convenient means of obtaining a listing of any group of samples that have been examined by more than one of the various laboratory departments.

This is important in data retrieval.

Each work area has its own Group Master (Figs. 22, 24, 26, 33, 34) library corresponding to the samples passing through that department only. While the General Master cards form a single common library of all samples, the Group Master cards form a number of independent libraries which can be added to as required without affecting each other.

All Group Masters carry registered number, locality, stratigraphy etc. in the same sequence as the General Master, they are identical to the General Master card as far as column 55 with the exception of columns 12-26 on the Oceanographic Group Master. (This arrangement allows for rapid machine-duplication of common information on the cards). The remainder of each Group Master card is devoted to recording detailed sample information specific to its own group.

The next stage of recording the analytical results is done by using two types of cards, the Group Detail (Figs. 25, 27 - 30, 32, 35, to 38) and Group Reference cards (Figs. 23, 31, 39-41). At this level the multiplicity of card designs increases markedly due both to the quantity and to the complexity of the data to be recorded. In the Age Determination Group for example, four types of Detail (Figs. 35 to 38) and two types of Reference cards (Figs. 39 to 41; Fig. 40 is the reverse side of Fig. 39) are required to accommodate all the possible analytical data available for any given specimen.

The Detail and Reference cards have only the "Registered Number" in common with the Group Master and General Master Cards and this gives the means of collating the analytical results on the Detail cards with the information on the Group Master Card. The remainder of the card is occupied by analytical results and related data.

The Reference card differs from all other card types in that it provides for short typed reports and references. Although it can be collated mechanically by means of the registered number punches, the information carried on the body of the card must be copied manually or photographically. In all other cases punched information is retrieved mechanically by means of a document writer or, ideally, by a computer.

The cards of each Group have a body colour which is distinctive for that Group and corresponds with the body colour of the related Report Forms. Colour coding of the Detail cards within the Group is done by overprinted stripes. By using this method of colour identification the selection, handling and final filing of the cards is simplified and the possibility of error reduced.

The colour code is given on the following page:

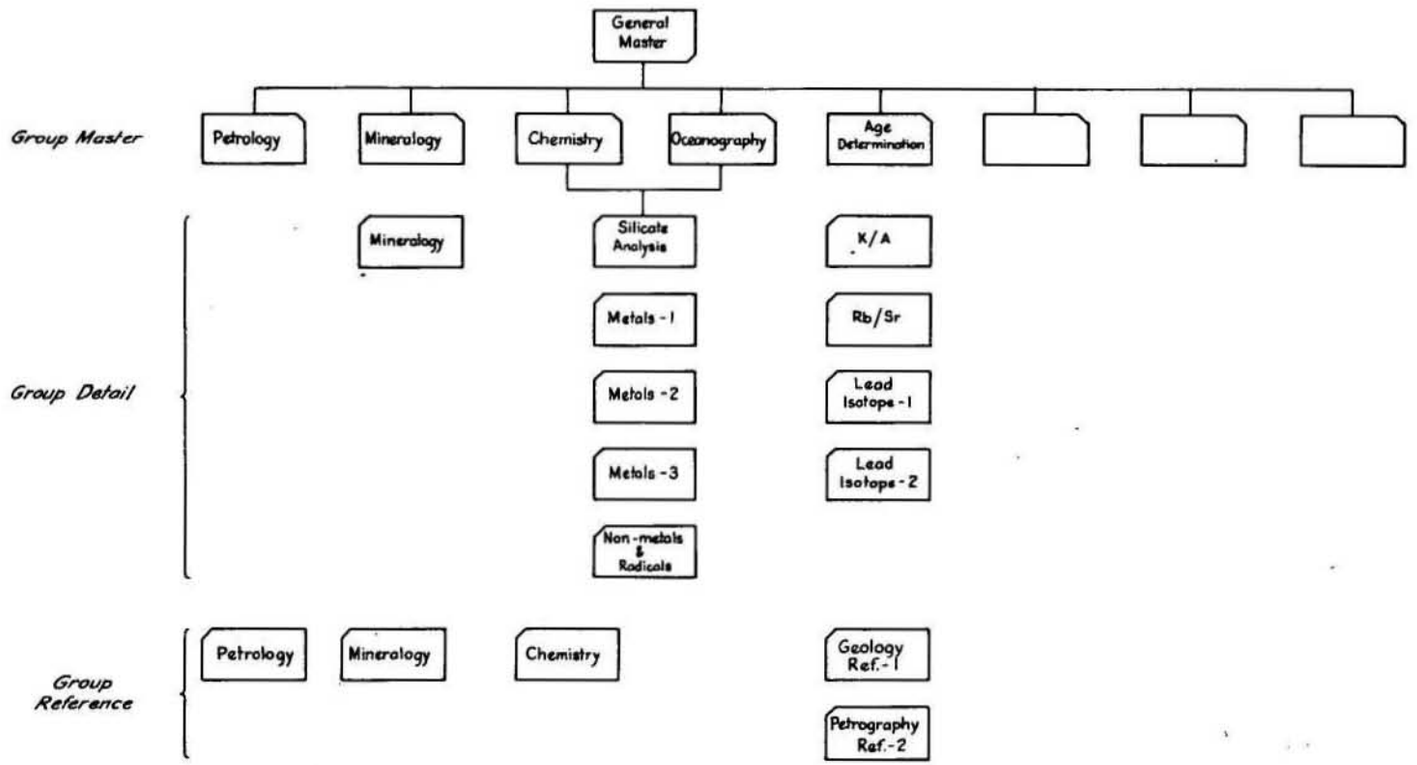
Punched Card Colour Code

Card Type	Card Colour	Stripe - Colour and position	Lettering
General Master	Red	None	Black
Chemistry:			
(a) Master	Manila	None	Black
(b) General chemistry - metals	Manila		
i. Atomic absorption unit	Manila	Brown, top edge	Black
ii. Manual X-Ray Spectrograph	Manila	Green, top edge	Green
iii. Quartz spectrograph	Manila	Red, top edge	Red
iv. Automatic X-Ray spec.	Manila	Salmon, top edge	Black
v. Other	Manila	Grey, top edge	Black
(c) General Chemistry - non metals and radicals			
1. Atomic absorption unit	Manila	Two brown, top edge, $\frac{1}{4}$" apart	Black
2. Manual X-Ray spectrograph	Manila	Two green, top edge, $\frac{1}{4}$" apart	Green
3. Quartz spectrograph	Manila	Two red, top edge, $\frac{1}{4}$" apart	Red
4. Automatic X-Ray spectrograph	Manila	Two salmon, top edge, $\frac{1}{4}$" apart	Black
5. Other	Manila	Two grey, top edge, $\frac{1}{4}$" apart	Black
(d) General Chemistry - Rare earths.			
i. Manual X-Ray Spectrograph	Manila	Two green, top edge and horizontal centre	Green
ii. Automatic X-Ray Spectrograph	Manila	Two salmon, top edge and horizontal centre	Black
(e) Direct reading optical spectrograph	Manila	Rose, top edge	Black
(f) Silicate analysis	Manila	Blue, top edge	Black
Petrology - Master	Green	None	Black
Reference	Green	None	None
Age-Determination - Master	Salmon	None	Black
Potassium/Argon	Salmon	Grey, top edge	Black
Rubidium/Strontium	Salmon	Two grey, top edge, $\frac{1}{4}$" apart	Black
Lead Isotope	Salmon	Two grey, top edge and horizontal centre	Black
Reference	Salmon	None	None
Mineralogy	Yellow	None	Black
Oceonographic	Blue	None	Black

Note : Colours listed above refer to those included in the IBM card colour scheme.

Fig. 42

THE PUNCHED CARD SYSTEM



Bureau of Mineral Resources Geology and Geophysics September 1964

To accompany Record 1964/139

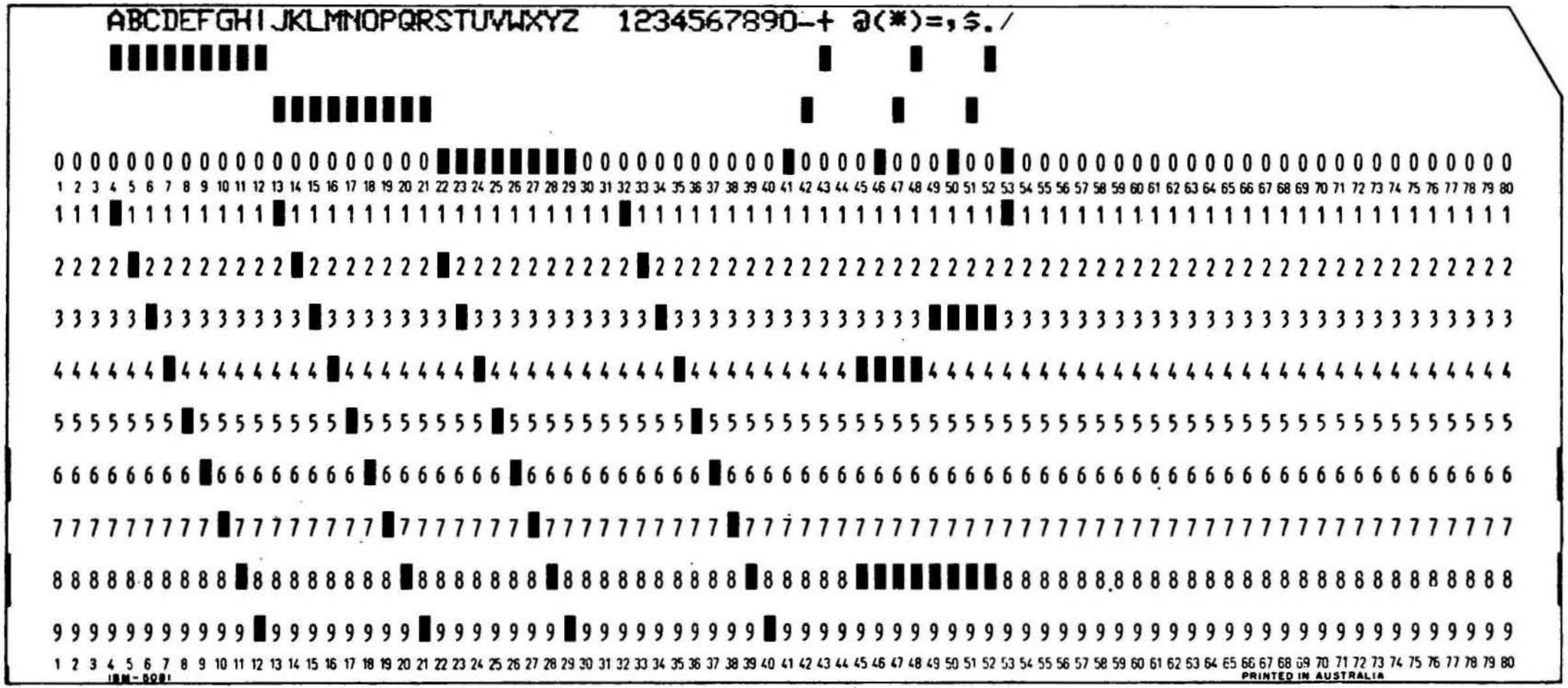
M(0)/21

As the system is designed for mechanical card sorting, like cards are kept together at all levels, that is the General Master cards are filed separately from the Group Master cards which themselves are kept in separate groups. Within the group the Detail cards where applicable are split systematically into separate files. This allows preselection of the files at any level for information retrieval, so that only those files known to contain the information sought are passed through the card sorter. For example if it is required to list all samples that have a copper content greater than 0.1% it is only necessary to search the file "Chemistry Detail Metals"1" as this is the only card recording results for copper. Cards have a limited life of about 100-200 sortings depending on the amount of additional hand sorting.

The details of the information recorded on each of the different cards can be seen from figs. 21 to 41. The methods of coding used to convert this information to the punch card system is dealt with in the chapter on the Punched Card code in this report.

The 80 column card system is of course not the complete answer for punched card data storage but it does have very definite advantages in its flexibility and the fact that it is a necessary step for recording information on magnetic tape for retrieval by computer. This latter stage can be justified when a stack reaches a number of about 10,000 cards. Below this number, mechanical sorters are economical for most purposes: with small numbers of cards manual sorting is probably most effective. Although duplication of cards is a machine process and not excessively costly, due care needs to be exercised over the card library to avoid unnecessary sorting and collecting. This is one reason for breaking the card library up as we have done. We are not certain that this arrangement is the best arrangement and only experience in using the system will tell if changes should be made.

Fig 43 Hollerith 80-Column Automatic Punched Card



THE PUNCHED CARD CODE

CODING METHODS

The system described here is based on the Hollerith 80-column automatic punched card, an example of which is shown in figure 43. The idea in using the cards is to attach a particular significance to a hole punched in a particular place on the card. Thus, for example, column 41, hole 1 could represent Tertiary; hole 3 in the same column - Mesozoic and so on.

On the Hollerith card there are eighty vertical columns and ten horizontal rows. Two more unmarked horizontal rows are present above 0(zero), as shown by the punched holes. For the purpose of coding, the two unmarked rows are termed - (minus) and +(plus). The area enclosing rows 0, -, + is termed the zone, and the rows 1 to 9 are called digits.

Four types of coding are used in the system described here. Two are numerical and alphabetical - in these, only one character in any particular column can be coded on one card. A third type is the zone-digit binary coding that enables two characters to be coded in one column. The fourth is coding by means of special characters (to be described below), enabling three characters to be coded in one column.

Numerical Coding is shown in columns 32 to 43 of figure 43 0(zero) is punched on this card, in column 41, 1 in column 32, and so on to 9 in column 40. An example of this type of coding is found in page 22 of this report, and refers to column 41 of the General and Group Master cards - Age (Era). No more than one subject can be coded in any one column.

Alphabetical Coding (Alpha-coding) is shown in columns 4 to 29 of figure 43. Each letter is represented by two holes in any one column; one of these is in a zone position (0, -, or +), and the other is in a digital position (1 to 9). The letters A to I are presented by holes punched in + and in the positions 1 to 9, J to R by holes in - and 1 to 9, and S to Z by holes in 0(zero) and 2 to 9. An example of this type of coding can be found on page 22 , and refers to column 42 - Age (Period). No more than one subject can be punched into any one column by alpha-coding methods.

Zone-digit binary coding is an adaptation of alphabetical coding that enables two characters to be punched in one column. The three zonal positions (+, -, 0) are allotted headings mutually exclusive of each other; the digits are occupied by another nine headings mutually exclusive of each other, but which have something in common with the zonal headings. A good example of this type of coding can be found on page 31 , and refers to the texture of igneous rocks as coded in column 64 of the Petrology Group Master Card.

Special character codes can be found in columns 45 to 52 of figure 43. Combinations of these symbols can form special three-hole characters. An example of this type of coding can be found on page 39 , and refers to the "work-done" log on the Age Determination Group Master Card in columns 67 and 68. This type of code is used where up to three subjects, not mutually exclusive from each other, have to be represented by holes in one column. No more than three of these can be represented, because the 870 Document-Writer (see page 65) is incapable of reading any more; likewise, the equipment cannot read any three-hole combination other than those specified.

No Information

A general rule has been adopted for this system that 'no information' is shown as / (an oblique stroke or slash) where alpha coding is used, and 0(zero) where numeric coding is used.

An index to the Punched Card Code is given as Appendix I.

PUNCHED CARD LAY-OUTS

As previously noted four major card types have been adopted - General Master, Group Master, Detail, and Reference Cards. The General Master is an index of all registered specimens or samples entering the Branch. The Group Master Cards are indices to specimens investigated in particular work areas; Detail Cards contain analytical results, and descriptive information is written or typed onto Reference Cards.

The information coded in columns 1 to 11 is common to all cards in the system; this information is Card Code, Sequence Number, and Registered Number. The information in columns 12 to 55 is common to all Master cards - i.e. locality, stratigraphy, specimen information, and report reference - with the exception of columns 12-26 on the Oceanographic Group Master.

Common Information

Column 1

The Card Code specifies the work area to which the information contained on a punched card belongs as shown below.

Code	Information
1	General Master
2	Chemistry
3	Petrology
4	Mineralogy
5	Age-Determination
6	Oceanographic

Six additional work areas can be added by using numerals 7, 8 and 9, 0(zero) and plus and minus signs. The addition of further work areas requires alpha coding.

Sequence Number (Column 2)

The sequence number is a means of distinguishing between different cards within a work area; thus, in Chemistry, there is the Master Card, several types of General Chemical Detail cards, and a silicate analysis card. The codes within each work area heading are given on the next page. Please note that information within this column is always sorted in conjunction with Card Code; this is because cards from different work areas can have the same sequence numbers. For example, Card 2 (Mineralogy Detail) in Mineralogy (Card Code 4), has the same sequence number as Card 2 (Potassium/Argon method) in Age-Determination (Card Code 5).

General Master. No sequence number.

Chemistry

Code	Information
1	Master
2	General Chemical, Metals - 1.
3	General Chemical, Metals - 2.
4	General Chemical, Metals - 3.
5	General Chemical, Non-Metals and Radicals.
6	Silicate Analysis - 1.

Petrology

Code	Information
1	Master
2	Reference

Mineralogy

Code	Information
1	Master
2	Detail
3	Reference

Age-Determination

Code	Information
1	Master
2	Potassium/Argon Method
3	Rubidium/Strontium Method
4	Lead Isotope - A.
5	Lead Isotope - B.
6	Reference Card - A.
7	Reference Card - B.

Oceanographic

Code	Information
1	Master

Cores and Cuttings

Code	Information
1	Master
2	Reference

Registered Number (Columns 3 to 11)

The Registered Number has three forms.

The new style of Registered Number adopted consists of year, prefix, serial number of the specimen within the year and prefix, and the fraction number. Year is to be coded by two figures - e.g., 1963 as 63 - in columns 3 and 4. The prefix is a two figure number in columns 5 and 6 and will be allocated to each project either annually or on a continuing basis (see page 3). The serial number may have up to four figures, and is coded in columns 7 and 10; if the serial number has less than four figures, 0(zero) is to be coded progressively in the left hand part of the serial number field (e.g. serial number 4 is 0004). The fraction number is used for specimens that are divided after reaching the work area.

The old "R. NUMBER", as used until this year has up to five figures, prefixed by letter R. To avoid a great deal of work in remembering the large number of samples registered in past years, the system adopted is to code the prefix R in column 5, and the figures in columns 6 to 10; if there are less than five figures in the number, 0(zero) is to be coded progressively between the prefix and the number.

Registered numbers of Age-Determination specimens will be GA, coded in columns 5 and 6 (prefix: number), followed by four figures, coded in columns 7 to 10. The year of collection, if known, can be coded in columns 3 and 4. The prefix GA is retained because it appears in a number of publications, and will continue to be used.

GENERAL MASTER CARD (Fig.21)

The code in columns 12 to 55 is common to the General Master and Group Master cards. That from column 56 onwards is specific to each type of Master card. The code for columns 12 to 55 described below, will not be repeated for the other Master cards.

Grid Reference (Columns 12 to 26)

Grid Reference occupies a 15-column field, and refers to the Australian Military grid, the metric grid, or to some other arbitrary grid, such as a mine or geochemical sampling grid.

Zone (Columns 12 and 13): For the Australian Military grid, the zone is a single figure number ranging between 1 and 8, to be coded in column 13, 0(zero) being written in column 12. The zone for the metric grid is a two-figure number, coded in columns 12 and 13. The number 09 is to be coded in these columns if the reference is to an arbitrary grid, (e.g. a mine grid or geochemical sampling layout).

Eastings and Northings together, form the actual grid reference. The northings consist of seven digits in the military and metric grids. Where arbitary grids are being used, eastings and northings are given in feet and the respective easting and northing sections filled in progressively from the right. Zeros are inserted in unused columns on the left. Military or Metric Coordinates of two points on base line (see p. 4) will be recorded on a detail punch card (not shown in text) for later conversion of arbitrary grid coordinates to military grid.

For Antarctic and oceanographic samples, the location should be given as geographical coordinates. Latitude should be recorded as a six digit number (four decimal places) in the Easting boxes and longitude as a seven digit number (four decimal places in the Northing boxes. Both should be decimalised in terms of degrees (see Inman's Nautical Tables).

With oceanographic samples the Marine Province should be indicated in the Zone boxes as follows:

AB	Great Australian Bight	CP	Coral Sea Platform
AS	Arafura Sea	CS	Coral Sea
BR	Barrier Reef	GC	Gulf of Carpenteria
BS	Bass Strait	IO	Indian Ocean

NR Naturalists Ridge
PO Pacific Ocean
TM Timor Sea
TS Tasman Sea

For Antarctic samples the appropriate U.T.M. zone should be indicated.

Foreign Collection (Columns 27 and 28)

A two-letter alpha-code is used to indicate the country from which the specimens were collected. The usual form will be the first letter and the next consonant. For countries with two or more names, the initial letter of each of the first two words is to be used, e.g., New Zealand - NZ, Great Britain - GB.

State (Column 29)

Code	Information	Code	Information
A	Antarctica	P	Papua and New Guinea
C	Australian Capital Territory	Q	Queensland
D	Northern Territory	T	Tasmania
I	Island Territories	V	Victoria
N	New South Wales	W	Western Australia

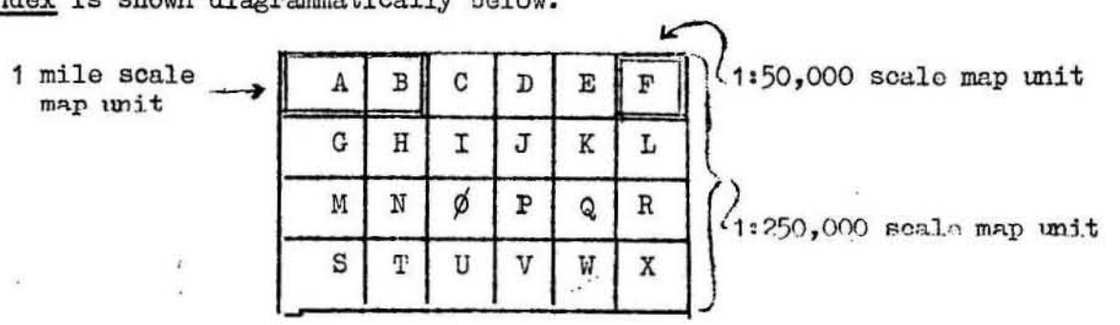
Wherever possible, the initial letter of the state or territory has been used. However, C (for A.C.T.) is taken from Capital, because A is used for Antarctica; D (for Darwin) is used for Northern Territory.

1:250,000 Sheet Number (Columns 30 to 34)

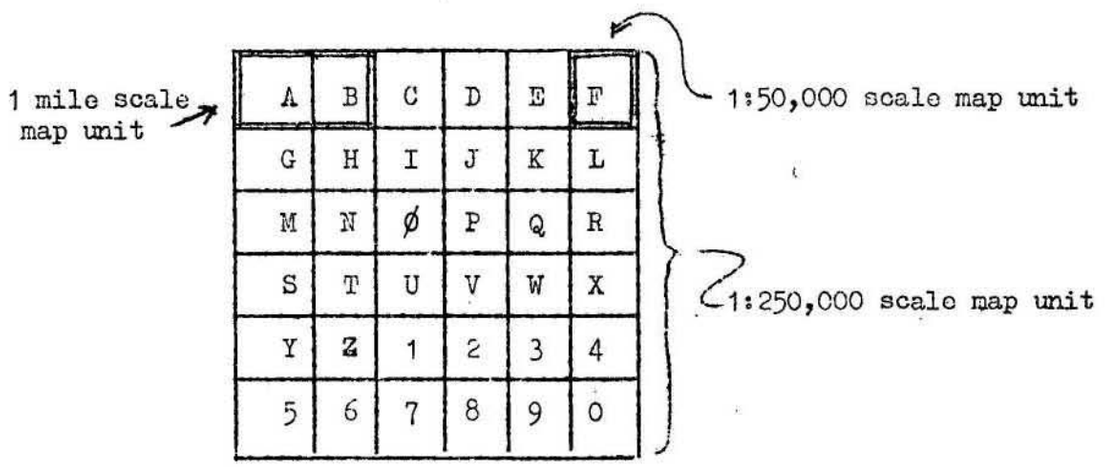
An example of a full 1:250,000 sheet number is SG54/16. In coding, S (referring to Southern hemisphere) and the oblique stroke are omitted - G5416. The number SG54/6 is coded G5406.

1 Mile or 1:50,000 Map Reference

The procedure to be adapted for coding of 1 mile and 1:50,000 map areas within 4 mile or 1:250,000 scale maps in the Australian Index is shown diagrammatically below.



Coding of 1 mile and 1:50,000 map areas within 4 mile or 1:250,000 scale maps in Papua - New Guinea Index is shown below.



With the old and current map index System each 4 mile or 1:250,000 Sheet was divided into twelve 1-mile sheets. In the next year or two the 1:250,000 scale map unit will be divided into 1:100,000 Sheets and also subdivided into twenty-four 1:50,000 scale map units. In Papua - New Guinea there are thirty-six 1:50,000 scale map units per 1:250,000 map unit.

The coding system illustrated above indicates the code letters that would be used for all 1:50,000 maps in a 1:250,000 map unit. Pairs of these units, A + B, etc., represents a 1-mile scale maps at present in use. Thus when giving a sample location on a one-mile map, one should give the 1:50,000 map code letter or digit depending whether the sample is on the west or east half of the one-mile map. For the present, 1:100,000 scale maps are not included in the rock indexing scheme.

Stratigraphy (Columns 36 to 46)

Rock Unit (Columns 36 to 40). The code is divided into two parts : Rock Unit Name, and Rock Unit Rank.

The Rock Unit Name is coded by the first letter and the three succeeding consonants of the geographical part of the name. The letters A, E, I, O, U, W, and Y are to be regarded as vowels. When a double consonant is present they are to be treated as a single consonant (see examples 5 & 6 below). Commonly, the geographical part of the name consists of two words - e.g., Cannibal Creek, Saint William, Mount Mulligan, and so on. The words Creek, Saint, Mount, Lake, River, etc. are to be omitted from the coding. Examples of coding follow :

	Information	Code
(1)	Hodgkinson Formation	- HDGK
(2)	Almaden Granodiorite	- ALMD
(3)	Laura Sandstone	- LR //
(4)	Nychum Volcanics	- NCHM
(5)	Saint William Beds	- WLM/
(6)	Cannibal Creek Granite	- CNBL

An oblique stroke / is used to fill up the blank spaces in short names, as in the code for the Laura Sandstone.

One column (40)is used to signify the Rank of the rock unit. The Ranks are coded alphabetically, with sedimentary units in the A to H series, igneous in the J to R series, and metamorphics in the S to X series; this will enable general sorting for sediments, igneous rocks, or metamorphics on + (plus), - (minus), or 0 (zero) respectively. An oblique stroke indicates that there is no information.

Rank (Column 40)

Sediments		Igneous		Metamorphic	
Code	Information	Code	Information	Code	Information
A	Group	J	Complex	S	Complex
B	Formation	K	Porphyry	T	Metamorphics
C	Member	L	Granite	U	Schist
D	Beds	M	Volcanics	V	Gneiss
E	Sandstone	N	Dolerite	W	Amphibolite
F	Shale	P	Basalt	Z	Others
G	Limestone, Dolomite	R	Others	/	No information
H	Others				

Age. This is divided into five parts : Era, Period, Million year ranges, epoch, and palaeontological stage.

Era (Column 41)

Code	Information	Code	Information
+	Quaternary	5	Upper Palaeozoic (Devonian, Carboniferous, Permian)
1	Tertiary		
2	Cainozoic	6	Lower Palaeozoic (Cambrian, Ordovician, Silurian).
3	Mesozoic	7	Proterozoic
4	Palaeozoic	8	Pre-Cambrian
		0(zero)	No information

Period (Column 42)

Code	Information	Code	Information
A	Recent	M	Permo-Carboniferous
B	Pleistocene	N	Carboniferous
C	Pliocene	Ø	Devonian
D	Miocene	P	Siluro-Devonian
E	Oligocene	Q	Silurian
F	Eocene	R	Ordovician
G	Palaeocene	S	Cambrian
H	Cretaceous	T	Sub-Cambrian
I	Jurassic	U	Upper Proterozoic
J	Triassic	V	Middle Proterozoic
K	Permo-Triassic	W	Lower Proterozoic
L	Permian	X	Archaean

/ No information

Million Year Range (Column 43)

This is to be used for Age-determination samples only.

Code	Information	Code	Information
A	0–15 thousand years	N	600–700 m.y.
B	15 thousand to 1 m.y.	Ø	700–800 m.y.
C	1–7 m.y.	P	800–900 m.y.
D	7–70 m.y.	Q	900–1000 m.y.
E	70–135 m.y.	R	1000–1100 m.y.
F	135–180 m.y.	S	1100–1200 m.y.
G	180–225 m.y.	T	1200–1300 m.y.
H	225–270 m.y.	U	1300–1400 m.y.
I	270–350 m.y.	V	1400–1600 m.y.
J	350–400 m.y.	W	1600–1800 m.y.
K	400–440 m.y.	X	1800–2000 m.y.
L	440–500 m.y.	Y	2000–2500 m.y.
M	500–600 m.y.	Z	$\geq$ 2500
		/	No information

Epoch (Column 44). This is coded only in relation to Period. It is not to be used in relation to Era or Stage, otherwise confusion will result from ambiguous sorting.

Code	Information
1	Upper
2	Middle
3	Lower
0	No information.

Stage (Columns 45 and 46). A two-letter code using the first letter and next significant consonant of the name. As an example of coding, the names of stages in the Cretaceous system are listed below:

Name	Code
Neocomian	NC
Aptian	AP
Albian	AL
Cenomanian	CN
Turonian	TN
Senonian	SN
Maestrichtian	MS

In cases where, within one period, the first letter and the next consonant are the same - e.g., Llanvirnian and Llandeilian in the Ordovician - the next significant consonant after the first letter should be coded. Thus, the code for Llanvirnian is LV, and for Llandeilian, LD.

Stage is to be coded and sorted in conjunction with Period. In this way, confusion between stage names in different periods, but with the same code, will be avoided. Oblique strokes should be inserted where there is no information.

Sample Significance (Column 47)

This relates the method of sampling a specimen to the rock body or deposit from which it was obtained.

Typical of rockmass or deposit	Typical of a particular part of a rockmass or deposit	Relationship to rockmass or deposit not known.	
B	K	S	Single specimen, purpose fully selected.
C	L	T	Other single specimen.
D	M	U	Composite specimen, fractions combined quantitatively proportional to some rock characteristic.
E	N	V	Composite, fractions combined intuitively.
F	Ø	W	Composite, fractions combined in taking (channel sample).
G	P	X	Composite in nature (drill cuttings).
		/	No information

Examples of coding :

(a) A specimen which is typical of a rockmass(B to G) and which is purposefully selected (B, K, S) is coded B.

(b) A composite specimen, fractions combined quantitatively proportional to some rock characteristic (D, M, U), and which is typical of a particular part of a rock mass (a facies in a sedimentary formation, or a chilled margin of an igneous intrusion), i.e., K to P, is coded M.

Source and A.V.M. (Columns 48 and 49)

Source implies how and where a sample was collected. It is coded in conjunction with A.V.M. which, broadly speaking, gives an idea of the type of material that was collected.

Source (Column 48)

Code	Information
A	Outcrop
B	Artificial exposure
C	Floater
D	Erratic
E	Mine
F	Volcanic exhalation product

A.V.M. (Column 49)

Code	Information
A	Rock
B	Weathered rock
C	Sand
D	Detrital concentrate
E	Magnetic fraction of detrital concentrate
F	Sediment sample

Source(Column 48) contd.

Code	Information
G	Surface seepage
H	Stream
I	Lake
J	Marine
K	Beach
L	Auger
M	Bore, Well, D.D.H.
N	Core cuttings
O	Smelter
P	Refinery
Q	Extra-terrestrial
R	Mine dump (untreated)
S	Tailings
Z	Miscellaneous
/	No information

A.V.M. (Column 49) contd.

Code	Information
G	Soil
H	Encrustation
I	Sublimate
J	Water
K	Oil
L	Tar
M	Gas
N	Ore
P	Mineralized Rock
/	No information

Report Reference (Columns 50 to 55)

The reference is divided into two parts for the purpose of coding. A one-column field refers to the type of report, and is followed by a five-column field where the report number is coded.

Report Type

Code	Information
1	Record
2	Report
3	Bulletin

This can be expanded if required.

0(zero) No information.

Report Number Bulletin and Report numbers are coded without modification on the right hand side of the field - i.e., single figure numbers in column 55, double figure numbers in columns 54 and 55, and so on. Add progressive zeros where necessary e.g., Bulletin or Report numbers 1 is coded 00001.

Record numbers are coded as shown in the examples below.

1962/232 - 62232
1953/103 - 53103
1970/3 - 70003

Sample Disposal (Column 56)

The purpose of this field is to record whether or not a specimen exists and if so, where it is stored. The sub-headings for stored specimens are alphabetically coded in the series A to I. This ensures that, if a specimen has been retained, a hole will be punched in + , no matter where it is stored; this is useful for sorting purposes. The second hole of the two-hole alpha-code denotes where the specimen is stored. If a specimen has not been retained, this fact is recorded by an oblique stroke.

Code	Information
A	Museum
B	Cores and Cuttings store
C	General specimen store, Fyshwick.
Others can be added in the future if required.	
/	No information

Work Area (Columns 57 to 63)

Work area signifies the types of work done on a specimen - i.e., one specimen may be examined petrologically, chemically, and mineragraphically. This is a device to cross-reference between the work areas for one specimen. The coding used is based on three-hole special characters.

Column 57		Column 58	
Code	Information	Code	Information
0 (figure zero)	No information	0	No information
+	Mineralogy	+	Age-determination
3	Petrology	3	Phosphate
4	Water	8	Engineering geology
8	Chemistry	C	Age-determination and phosphate
C (+ and 3)	Mineralogy and Petrology	H	Age-determination and Engineering geology
H (+ and 8)	Mineralogy and Chemistry		
= (3 and 8)	Petrology and Chemistry	=	Phosphate and Engineering Geology.
@ (4 and 8)	Water and Chemistry		
* . (+, 3 and 8)	Mineralogy, Petrology, and Chemistry	.	Phosphate, Age-determination, and Engineering geology.

---

* Although the dot (.), is used for coding information into the system, the 870 machine will be wired up to print out the dollar sign ($), in the type out, to indicate mineralogy, petrology, and chemistry.

Column 59		Column 60	
Code	Information	Code	Information
0	No information	0	No information
+	Palynology	+	Petroleum Technology
3	Micro-palaeontology	3	Petroleum Exploration
8	Macro-palaeontology		

PETROLOGY GROUP MASTER CARD (Fig. 22)

The information in columns 1 to 55 is coded in exactly the same way as on the General Master Card. The code described below concerns Sample Information for the Petrology Group Master Card in columns 56 onwards.

Sample Type (Column 56)

The purpose of this column is to denote the kind of information stored in the succeeding columns - thus, if 'Igneous' is coded in this column, the information in the succeeding column refers to a specimen of igneous rock; if "Metamorphic" is coded, then the specimen information is about a metamorphic rock, and so on. The code is :-

Code	Information
1	Igneous
2	Metamorphic
3	Sedimentary
0	No information

The code for each of the three groups of rocks is described separately below.

Igneous Rocks - General Description (Column 57).

The general description is to be used in order to give a general name to rocks in hand specimen, and to facilitate sorting of general rock types with specimens that have detailed names. They are also used in order to define pyroclastic rock names, e.g., basaltic lapilli tuff, rhyolite vitric tuff, andesitic agglomerate, etc.

Code	Information	Code	Information
A	Granitic	M	Gabbroic
B	Micro-granitic	N	Doleritic
C	Granodioritic	Ø	Basaltic
D	Micro-granodioritic	P	Basaltic glass
E	Rhyolitic	Q	Undersaturated rocks
F	Rhyolitic glass	R	Ultramatic
G	Syenitic	S	Acid pegmatite
H	Micro-syenitic	T	Intermediate pegmatite
I	Trachytic	U	Basic pegmatite
J	Dioritic	X	Xenolithic
K	Micro-dioritic	/	No information
L	Andesitic		

Rock Name (Columns 58 to 60). These are given in Table I. The names are based on an adaptation of the classification of S.R. Nockolds (1954). In rock nomenclature, all officers should use the same classification. The Nockolds classification has been chosen because it is simple ; the names are based on mineralogical characteristics. However, Nockolds, in his paper, presents averages of chemical analyses for each of his rock types, thus relating, in a general way, mineral content to chemical composition. The classification is fully described by Morgan (1964).

In the code (Table I), to sort groups of rock types, i.e., acid, intermediate, and so on, sorting on the first figure of the code (i.e., column 58) should be carried out:-

Code	Information	Code	Information
1	Acid	5	Ultra-alkaline
2	Intermediate	6	Ultramafic
3	Basic	7	Spilitic
4	Feldspathoidal basic/and intermediate, and lamprophyres.	8	Late-stage
		9	Pyroclastic

Mineralogical Qualifier (Columns 61 to 63). The constituent minerals of igneous rocks are termed essential, characterizing accessory, and minor accessory, minerals. In a biotite adamellite the essential minerals are quartz, potash feldspar, and plagioclase - the presence of these minerals defines the rock name: they are not coded. Biotite is a characterizing accessory in this adamellite; zircon, apatite, etc., are minor accessory minerals.

The characterizing accessory minerals of an igneous rock are coded. Examples of how to code are :

(a) For hornblende granite, code Hornblende (3 in column 62).

(b) For augite-hornblende diorite with opaque ore accessory, code 4 (clinopyroxene) in column 61, and U (hornblende and opaque ore accessory) in column 62.

(c) For quartz dolerite, code quartz as a plus sign in column 63.

(d) For nepheline-bearing (i.e., nepheline less than 10% of total rock) trachyte, code feldspathoid as a minus sign in column 63.

Column 61

Ortho-pyroxene	Biotite	Olivine	None	
			/	No information
	J		1	Olivine
	K	S	2	Ortho-pyroxene
C	L	T	3	Clinopyroxene
D	M	U	4	Titaniferous pyroxene
E	N	V	5	Soda-pyroxene
F	Ø	W	6	Biotite
G	P	X	7	Cordierite
H	Q	Y	8	Tourmaline
I	R	Z	9	

Column 62

Opaque Oxide dominant	Opaque oxide subsidiary	Opaque oxide less than 5%	None	
+	-	0 (Zero)	/	No information
B	K	S	2	Ortho-amphibole
C	L	T	3	Tremolite-actinolite
D	M	U	4	Hornblende
E	N	V	5	Lamprobolite
G	P	X	7	Soda-amphibole
H	Q	Y	8	Muscovite

Column 63

Quartz	Feldspathoid	Alkali feldspar	None	
+	-		/	No information
A	J		1	Alkali feldspar
B	K	S	2	Albite-oligoclase
C	L	T	3	Andesine-labradorite
D	M	U	4	Bytownite-anorthite
E	N	V	5	Tourmaline
G	P	X	7	Garnet
H	Q	Y	8	Kyanite, sillimanite

Table I Igneous Rock Names

Code	Name
	Acid Rocks
101	Calc-alkaline granite
102	Calc-alkaline micro-granite
103	Calc-alkaline rhyolite
104	Alkaline granite
105	Alkaline micro-granite
106	Alkaline rhyolite
107	Peralkaline granite
108	Peralkaline micro-granite
109	Peralkaline rhyolite
110	Adamellite
111	Micro-adamellite
112	Dellenite
113	Granodiorite
114	Micro-granodiorite
115	Rhyodacite
116	Tonalite
117	Micro-tonalite
118	Dacite
119	Pitchstone
120	Obsidian
121	Felsite
122	Pumice
	Intermediate rocks
201	Calc-alkaline syenite / micro-syenite
202	Calc-alkaline
203	Calc-alkaline trachyte
204	Alkaline syenite
205	Alkaline micro-syenite
206	Alkaline trachyte
207	Peralkaline syenite
208	Peralkaline micro-syenite
209	Peralkaline trachyte
210	Monzonite
211	Micro-monzonite
212	Latite
213	Mangerite
214	Micro-mangerite
215	Doreite
116	Mugearite
217	Diorite
218	Micro-diorite
219	Andesite
220	Andesitic basalt
221	Basaltic andesite
222	Hawaiite
223	Hyalo-andesite
224	Ferro-diorite

Code	Name
	Basic Rocks
301	Gabbro
302	Norite
303	Troctolite
304	Dolerite
305	Micro-norite
306	Micro-troctolite
307	Basalt
308	Hypersthene-basalt
309	Picrite basalt
310	Leuco-gabbro
311	Leuco-norite
312	Leuco-troctolite
313	Leuco-dolerite
314	Leuco-micro-norite
315	Leuco-micro-troctolite
316	Leuco-basalt
317	Ferro-gabbro
318	Ferro-dolerite
319	Andesine-dolerite
320	Oligoclase-dolerite
321	Kentallenite
322	Micro-kentallenite
323	Trachybasalt
324	Shonkinite
325	Micro-shonkinite
326	Mela-trachyte
	Feldspathoidal Basic and Intermediate rocks.
401	Theralite
402	Micro-theralite
403	Tephrite
404	Basanite
405	Teschenite
406	Malignite
407	Foyaite
408	Micro-foyaite
409	Phonolite
	Lamprophyres
451	Lamprophyre
452	Minette
453	Vogesite
454	Soda vogesite
455	Kersantite
456	Spessartite
457	Camptonite
458	Alnoite
459	Monchiquite

Code	Name
	Ultra-alkaline rocks
501	Ijolite
502	Nephelinite
503	Urtite
504	Melteigite
505	Fasinite
506	Jacupirangite
507	Leucitite
508	Fergusite
509	Analcitite
510	Melilitite
511	Uncompahgrite
512	Carbonatite
	Ultramafic Rocks
601	Dunite
602	Olivinite
603	Peridotite
604	Orthopyroxenite
605	Clinopyroxenite
606	Pyroxenite
607	Perknite
608	Magnetitite
609	Chromitite
610	Ilmenitite
611	Limburgite
	Spilitic Rocks
701	Spilite
702	Keratophyre
703	Quartz keratophyre
	Late-stage rocks
801	Granite-pegmatite
802	Granite-aplite
803	Tholeiitic dolerite-granophyre
804	Tholeiitic dolerite-pegmatite
805	Alkali dolerite-pegmatite
806	Schorl-rock
	Pyroclastic Rocks
901	Agglomerate
902	Volcanic conglomerate
903	Volcanic breccia
904	Lapilli tuff
905	Tuff
906	Vitric tuff
907	Vitric crystal tuff
908	Vitric, crystal and lithic tuff
909	Crystal tuff
910	Crystal and lithic
911	Lithic tuff
912	Lithic and vitric tuff
913	Palagonite tuff
914	Sorted tuff
915	Welded tuff
916	China-stone tuff
917	Intrusion breccia
918	Explosion breccia
909	Tuffisite
000	No information.

Texture (Column 64)

Porphyritic	Non-massive	Massive	None	
+	-	O(Zero)	/	No Information
A	J		1	Tectonically deformed
B	K	S	2	Glassy
C	L	T	3	Aphanitic
D	M	U	4	Grain-size < 1 mm.
E	N	V	5	" " 1-5 mm.
F	Ø	W	6	" " 5-30 mm.
G	P	X	7	" " > 30 mm.
H	Q	Y	8	Pumiceous, scoriaceous
I	R	Z	9	Other

Alteration (Column 65)

Weathering	* Other	Both	None	
			1	Fresh
B	K	S		Slightly altered
C	L	T		Moderately altered
D	M	U		Strongly altered
E	N	V		Completely altered

An oblique stoke / is to be inserted if there is no information in this column.

* "Other" means metasomatic, late stage alteration, etc.

Mode of Occurrence (Column 66)

Extrusive		Intrusive	
Code	Information	Code	Information
A	Flow	J	Pipe (Plug)
B	Cone	K	Sill
C	Neck	L	Dyke
D	Tholoid, spine	M	Ring-dyke
E	Pyroclast, unsorted, loose	N	Cone-sheet
		Ø	Stock
F	Pyroclast, unsorted, indurated	P	Laccolith
		Q	Lopolith
G	Pyroclast, bedded, loose	R	Batholith
H	Pyroclast, bedded, indurated	S	Intrusive (form not known)

General

Code	Information
T	Intrusive or extrusive
U	Inclusion
V	Segregation
W	Other
/	No information

Metamorphic Rocks

General Description (Column 57). This is to be used for hand specimen names, and to be filled in for rocks with detailed names, in order to facilitate sorting of general rock types.

Code	Information	Code	Information
A	Amphibolite	J	Migmatite
B	Buchite	K	Mylonite
C	Charnockite	L	Phyllite
D	Eclogite	M	Phyllonite
E	Gneiss	N	Schist
F	Granofels	P	Skarn
G	Hornfels	Q	Slate
H	Marble	R	Spotted Slate
I	Metaquartzite	S	Metasomatic
		/	No information

Rock Name (Columns 58 to 60). Rock names can be sorted into the very general types (contact, dynamic, regional, etc.) on the first figure (Column 58) of the code. The code is shown in Table II. Metamorphic rock nomenclature is described by Morgan (1964).

Table II - Metamorphic Rock Names

Contact Metamorphic Rocks		Dynamic Metamorphic Rocks		Regional Metamorphic Rocks		Miscellaneous Marble	
Code	Information	Code	Information	Code	Information	Code	Information
001	Hornfels	201	Ultramylonite	301	Slate	901	Marble
002	Skarn	202	Hartschiefer	302	Phyllite	902	Predazzite
003	Tactite	203	Mylonite	303	Semi-schist	903	Ophicalcite
004	Buchite	204	Cataclasite	304	Schist	904	Metaquartzite
005	Spotted slate	205	Mylonite gneiss	305	Gneiss	905	Chernockite
Metasomatic Rocks		206	Blastomylonite	306	Granofels		
101	Greisen	207	Hyalomylonite	307	Amphibolite	///	No information
102	Schorl rock	208	Gangmylonite	308	Eclogite		
		209	Pseudotachylite	309	Migmatite		
		210	Protomylonite				
		211	Fault breccia				
		212	Phyllonite				

Mineralogical Qualifier (Columns 61 to 63). Code only the mineral or minerals that give an indication of the metamorphic grade of the rock.

Column 61

Andalusite	Epidote	Tremolite-Actinolite		
+	-		/	No information
A	J		1	Tremolite-actinolite
B	K	S	2	Cordierite
C	L	T	3	Chloritoid
D	M	U	4	Soda-plagioclase
E	N	V	5	Wollastonite
			6	Soda-amphibole

Column 62

Hornblende	Clino-pyroxene	Ortho-pyroxene		
+	-		/	No information
A	J		1	Orthopyroxene
B			2	Clinopyroxene
C	L	T	3	Soda-pyroxene
D	M	U	4	Lime-plagioclase
E	N	V	5	Ortho-amphibole
F	ø	W	6	Staurolite

Column 63

Kyanite-Sillimanite	Biotite	Muscovite	None	
+			/	No information
A	J		1	Muscovite
B			2	Biotite
C	L	T	3	Chlorite
D	M	U	4	Olivine
E	N	V	5	Garnet
G	P	X	7	Talc

Texture (Column 64)

Porphyroblastic	Massive	Post-metamorphic deformation		
+	-	0(Zero)	/	No information
B	K	S	2	Granoblastic
C	L	T	3	Schistose
D	M	U	4	Decussate
E	N	V	5	Mimetic
G	P	X	7	Skarn-like
H	Q	Y	8	Sheared

If there is no information to be coded in this column, an oblique stroke / is to be inserted in this column.

Alteration (Column 65)

Weathering	* Other	Both	None	
			1	Fresh
B	K	S	2	Slightly altered
C	L	T	3	Moderately altered
D	M	U	4	Strongly altered
E	N	V	5	Completely altered

An oblique stroke / is to be inserted in this column if there is no information to be coded.

* "Other" means metasomatic, etc.

Metamorphic Facies (Column 66)

Code	Information	Code	Information
A	Albite-epidote hornfels	K	Greenschist
B	Hornblende hornfels	L	Glaucophane schist
C	Pyroxene hornfels	M	Almandine-amphibolite
D	Sanidine hornfels	N	Granulite
J	Zeolite	P	Eclogite
		/	No information

The hornfelses are coded in the A to I series (i.e., zone punch +), and the regional metamorphic facies in the J to R series (- punch). This facilitates sorting for all hornfelses, or all regionally metamorphosed rocks.

Type of Metamorphism (Column 67)

Code	Information	Code	Information
1	Regional	5	Contact metasomatic
2	Dynamic	6	Retrograde
3	Contact	7	Polymetamorphic
4	Regional metasomatic	8	Not known
		0	No information

Original Material (Column 68)

Code	Information	Code	Information
+	Pelitic	6	Acid Igneous
1	Semi-pelitic	7	Aluminous
2	Psammitic	8	Ferruginous
3	Calcareous sediment	9	Other
4	Carbonate	-	(minus) Not known
5	Basic igneous	0	No information

Type of Metasomatism (Column 69)

F, B,	Sn, Li.	Si	Ca	None	
+				/	No information
A		J		1	Ca
B				2	Si
C		L	T	3	Fe-Mg
D		M	U	4	Alkali
E		N	V	5	Cl, CO_2, S

An oblique stroke / is to be inserted in this column if there is no information to be coded.

Sedimentary Rocks

General Description (Column 57). The general description is to be used in order to give a general name to rocks in hand specimens and to facilitate sorting of general rock types with specimens that have detailed names.

Code	Information	Code	Information	Code	Information
A	Conglomerate	H	Limestone	P	Chert
B	Breccia	I	Dolomite	Q	Flint
C	Sandstone	J	Peat	R	Other siliceous
D	Greywacke	K	Coal	S	Phosphorite
E	Siltstone	L	Bitumen	/	No information
F	Mudstone	M	Evaporite		
G	Shale	N	Bedded iron ore		

Rock Name (Columns 58 to 60). These are given in Table III, (see next page). The names are used as defined in Pettijohn (1957), and Guppy (1964).

Mineralogical Qualifier (Columns 61 to 63). The headings below are coded in each of columns 61, 62, and 63. Choose the one, two, or three most dominant qualifiers. If two or three are chosen, code one in each column.

Code	Information	Code	Information
A	Arenaceous	K	Glauconitic
B	Argillaceous	L	Gypsiferous
C	Bauxitic	M	Magnesian
D	Calcareous	N	Micaceous
E	Carbonaceous	Ø	Phosphate
F	Chamositic	P	Pyritic
G	Chloritic	Q	Sideritic
H	Dolomitic	R	Siliceous
I	Feldspathic	S	Silty
J	Ferruginous	T	Tuffaceous
		U	Sandy

Texture (Column 64)

Poorly sorted	Moderately sorted	Well Sorted	Not Known	
+	-	0(Zero)	/	No information
B	K	S	1	Boulder
C	L	T	2	Cobble
D	M	U	3	Pebble
E	N	V	4	Very coarse, 1-2 mm.
F	Ø	W	5	Coarse, 0.5 - 1 mm.
G	P	X	6	Medium, 0.25 - 0.5 mm.
H	Q	Y	7	Fine, 0.125 - 0.25 mm.
I	R	Z	8	Very fine, 0.063 - 0.124

Table III Sedimentary Rock Names

Code	Name
	Rudites
001	Oligomict conglomerate
002	Polymict conglomerate
003	Tilloid
004	Tillite
005	Intraformational conglomerate
006	Intraformational breccia
007	Breccia
	Pebbles
051	Acid igneous, coarse
052	Acid igneous, fine
053	Basic igneous, coarse
054	Basic igneous, fine
055	Contact metamorphic
056	Regional metamorphic
057	Dynamic metamorphic
058	Metasomatic rock
059	Rudite pebble
060	Sandstone pebble
061	Siltstone pebble
062	Carbonate pebble
	Arenites
101	Orthoquartzite
102	Protoquartzite
103	Subarkose
104	Arkose
105	Subgreywacke
106	Lithic greywacke
107	Feldspathic greywacke

Code	Name
	Lutites
201	Claystone
202	Mudstone
203	Shale
204	Siltstone
205	Loess
206	Laterite
207	Bauxite
	Limestone and Dolomites (Autochthonous)
301	Bioherm
302	Klintite
303	Biostrome
304	Pelagic limestone
	Limestones and Dolomites (Detrital)
321	Calcirudite
322	Dolorudite
323	Calcarenite
324	Dolarenite
325	Calcilutite
326	Dololutite
327	Coquina
328	Microcoquina
329	Encrinite
330	Spargenite
331	Lithographic limestone
332	Tufa
333	Travertine
334	Caliche
335	Marlstone
336	Sandy limestone (Fontainbleau)

Code	Name
	Siliceous
401	Chert
402	Flint
403	Jaspilite
404	Jasper
405	Porcellanite
406	Diatomite
407	Radiolarite
408	Siliceous Sinter
	Organic
501	Peat
502	Lignite, brown coal
503	Sub-bituminous coal
504	Bituminous coal
505	Semi-bituminous coal
506	Anthracite
507	Cannel coal
508	Boghead coal
509	Oil shale
510	Torbanite
551	Asphalt
552	Albertite
553	Elaterite
554	Ozokerite

Code	Name
	Iron-Bearing
601	Bedded iron sulphide
602	Bedded siderite
603	Clay ironstone
604	Sedimentary hematite
605	Bog iron ore
606	Bedded iron silicate
607	Ferricrete
608	Silcrete
	Evaporites
701	Halite
702	Gypsum
703	Anhydrite
	Miscellaneous
901	Greensand
951	Phosphorite
952	Guano
///	No information

Note: The main groups of sedimentary rocks (rudites, arenites, etc.), can be sorted on the first figure of the code, in column 58.

Alteration (Column 65)

Weathering	* Other	Both	None	
			1	Fresh
B	K	S		Slightly altered
C	L	T		Moderately altered
D	M	U		Strongly altered
E	N	V		Completely altered

An oblique stroke / is to be inserted if there is no information to be coded in this column.

* "Other" means metasomatic, etc.

Porosity and Grains to Matrix Ratio (Column 66)

Porous	Low Porosity	Non-porous		
+	-	0(Zero)	/	No information
B	K	S	2	Matrix predominant
C	L	T	3	Cement predominant
D	M	U	4	Grains predominant
E	N	V	5	Matrix and cement roughly equal, both predominant over grains.

Permeability and Grain Angularity (Column 67)

Very Permeable	Permeable	Impermeable		
+	-	0(Zero)	/	No information
B	K	S	2	Angular
C	L	T	3	Sub-angular
D	M	U	4	Sub-rounded
E	N	V	5	Rounded

Cement or Matrix (Column 68)

Calcite	Silica	Argill-aceous		
+	-	O(Zero)	/	No information
B	K	S	2	Kaolinite
C	L	T	3	Montmorillonite
D	M	U	4	Illite
E	N	V	5	Iron oxide
F	ø	W	6	Chert
G	P	X	7	Phosphate
H	Q	Y	8	Other Carbonate
I	R	Z	9	Other

PETROLOGY REFERENCE CARD (Fig. 23)

The information punched into columns 1 to 11 is the same as that on the Master and Detail Cards, i.e., Card Code, Sequence Number, Registered Number, and Fraction Number. The remaining space is blank, so that descriptive information can be typed or written in.

AGE-DETERMINATION GROUP MASTER CARD (Fig. 34)

The information coded in columns 1 to 55 is coded in exactly the same way as on the General Master Card. In columns 56 to 66 the information on petrography should be coded in the same way as on the Petrology Group Master Card. The code referred to below concerns Sample Information for the Age-Determination Group Master Card for columns 51 onwards.

"Work-done" Log

The information here is inserted in columns 67 and 68. In each column, three-hole, special character codes (see page 16) are used for the headings.

Column 67

Code	Information
0	No information
+	Sample rejected
3	Sample rejected
4	Sample to Age-determination laboratory
8	Age-determined

Combinations

+ and 3 is C

+ and 4 is D

+ and 8 is H

3 and 8 is =

4 and 8 is @

+ and 3 and 8 is .

Column 68

Code	Information
0	No information
+	Slide available
3	Petrographically described
8	Chemically analysed

Note that in column 67, 3 and 4 are mutually exclusive.

Method/Mineral Index

In this field, the method of age-determination used, and the material (i.e., mineral or total rock) on which it was performed, are indexed using the special character three-hole codes. Columns 69 to 72 are for the potassium/argon method, 73 to 76 for rubidium/strontium, 77 and 78 for lead isotopes, and 79 for other methods.

Column 69
Potassium/Argon

Code	Information
0	No information
+	Total rock
3	Muscovite (sericite, illite)
4	Amphibole
8	Potash feldspar

Column 70
Potassium/Argon

Code	Information
0	No information
+	Plagioclase
3	Pyroxene
8	Biotite
1	Glauconite

Column 71
Potassium/Argon

Code	Information
0	No information
+	Garnet
3	Calcite

Column 72, for potassium/argon, is spare

In columns 73 to 76 (rubidium/strontium), the information is coded as in columns 69 to 72.

Column 77
Lead Isotope

Code	Information
0	No information
+	Zircon
1	Lead minerals
3	Pitchblende
8	Other radio-active minerals.
9	Other minerals

Column 78
Lead Isotope

Code	Information
0	No information
+	Total rock

Column 79
Other methods

Code	Information
1	Carbon

Column 80 is spare.

DETAIL CARDS, AGE-DETERMINATION (Figures 35 to 38)

Columns 1 to 11 are coded in exactly the same way as on the Master Cards, i.e., fields are present for Card Code, Sequence Number, Registered Number, and Fraction Number. On all Age-Determination Detail Cards, columns 12 to 21 are used for Mineral Information, column 22 for method used, and 23 to show how many replicate analyses there are of a particular specimen by a particular method, and on the same mineral, have been done. From column 24 onwards is recorded the analytical information necessary for determination of the age of a specimen. There are cards for each of the Potassium/Argon, Rubidium/Strontium, and lead isotope methods.

The coding of information common to all Age-Determination cards will be described first (i.e., columns 12 to 23). Then the coding of information in columns 24 onwards will be described for each type of detail card.

Mineral Information

Mineral Name (Columns 12 to 15) is the mineral (or total rock sample) on which the analysis was done. The mineral is coded by using the first letter and the next three consonants; A, E, I, O, U, W, and Y are to be regarded as vowels. Examples are given below.

Muscovite	: MSCV	Sericite	: SRCT
Biotite	: (BTT/ in columns 12 to 14 oblique stroke / in column 15	Glauconite	: GLCN
		Garnet	: GRNT
		Plagioclase	: PLGC
Illite	: ILLT	Orthoclase	: ORTH
Pyroxene	: PRXN	Microcline	: MCRC
Hornblende	: HRNB	Calcite	: CLCT
Amphibole	: AMPH	Monazite	: MNZT
Zircon	: ZRCN	Cerussite	: CRSS
Total Rock	: TTLR		

Note: Where a fourth consonant does not occur, as in biotite above, an oblique stroke / should be put in the last column.

Concentrate (Column 16)

A hole punched in position one indicates that a concentrate of the mineral coded in the previous columns is available after completion of analysis. Code 0 (zero) if the concentrate is not available.

Grain Size (Columns 17 to 19)

The grain size for the concentrate used in the analysis is recorded in terms of the BSS sieve mesh diameter. Size 6 is recorded in column 17, 66 in 16 and 17, and 666 in columns 15, 16, 17. Code zeros in the unused columns.

Purity (Columns 20 and 21)

This refers to the purity of the sample that is analysed, and is expressed as a percentage.

Method (Column 22)

This information is inserted to facilitate sorting, and refers to the method of age-determination used.

Code	Information
1	Potassium/Argon
2	Rubidium/Strontium
3	Lead Isotope
0	No information

Replicate (Column 23)

In this column, the number of repeat determinations done on the particular concentrate for the sample, by the method coded in column 20, is punched. Code 0(Zero) if there is no information.

Lead Isotope Method

The results of this method of analysis are spread over two

to 60), and Concentrations (columns 61 to 78). Card B (5 in "Sequence Number") contains Calculated Ages, True Age, and Age of Metamorphism, for Radiogenic Leads (columns 24 to 49), together with data for Common Lead (columns 50 to 70). Column 71 indicates the number of related specimens in a particular suite.

Decay Constants (Columns 25 to 36). The constants are used in calculations and are punched into the cards in order to indicate that these are the figures actually used. Later research, or a change of opinion, may produce slightly different values, for the constants. At the Australian National University Geochronology Laboratory, where Bureau samples are dealt with, the constants used at present are :

$U^{238} = 1.54 \times 10^{-10} y^{-1}$

$U^{235} = 9.72 \times 10^{-10} y^{-1}$

$Th = 4.88 \times 10^{-11} y^{-1}$

Atomic Ratio $U^{238}/U^{235} = 137.7$

The decimal point is not coded.

Observed Isotopic Ratios (Columns 37 to 60). The method used here to record the ratios is to assume Pb^{206} to be 100.00%, and to express the other lead isotopes as percentages in terms of Pb^{206}. The decimal point is thus placed between the third and fourth columns in each of the Isotopic Ratio fields. If, however, the actual result to be recorded in these fields is less than 100.00%, the number of places the decimal point has moved to the left is recorded in the exponential column (EXP) in the relevant fields. For example (see figures 19 and 37), if a value for Pb^{207} ; Pb^{206} is 115.36%, nothing is punched in EXP (column 54); however, if a value of 0.00057364% for the ratio Pb^{204}/Pb^{206} is to be punched, 573.62 is punched for the value, and 6 is punched in EXP, indicating that the decimal point, in fact, is 6 places to the left of figures 64. On the Document-Writing equipment, for this ratio, the figures 573.646 will be typed out; 6 is the exponential, and indicates that the decimal point is actually 6 places left of where it is shown.

Concentrations (Columns 61-78). In these fields, the decimal point is assumed to be between columns 61 and 62 for uranium, columns 67 and 68 for thorium, and 73 and 74 for lead. The exponential column is used in a similar fashion to that in the Isotopic Ratios fields.

Radiogenic Lead (Fig. 38, Card 5, columns 24 to 49). The Calculated Ages for the four different ratios are expressed in terms of millions of years.

True Age and Metamorphic Age are also expressed in terms of millions of years, but in addition, an exponential column is used in order to indicate fractions of millions of years for very young rocks. The decimal point is assumed to be between columns 43 and 44, and 48 and 49, unless a figure is punched in the exponential.

Common Lead (Columns 50 to 70).

(a) For the ratios U^{230}/Pb^{204} and Th/U, the decimal point is always between columns 50 and 51, and 54 and 55, in the respective fields.

(b) The Model and Remobilization Ages are expressed in the same manner as True and Metamorphic Ages of Radiogenic Leads.

(c) $T_o \times 10^9 y$ is a constant.

(d) The actual number of related samples is punched into column 71.

Note : Pb^{204}/Pb^{206}. The expected values for this ratio range from 0.001% to 0.000005%.

Pb^{207}/Pb^{206}. Here, the values are expected to range between 5% and 120%.

Pb^{208}/Pb^{206}. The values range from 0.3% to 700%.

Uranium. The values range up to 0.1%.

Thorium. The values range from 0.1% to 5%.

Lead. Values are from 45 p.p.m. to 1%.

U^{238}/Pb^{204}. Values are between 8.9% and 9.2%.

Th/U. 3.7% to 4.4%

The figures noted above are estimates given by Dr. J.R. Richards, of the Australian National University.

Potassium/Argon Method

Decay Constants (Columns 24 to 32)

$\lambda\beta = 4.72 \times 10^{-10} y^{-1}$

$K = 0.584 \times 10^{-10} y^{-1}$

K^{40} Abundance $= 1.22 \times 10^{-4} g/g^{K}$

Analytical Detail

(a) Percentage K. The decimal point will be assumed to be between columns 34 and 35 (or 52 and 53), unless qualified by an exponential (column 37 or 55).

(b) ^{40} Ar* Atmosphere. The decimal point is between columns 39 and 40 (or 55 and 56).

(c) ^{40} Ar*/^{40}K. The decimal point is between columns 40 and 41 (or 58 and 59) unless qualified by an exponential in column 43 or 61.

(d) The Calculated Age is coded in terms of millions of years.

(e) Significance, this refers to value coded in the Calculated Age field.

Code	Information
1	Age of emplacement
2	Age of metamorphism
3	Age of faulting
4	Other
0	No information

Rubidium/Strontium

Constants

Decay Constant λ Rb^{87} = $1.39 \times 10^{-11} y^{-1}$ - Columns 24 to 26
Rb^{85}/Rb^{87} ratio = 2.600 - columns 27 to 30
Sr^{88}/Sr^{86} ratio = 8.3400 - columns 31 to 35

Analytical Detail. The decimal point will be placed as shown for the values listed below, unless qualified by an exponent .

Common Sr - between columns 41 and 42
Total Rb - " " 48 and 49
Rb^{87}/Sr^{86} - " " 53 and 54
Sr^{87}/Sr (present ratio) - between columns 64 and 65

For the Initial Ratio of Sr^{87}/Sr^{86}, the decimal point will always be between columns 55 and 56.

Calculated Age (Columns 66 to 70). This is expressed in terms of millions of years; the exponential column is used in order to indicate fractions of millions of years for young specimens. The decimal point is assumed to be between columns 69 and 70, unless a figure is punched in the exponential.

Related specimens. The number of related specimens is punched in to column 71. Code 0(zero) if there is no information.

Age Significance (Column 72). The same code as is used in column 50 (68) on the Potassium/Argon card.

REFERENCE CARDS, AGE-DETERMINATION (Figures 39 to 41)

There are two Age-Determination reference cards. On both, the information punched into columns 1 to 11 is the same as on the Master and Detail Cards, i.e., Card Code, Sequence Number and Registered Number. On both cards, the remaining space is left blank, except for headings, so that descriptive information can be typed or written in.

Reference Card A (figure 6 punched in "Sequence Number"), General Geology, is entered on the front, and References on the reverse side. Card B (figure 7 punched on Sequence Number) will carry the petrographic description of the specimen concerned.

CHEMISTRY GROUP MASTER CARD (Fig.26)

The information in columns 1 to 55 is coded in the same way as on the General Master Card. The code for the remaining columns is given below.

Sample Type (Column 56)

Code	Information	Code	Information
1	Igneous	6	Minerals
2	Metamorphic	7	Water
3	Sedimentary	8	Vegetation
4	Soils	0	No information
5	Weathering products		

This information qualifies that contained in columns 57 to 67; i.e., if "soils" 4 is coded here, then the information coded in columns 57 to 67 is about soils; if "minerals" 6 is coded, then the information in the next eleven columns is about mineralogy.

Sample Information (Columns 57 to 67)

The information coded here is related/to the subject coded in the previous column (56 see above).

For Igneous, Metamorphic, and Sedimentary, (types 1 2 and 3 in column 56), the General Description and Rock Names coded in columns 57, and 58 to 60 respectively in the Petrology Master Card (Igneous p.27, Metamorphic p.32 and Sedimentary p. 35 are to be used.

Soils (Type 4 in column 56)

General Description (Column 57)

Code	Information	Code	Information
1	Alluvial soils	3	Calcareous coastal sands
2	Skeletal soils	4	Wind-blown dust and sand
		5	Pedalfers
		6	Pedocals
		0	No information

Soil Type - Pedalfers (column 58)

Code	Information
1	Soil dominated by acid peat or peaty alluvial horizon, e.g. moor peats, alpine humus soils, moor podsol peats, and acid swamp soils.
2	Soil acid with organic, sesquioxide, and in some cases clay illuvial horizons, e.g. podsols and ground water podsol.
3	Soil acid and with clay and sesquioxide horizons, e.g., laterites, greybrown, brown, red, yellow, and non-calcic podsols.
4	Soil acid to neutral and lacking pronounced eluviation of clay, e.g., yellow earths, Krasnozem, lateritic Krasnozem, lateritic red earths, terra-rossa, and prairie soils.
0	No information.

Soil Type - Pedocals (column 59)

Code	Information
1	Soil dark coloured and slightly acid to neutral in eluvial horizons, calcareous illuvial horizons, e.g., black earths, wiesenboden, brown forest soils, redzinas, ground water, and fen soils.
2	Soil saline or showing post-saline structure in the illuvial horizon, e.g., solonchaks, solonetz, solodised solonetz, soloths, and solonised brown soils.
3	Soil with slightly acid to neutral eluvial horizons and calcareous illuvial horizons, e.g., red brown earths, brown earths, brown soils of light texture, arid red earths, and grey calcareous soils.
4	Soil with neutral to alkaline, weakly developed eluvial horizons and calcareous and/or gypseous illuvial horizons, e.g., grey to brown soils of heavy texture.
5	Soil with deflated, slightly acid to alkaline eluvial horizons and calcareous and/or gypseous illuvial horizons, e.g., desert loams, grey-brown and red calcareous desert soils, red and brown hard pan soils, desert plain soils, calcareous laterite soils, and desert tableland soils.
0	No information.

Parent - Igneous Rocks (Column 60)

Intrusive	Extrusive (flow)	Pyroclastic	Not Known	
+	-	0(zero)	/	No information
B	K	S	2	Granitic, rhyolitic
C	L	T	3	Granodioritic, dacitic
D	M	U	4	Syenitic, trachytic
E	N	V	5	Dioritic, Andesitic
F	Ø	W	6	Gabbroic, basaltic
G	P	X	7	Undersaturated rocks
H	Q	Y	8	Ultramafic
I	R	Z	9	Pegmatite, aplitic

Parent - Metamorphic Rocks (Column 61)

Regional	Contact	Dynamic	Not Known	
+	-	0 (zero)	/	No information
			1	Not known
B	K	S	2	Pelitic
C	L	T	3	Psammitic
D	M	U	4	Calc-silicate
E	N	V	5	Marble
F	Ø	W	6	Orthogneiss
G	P	X	7	Paragneiss
H	Q	Y	8	Aluminous metamorphic
I	R	Z	9	Ferruginous metamorphic

Parent-Sedimentary Rocks (Column 62)

Code	Information	Code	Information
A	Conglomerate	J	Peat
B	Breccia	K	Coal
C	Sandstone	L	Bitumen
D	Greywacke	M	Evaporite
E	Siltstone	N	Bedded iron ore
F	Mudstone	Ø	Chert
G	Shale	P	Flint
H	Limestone	Q	Other siliceous
I	Dolomite	R	Phosphorite
		/	No information

Soil Horizon (Column 63)

Code	Information
1	A_{00} horizon
2	A_0 horizon
3	A_1 horizon
4	A_2 horizon
5	B_1 horizon
6	B_2 horizon
7	C horizon
0	No information

Topography (Column 64)

Code	Information
1	Flat
2	Rolling
3	Steep
4	Very steep
5	Broken and irregular
0	No information

Rainfall (Column 65)

Code	Information
1	0 - 5 inches per year
2	5 -10 inches per year
3	10 -20 inches per year
4	20 -30 inches per year
5	30 -40 inches per year
6	40 -50 inches per year
7	50 -60 inches per year
8	60 -80 inches per year
9	80-100 inches per year
+	Over 100 inches per year
0	No information.

Soil Components (Column 66)

Code	Information	Code	Information
A	Quartz	K	Muscovite
B	Orthoclase	L	Biotite
C	Albite	M	Chlorite
D	Oligoclase	N	Hematite
E	Labradorite	O	Limonite
F	Anorthite	P	Clay
G	Apatite	Q	Ferruginous gravel
H	Magnetite	R	Aluminous gravel
I	Amphiboles and pyroxenes	S	Siliceous gravel
J	Olivine	T	Organic matter
		/	No information

Note, code only the dominant component

Minerals (Type 6 in column 56)

General Description (Column 57)

Mineralized Sample	Gangue	Wall Rock	Others	
+	-	0(zero)	/	No information
B	K	S	2	Carbonate
C	L	T	3	Native element
D	M	U	4	Sulphide or sulphosalt
E	N	V	5	Oxide, hydroxide
F	Ø	W	6	Sulphate
G	P	X	7	Uranium compound
H	Q	Y	8	Silicate
I	R	Z	9	Others

Dana Class Number (Columns 58 and 59)

The class number and mineral groups are shown in Table IV Code the tens in columns 58 and the units in column 59.

Mineral Name (Columns 60 to 64)

A five letter code using the first letter and the next four consonants - e.g., chalcopyrite would be coded CHLCP; biotite would be coded BTT in columns 60 to 62; oblique strokes are used to fill up the spaces in columns 63 and 64, thus biotite, fully coded, is BTT//.

Table IV Dana Class Number

Code	Information
01	Native elements
02	Sulphides
03	Sulphosalts
04	Simple oxides
05	Oxides containing U, Th and Zr.
06	Hydroxides and Oxides containing hydroxyl.
07	Multiple Oxides
08	Multiple Oxides containing Nb Ta, and Ti.
09	Normal Anhydrous and Hydrated Halides.
10	Oxyhalides and Hydroxyhalides
11	Halide complexes, Alumino - fluorides.
12	Compound Halides
13	Acid Carbonates
14	Anhydrous Normal Carbonates
15	Hydrated Normal Carbonates
16	Carbonates containing Hydroxyl and Halogen
17	Compound Carbonates
18	Normal Anhydrous and Hydrated Nitrates.
19	Nitrates containing Hydroxyl or Halogen
20	Compound Nitrates
21	Normal Anhydrous Hydrated Iodates.
22	Iodates containing Hydroxyl or Halogen.
23	Compound Iodates
24	Anhydrous Borates
25	Hydrated Borates
26	Borates containing Hydroxyl or Halogen
27	Compound Borates
28	Anhydrous acid and Normal Sulphates
29	Hydrated Acid and Normal Sulphates
30	Anhydrous sulphate containing hydroxyl or halogen
31	Hydrated sulphates containing hydroxyl or halogen
32	Compound sulphates
33	Selenates and Tellurates
34	Selenites and Tellurites
35	Anhydrous Normal Chromates
36	Compound Chromates
37	Anhydrous Acid Phosphates etc.
38	Anhydrous Normal Phosphates etc.
39	Hydrated acid Phosphates etc.
40	Hydrated Normal Phosphates etc.
41	Anhydrous Phosphates etc. cont. hydroxyl or halogen.
42	Hydrated Phosphate etc. containing hydroxyl.
43	Compound Phosphates etc.
44	Antimonites
45	Acid and Normal Antimonites and Arsenites
46	Basic or Halogen - containing Antimonites and Arsenites
47	Vanadium oxysalts.
48	Normal Anhydrous Molybdates and Tungstates.
49	Basic and Hydrated Molybdates and Tungstates.
50	Salts of organic acids.
	ANHYDROUS SILICATES (Disilicates, Polysilicates Division).
51	Feldspar group
52	Leucite group
53	Pyroxene group
54	Amphibole group
	(Orthosilicates Division)
55	Nephelite group
56	Sodalite group
57	Helvite group
58	Garnet group
59	Chrysolite group
60	Phenacite group
61	Scapolite group
62	Zircon group
63	Danburite group
64	Datolite group
65	Epidote group
	(Subsilicates Division)
66	Humite group
	HYDROUS SILICATES (Zeolite Division)
67	Mordenite group
68	Healandite group
69	Phillipsite group
70	Chabazite group
71	Natrolite group
	(Mica Division)
72	Mica group
73	Clintonite group
74	Chlorite group
	(Serpentine and Talc Division)
75	Serpentine
76	Talc
	(Kaolin Division)
77	Kaolin minerals group
78	Hydrous aluminium silicates
	(Concluding Division)
79	Hydrous iron silicates
80	Hydrous manganese silicates
81	Hydrous copper silicates
82	Silicates containing other acid radicals
83	Titano silicates

Genetic classification (Column 65)

Code	Information	Code	Information
+	Hypogene	6	Detrital concentrates
1	Supergene	7	Evaporite
2	Metamorphic	8	Residual concentrate
3	Magmatic segregation	9	Other
4	Syngenetic (includes bedded deposits).	0	Other information
5	Oxidized ore (includes gossans).		

Form of deposit (Column 66)

Code	Information
+	Tabular - lenticular discordant
1	Tabular - lenticular concordant (includes bedded and alluvial deposits).
2	Massive
3	Irregular
4	Local segregation (ore segregated into isolated veins, pods, pockets).
5	Stockwork (complex of veins and ore filling complex of fissures or shears).
6	Blanket (relatively large areal extent - e.g., laterite, evaporite). Includes dune deposits.
7	Banded (sedimentary or metamorphic banding).
8	Disseminated
9	Other
0	No information

Major Product (Column 67)

Code	Information	Code	Information
A	Pb - Zn	N	As - Sb
B	Cu - Mo	Ø	Hg
C	U - V	P	Bi
D	Fe - Mn	Q	Be
E	Al - Mg	R	Se - Te
F	W	S	Rare earths
G	Cu	T	Platinum group
H	Co - Ni	U	Phosphate
I	Th	V	Nb - Ta
J	Sn	W	Barium minerals
K	Cr	X	Strontium minerals
L	Au	Y	Zirconium - Hafnium
M	Ag	Z	Others
		/	No information

Sample Depth and Interval (Columns 68 to 75)

Depth to top of sample interval (Columns 59 to 63)

This gives the depth from the surface to the top of the sample in feet (recorded in columns 68 to 71), and inches (in column 72. For inches, code the digits 1 to 9 for 1 to 9 inches, together with (minus) for 10 inches and + (plus) for 11 inches. Figure 0 (zero) must be used if there are no inches to record, in order to prevent ambiguities in selection on the sorter-selector equipment.

Feet are coded in columns 68 to 71, and by coding numerically, a depth of 9999 feet can be recorded where footage occupies less than 4 columns, zeros are inserted in unused columns. For depths greater than this, alpha-coding in column 68 is used, the zone punches + and - and 0 (zero) adding 10,000, 20,000 and 30,000 feet respectively, to the footage shown by the digits, according to the scheme shown below:

Code	Depth	Code	Depth	Code	Depth
+	10,000 feet	-	20,000 feet	0(zero)	30,000 feet
A	11,000 feet	J	21,000 feet	/ (oblique stroke)	31,000 feet
B	12,000 feet	K	22,000 feet	S	32,000 feet
C	13,000 feet	L	23,000 feet	T	33,000 feet
D	14,000 feet	M	24,000 feet	U	34,000 feet
E	15,000 feet	N	25,000 feet	V	35,000 feet
F	16,000 feet	O	26,000 feet	W	36,000 feet
G	17,000 feet	P	27,000 feet	X	37,000 feet
H	18,000 feet	Q	28,000 feet	Y	38,000 feet
I	19,000 feet	R	29,000 feet	Z	39,000 feet

Sample Interval (Columns 73 to 75). This indicates the vertical extent of the sample interval in the drill hole shaft etc. at the depth recorded in the previous field. Footage is recorded in columns 73 and 74 and inches are coded in column 75 in the same way as in column 72, described above. In vacant columns, zeros are inserted.

Fraction Size (Columns 76 and 77). For the natural sample not split into size fractions, insert 00 (double zero) in these columns. Column 76 gives the coarse size limit, and 77 the finer limit. If either limit is unknown, insert an 0 (zero) is made in the relevant column.

The particle size limit is measured in millimetres; the position of the zone punches + (plus) - (minus) and 0 (zero), if present determine the position of the decimal point, according to the scheme shown below:

No zone punch		+ zone punch		- zone punch		0 (zero) zone punch	
Code	Particle size	Code	Particle size	Code	Particle size	Code	Particle size
	mm.		mm.		mm.		mm.
9	9	I	0.9	R	0.09	Z	0.009
8	8	H	0.8	Q	0.08	Y	0.008
7	7	G	0.7	P	0.07	X	0.007
6	6	F	0.6	O	0.06	W	0.006
5	5	E	0.5	N	0.05	V	0.005
4	4	D	0.4	M	0.04	U	0.004
3	3	C	0.3	L	0.03	T	0.003
2	2	B	0.2	K	0.02	S	0.002
1	1	A	0.1	J	0.01	/	no information

Table V and VI show U.S. Standard Series and B.S.S. Standard Sieve sizes respectively, together with the sizes of the openings. These are given to compare with the code above.

Table V U.S. Standard

Mesh	Opening mm.	Mesh	Opening mm.	Mesh	Opening mm.	Mesh	Opening mm.
2.5	8.0	12	1.7	45	0.35	200	0.074
3	6.7	14	1.4	50	0.30	230	0.062
3.5	5.7	16	1.2	60	0.25	270	0.053
4	4.8	18	1.0	70	0.21	325	0.044
5	4.0	20	0.84	80	0.18		
6	3.4	25	0.71	100	0.15		
7	2.8	30	0.59	120	0.125		
8	2.4	35	0.50	140	0.105		
10	2.0	40	0.42	170	0.088		

Table VI B.S.S. Standard

Mesh	Opening mm.	Mesh	Opening mm.	Mesh	Opening mm.	Mesh	Opening mm.
5	3.4	14	1.2	36	0.42	100	0.15
6	2.8	16	1.0	44	0.35	120	0.12
7	2.4	18	0.85	52	0.30	150	0.10
8	2.1	22	0.70	60	0.25	170	0.089
10	1.7	25	0.60	72	0.21	200	0.076
12	1.4	30	0.50	85	0.18	240	0.060

pH Value (Columns 78 and 79)

The two columns cover the range pH0 to pH11.9 . This range is considered adequate for any foreseeable requirements. Decimal points are not coded (they are assumed to be between columns 78 and 79). A pH below 1 is shown as 02 etc., between 1 and 9.9 as 12 (1.2), 43 (4.3) etc. A pH of more than 9.9 is shown by punching + (plus) for 10 and - (minus) for 11. Thus 10.2 is coded -2 and 11.4 is coded +4. Double zero indicates no information.

CHEMISTRY DETAIL CARDS (Figures 27 to 30 and 32).

The cards fall into two groups according to the method of coding the analyses - those for silicate analysos, in which only percentages are coded, and those for other types of analysis, in which the quantities coded on the cards can range from parts per million to percentages.

Silicate Analysis (Fig.32)

Column		
1	Card code 2	
2	Sequence number 5	
3-11	Registered number, coded as for the General Master and Chemistry Group Master.	
12 - 15	SiO_2	Each field contains four digits giving the result as a percentage to two decimal places. The decimal point is omitted on the cards, but is assumed to be between the second and third columns of each field. In each case all four columns must be occupied. A 0(zero) can be used where necessary (e.g. 9.1% is coded 0910)
16 - 19	TiO_2	
20 - 23	Al_2O_3	
24 - 27	Fe_2O_3	
28 - 31	Fe O	
32 - 35	MnO	
36 - 39	MgO	
40 - 43	CaO	
44 - 47	Na_2O	
48 - 51	K_2O	
52 - 55	P_2O_5	
56 - 59	H_2O+	
60 - 63	H_2O-	
64 - 67	CO_2	
68 - 72	Total	Five digits, giving the total as a percentage to two decimal places; the decimal point is assumed to be between the third and fourth columns.
73 - 77		Rock or mineral name, coded by its first letter and next three consonants, as for other card groups. Use an oblique stroke for blanks.
78 - 79		Analyste's initials. Use two letters e.g. A.D. Haldane is coded A.H.

Contamination (column 80)

This records any features that are likely to result in the contamination of the sample at the sampling site.

Code	Information
1	Mine workings
2	Smelter fumes or waste.
3	Mining waste used for road works, rail ballast etc.
4	Industrial and town effluents, and drainage.
5	Agricultural and horticultural activity.
6	Prospecting activity.
0	No information.

Column

80 Analytical Method. This signifies the general method of obtaining a silicate analysis.

Code	Information
1	X-Ray
2	Chemical
3	Rapid colorimetric

Other Analyses (Figures 27 to 30)

The code for these cards is shown in the table below. On each card the analytical result for each element is coded into four column fields. The first three columns of each field contain the actual result of the analysis; the fourth column contains an exponential that indicates the position of the decimal point. Thus, if 426 is coded in the first three columns of a field, and a 0 (zero) in the fourth, this indicates that there is 42.6% of that particular element present. If, however, 2 is coded in the fourth column, the result is interpreted as being 0.426%, i.e., the decimal point is two places to the left of the second digit. Again, if 4 is coded in the fourth or expenential column, it means that 0.00426%, or 42.6 parts per million, are present.

The code for element position, etc., on the four punched cards is shown below.

	Metals -1	Metals -2	Metals - 3	Non-metals and Radicals
Column	Information	Information	Information	Information
1	Card Code 2	Card Code 2	Card Code 2	Card Code 2
2	Sequence No.1	Sequence No.2	Sequence No.3	Sequence No.4
3-11	Registered No.	Registered No.	Registered No.	Registered No.
12-15	Ag	Al	Au	B
16-19	As	Ba	Cs	Br
20-23	Be	Ca	Ge	C
24-27	Bi	Cr	Hf	Cl
28-31	Cd	Fe	In	CO_3
32-35	Co	Ga	La	F
36-39	Cu	Hg	Nb	I
40-43	Mo	K	Pd	NO_3
44-47	Ni	Li	Pt	P
48-51	Pb	Mn	Sc	S
52-55	Sb	Mg	Ta	SO_4
56-59	Se	Na	Tl	
60-63	Sn	Rb	U	Insoluble Residue
64-67	Te	Si	W	Loss on Ignition
68-71	V	Sr	Y	H_2O (+)
72-75	Zn	Ti	Zr	H_2O (-)
76-77	Analyst	Analyst	Analyst	Analyst

OCEANOGRAPHIC GROUP MASTER CARD (Fig.33)

The information in columns 1 to 55 is coded in the same way as on the General Master Card. The information contained in columns 56 onwards is coded as on the Chemistry Group Master Card.

MINERALOGY GROUP MASTER CARD (Fig. 24)

The information contained in columns 1 to 55 is coded in the same way as on the General Master Card. Sample type (column 56), surface to top of interval (columns 68 to 72), and Interval (columns 73 to 75) are coded as on the Chemistry Group Master Card. The code for columns 58 to 67, and 76 to 79, is given below. Column 57 is spare.

Mine or Prospect Name (Columns 58 to 62)

The name is coded by using the first letter and the next four consonants. If there are less than four consonants, oblique strokes / are to be placed progressively on the right hand side. Examples of coding are shown below:

Sweet William	SWTWL
Peko	Pk/ /
Mitchell Surprise	MTCHL
Collingwood	CLLNG

Azimuth (Columns 63 to 65)

The azimuth is given in degrees and refers to the direction of inclination of the bore hole. This is given as a full circle bearing from north - e.g., 243°. The azimuth 55° is coded as 055.

Inclination (Columns 66 and 67)

This refers to the angle from the perpendicular of the bore hole at the collar, and is given in degrees - e.g., 78°. An almost horizontal hole dipping at, say, 5°, is coded as 05.

Note: Both Azimuth and Inclinations refer only to the readings at the collar of the hole.

Reduced Level, Collar (Columns 76 to 79)

The figure coded here is the height above sea level, in feet, of the drill hole collar, e.g., 1362 feet. A height of 76 feet is coded as 0076.

MINERALOGY DETAIL CARD (Fig. 25)

The information coded in columns 1 to 11 is the same as on the other cards. The code for the remainder is given below.

Sample Information, Minerals, Mineral Deposits

Number of Minerals (Column 12)

The number of minerals observed in the sample is coded in this column. Thus, if the sample is monomineralic, 1 is coded; if the sample is bimineralic, 2 is coded, and so on.

Composition-Metallic (Columns 13 to 15)

Major Metallic Element present in specimen (Column 13)

Code	Element	Code	Element
A	Ag	M	Mn
B	Al	N	Mo
C	Au	O	Pb
D	As-Sb	P	Platinum group
E	Be	Q	Rare earths
F	Bi	R	Sn
G	Cr	S	Se-Te
H	Cu	T	Th
I	Co-Ni	U	Uranium
J	Fe	V	Vanadium
K	Hg	W	Zinc
L	Mg	Z	Others
		/	No information

Minor Metallic Element present in the specimen (Column 14). Code as for Major Metallic element.

Other Economically Significant element not coded in columns 13 and 14 (Column 15) code as for Major Metallic Element.

Composition - Non-metallic (Columns 16 to 18)

Major Non-Metallic substance (~~column 16~~)

Code	Information	Code	Information
A	Asbestos	M	Zirconium-Hafnium
B	Silica	N	Zeolites
C	Feldspar	ø	Nb-Ta
D	Borates	P	Halides
E	Potash	Q	Nitrates
F	Rare alkalis Li, Rb, Cs	R	Vanadate, arsenate, antimonate
G	Calcium	S	Barium minerals
H	Sulphur	T	Titanium minerals
I	Micas (muscovite, biotite, chlorite)	U	Strontium minerals
J	Clay (of hydrothermal, secondary alteration, or detrital origin)	V	Abrasive and refractories
		W	Industrial sand or clay
K	Talc or soapstone	X	Rock aggregate
L	Phosphate	Y	Calc-silicate
		Z	Others
		/	No information

Minor Non-Metallic Substance (Column 17)

Code as for Major Non-metallic Substance.

Any of the substances listed above which may be of economic significance but which are present in accessory quantities only are coded in Column 18, using the same code as listed above.

Mineral Name (Columns 19 to 23). To be used only in the case of a single mineral identification. The name is coded by using the first letter and next four consonants. Oblique strokes are to be inserted progressively from the right where there are insufficient letters to fill five columns.

Mineral Deposits (Column 24)

Mineralized	Gangue	Wall Rock	Others	
+	-	0(zero)	/	No information
B	K	S	2	Carbonate
C	L	T	3	Native element
D	M	U	4	Sulphide or sulphosalt
E	N	V	5	Oxide, Hydroxide
F	ø	W	6	Sulphate
G	P	X	7	Uranium compound
H	Q	Y	8	Silicate
I	R	Z	9	Others

Genetic Classification (Column 25)

Code	Information	Code	Information
+	Hypogene (greater proportion of minerals hypogene)	6	Detrital or detrital concentrates.
1	Supergene (greater proportion of minerals supergene)	7	Evaporite
2	Metamorphic (regional, contact, pyrometasomatic)	8	Soil
3	Magmatic segregation	9	Extra-terrestrial
4	Syngenetic (Includes bedded deposits	-	Others
5	Oxidized ore (includes gossans)	0	No information

Form of Deposit (Column 26)

Code	Information
+	Tabular - lenticular discordant.
1	Tabular - lenticular concordant (including bedded and alluvial deposits).
2	Massive
3	Irregular
4	Local segregation (ore segregated into isolated veins, pods, pockets).
5	Stockwork (complex of veins, and ore filling complex of fissures or shears).
6	Blanket (relatively large areal extent - e.g., laterite, evaporite). Include dune deposits.
7	Banded (sedimentary or metamorphic banding).
8	Disseminated.
9	Other.
0	No information.

Textures and Structures (Columns 27 to 31)

Primary Structures (Columns 27 and 28)

Crystal or mineral habit (Column 27)

Code	Information
+	Inclusions.
3	Allotriomorphic
4	Idiomorphic
8	Exsolution intergrowths
0	No information

Combinations of this coding are: -

+ and 3 : C
+ and 4 : D
+ and 8 : H
3 and 8 : =
4 and 8 : @
+ and 3 and 8 : .
+ and 4 and 8 :)

Note that 3 (allotriomorphic) and 4 (Idiomorphic) are mutually exclusive.

Zoning or banding (Column 28)

Code	Information	Code	Information
1	Colloform	5	Sedimentary
2	Oolitic	6	Metamorphic
3	Replacement	7	Other
4	Compositional	0	No information

Note: These features are meant to be mutually exclusive, i.e. only the most important feature is to be coded.

Secondary Structures (Columns 29 to 31)

Supergene Alteration (Column 29)		Tectonic Deformation (Column 30)		Replacement Structures (Column 31)	
Code	Information	Code	Information	Code	Information
+	Leached	+	Recrystallization	+	Primary origin
3	Gossanous	3	Brecciated	3	Secondary origin
4	Supergene	4	Flow structure folding or twinning	4	Open space filling
8	Other	8	Other	8	Others
0	No information	0	No information	0	No information

Note: Combinations of 0, 3, and 8, and 0, 4, and 8 are shown above in Primary structures (a), column 27.

Paragenetic Sequence of minerals evident. If so, code 1 in column 32.

Other Work Areas (Column 33)

The information punched here shows whether or not the sample has been investigated in other work areas.

Code	Information
+	X-ray diffraction
3	Chemical analysis (Assay, optical and X-ray spectrograph trace element determination).
8	Petrology
0	No information

The coding here is of the three-hole special character type, enabling all three headings to be coded on the same card, if necessary.

Soils

Soil Type-Undifferentiated (Column 34)

Code	Information
1	Alluvial soils
2	Skeletal soils
3	Calcareous coastal sands
4	Wind-blown dust and sand
0	No information

Soil Type - Pedalfers (Column 35)

Code	Information
1	Soil dominated by acid peat or peaty alluvial horizon, e.g., moor peats, alpine humus soils, moor podsol peats, and acid swamp soils.
2	Soil acid with organic, sesquioxide, and sometimes clay illuvial horizons, e.g., podsols and ground water podsol.
3	Soil acid and with clay and sesquioxide horizons, e.g., laterites, greybrown, brown, red, yellow, and non-calcic podsols.
4	Soil acid to neutral and lacking pronounced eluviation of clay e.g., yellow earths, Krasnozem, lateritic Krasnozem, lateritic red earths, terra rossa, and prairie soils.
0	No information.

Soil Type - Pedocals (Column 36).

Code	Information
1	Soil dark coloured and slightly acid to neutral in eluvial horizons, calcareous illuvial horizons, e.g., black earths, wiesenboden, brown forest soils, redzinas, ground water, and fen soils.
2	Soil saline or showing post-saline structure in the illuvial horizon, e.g., solonchaks, solonetz, solodised solonetz, soloths, and solonized brown soils.

Code	Information
3	Soil with slightly acid to neutral eluvial horizons and calcareous illuvial horizons, e.g., red brown earths, brown earths, brown soils of light texture, arid red earths, and grey calcareous soils.
4	Soil with neutral to alkaline, weakly developed eluvial horizons and calcareous and/or gypseous illuvial horizons, e.g., grey to brown soils of heavy texture.
5	Soil with deflated, slightly acid to alkaline eluvial horizons and calcareous and/or gypseous illuvial horizons, e.g., desert loams, grey-brown and red calcareous desert soils, red and brown hard pan soils, desert plain soils, calcareous laterite soils, and desert tableland soils.
0 (zero)	No information.

Parent-Igneous Rocks (Column 37).

Intrusive	Extrusive (flow)	Pyroclastic	Mode of Emplacement Not known	
+	-	0 (zero)	/	No information
B	K	S	2	Granitic, rhyolitic
C	L	T	3	Granodioritic, dacitic.
D	M	U	4	Syenitic, trachytic
E	N	V	5	Dioritic, andesitic
F	ø	W	6	Gabbroic, basaltic
G	P	X	7	Undersaturated rocks
H	Q	Y	8	Ultramafic
I	R	Z	9	Pegmatite, Aplitic.

Parent-Metamorphic Rock (Column 38).

Regional	Contact	Dynamic	Not Known	
+	-	0 (zero)	/	Not known
B	K	S	2	Pelitic
C	L	T	3	Psammitic
D	M	U	4	Calc-silicate
E	N	V	5	Marble
F	ø	W	6	Orthogneiss
G	P	X	7	Paragneiss
H	Q	Y	8	Aluminous metamorphic
I	R	Z	9	Ferruginous metamorphic

Parent-Sedimentary Rocks (Column 39)

Code	Information
A	Conglomerate
B	Breccia
C	Sandstone
D	Greywacke
E	Siltstone
F	Mudstone
G	Shale
H	Limestone
I	Dolomite
J	Peat
K	Coal
L	Bitumen
M	Evaporite
N	Bedded iron ore
ø	Chert
P	Flint
Q	Other siliceous
R	Phosphorite
/	No information

Soil Horizon (Column 40)

Code	Information
1	A_{00} horizon
2	A_0 horizon
3	A_1 horizon
4	A_2 horizon
5	B_1 horizon
6	B_2 horizon
7	C horizon
0 (zero)	No information

Topography (Column 41)

Code	Information
1	Flat
2	Rolling
3	Steep
4	Very steep
5	Broken and irregular
0 (zero)	No information

Rainfall (Column 42)

Code	Information
1	0 - 5 inches per year
2	5-10 inches per year
3	10-20 inches per year
4	20-30 inches per year
5	30-40 inches per year
6	40-50 inches per year
7	50-60 inches per year
8	60-80 inches per year
9	80-100 inches per year
+	Over 100 inches per year
0 (zero)	No information

Soil Components (Column 43)

Code	Information	Code	Information
A	Quartz	K	Muscovite
B	Orthoclase	L	Biotite
C	Albite	M	Chlorite
D	Oligoclase	N	Hematite
E	Labradorite	ø	Limonite
F	Anorthite	P	Clay
G	Apatite	Q	Ferruginous gravel
H	Magnetite	R	Aluminous gravel
I	Amphiboles and pyroxenes	S	Siliceous gravel
J	Olivine	T	Organic matter
		/	No information

Note: Code only the dominant component.

Figure 44: The 870 Document -Writing System on the left of the photograph; the D82 sorter - selector in the background.

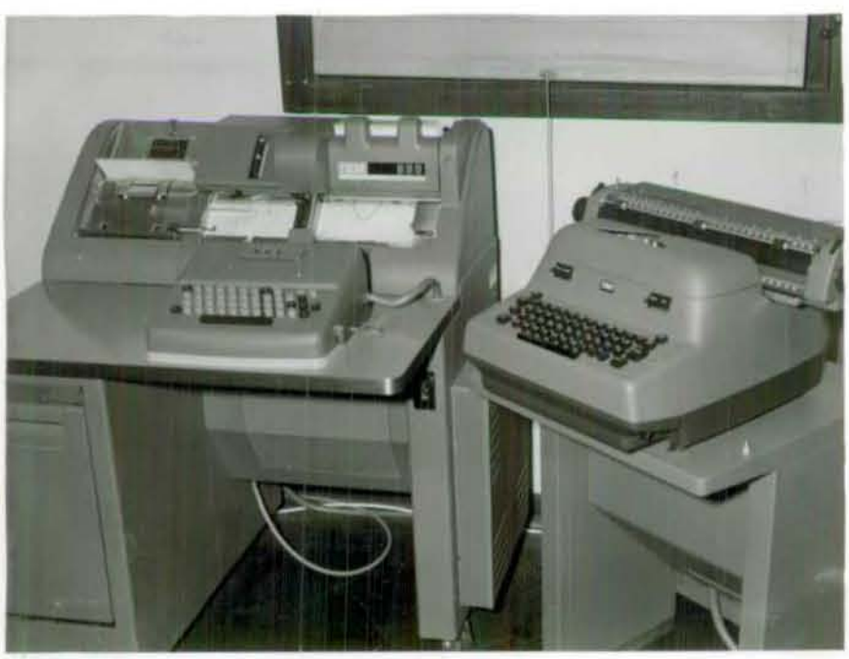


Figure 45: The 870 Document-Writing System. The instrument on the left is the 836 card-punch, card-read machine; that on the right is the 866 automatic type-writer.

DATA PROCESSING EQUIPMENT

The IBM equipment at present used by the Bureau consists of an 870 Document-Writing System, and an 082 Sorter-Selector. The instruments are illustrated in figures 44 and 45.

The 870 Document Writer consists of the 836 card-punch, card-read instrument, and an 866 automatic typewriter. The general principle of the system is to punch information on the cards with the 836 machine. Information punched into cards is also read out with the 836 machine this information being electrically transmitted to, and typed out with, the 866 typewriter, The 870 system for card punching and card reading is programmed to do its work by means of wiring a programme panel, in conjunction with instructions punched onto a card wrapped around a programme drum. Because of this many card punching and card-reading operations such as duplicating, space skipping, card feeding, typewriter carriage returns, etc., can be made automatic.

The 082 sorter used by the Bureau is a special type fitted with a ten-column selection scanner. Used simply as a sorter, without the scanning device, it can sort cards, one column at a time, into categories, numerical order, etc. With the ten-column scanner in operation it can select cards that have a particular arrangement of symbols in any number of up to ten adjacent columns. For example, in a field where 1:250,000 sheet numbers are punched, using five adjacent columns, a particular sheet number that is nominated can be selected in one movement; this particular operation could be done without the scanner, of course, one column at a time, but it would require five separate card sorts on the machine. The layout of the information on the punched cards takes this factor into account.

It should be noted that the 866 typewriter will exactly reproduce the information coded on cards; i.e. in code. The Document Writer cannot decode information. At a later stage, when sufficient information has accumulated on the punched cards it will be transferred to, and stored on, magnetic tape. Sorting and copying of the information will then be done by a computor - which can be programmed to decode the information. The computer used will most probably be the C.S.I.R.O. CDC 3200 installation.

AUTOMATIC PLOTTING

In the interpretation of large quantities of geochemical, petrological and other data, a 12 inch or 30 inch Calcomp automatic plotter linked to the CDC computer will be used for plotting and contouring. Military or metric grid coordinates for all sample points provide rectilinear ordinates for plotting. Punch cards containing these data are fed into the computer together with programmes for gridding, contouring and computation of intermediate data. In this way the time consuming problem of plotting and contouring the large volume of information accumulated (particularly in multi element geochemical surveys) will be overcome.

OPTICAL MARK PAGE READER

A further possible step in the future, is the use of an I.B.M. Optical Mark Page Reader. This device provides an improved method by which data are recorded at their source in a form that can be converted directly into data processing language.

The Optical Mark Page Reader reads positional marks made by an ordinaty lead pencil on 8½" x 11" data sheets. The positional marks are converted into a form usable for direct input into either a data processing system or into punch cards.

This instrument could be extremely useful in that it is able to convert information on geologists' field data sheets directly onto punch cards. Similarly, laboratory data can be simultaneously recorded on punch cards and presented on paper or stencil in decoded and report form layout. This of course would save a great deal of labour and also eliminate copying errors.

APPENDIX I

INDEX TO THE PUNCHED CARD CODE

The table shown below is a detailed index, or list of contents, of the punched card code. The subjects are arranged according to the order of occurrence on each of the punched card designs. Their positions on the cards are indicated by their column numbers; a page reference for each subject is given.

Subject	Column No.	Page
CODING METHODS	-	16
Numerical Coding	-	16
Alphabetical Coding	-	16
Zone-Digit Binary Coding	-	16
Special Character Codes	-	16
PUNCHED CARD LAY-OUTS	-	17
COMMON INFORMATION	1 - 11	17
Card Code	1	17
Sequence Number	2	17
Registered Number	3 - 11	3,19
GENERAL MASTER CARD	-	19
Common Information, see above	1 - 11	17
Grid Reference	12 - 26	4,17
Foreign Collection	27 - 28	20
State	29	5,20
1:250,000 Sheet Number	30 - 34	5,20
1:50,000 Sheet Number Code	35	5,20
Stratigraphy	36 - 46	21
Rock Unit and Rank	36 - 40	21
Age (Era, Period, Million year range, Epoch, and Stage)	41 - 46	22
Sample Significance	47	8,24
Source and A.V.M.	48 - 49	8,24
Report Reference	50 - 55	25
Sample Disposal	56	26
Work Area	57 - 63	26
PETROLOGY GROUP MASTER CARD	-	27
Common Information, see above	1 - 11	17
Code as for General Master Card	12 - 55	17
Sample Type	56	27
Igneous Rocks	57 - 66	27
General Description	57	27
Rock Name	58 - 60	28,30
Mineralogical Qualifier	61 - 63	28
Texture	64	31
Alteration	65	31
Mode of Occurrence	66	31
Metamorphic Rocks	57 - 69	32
General Description	57	32
Rock Name	58 - 60	32
Mineralogical Qualifier	61 - 63	33
Texture	64	34
Alteration	65	34
Metamorphic Facies	66	34
Type of Metamorphism	67	35
Original Material	68	35
Type of Metasomatism	69	35

Subject	Column No.	Page
Sedimentary Rocks	57 - 68	35
General Description	57	35
Rock Name	58 - 60	36, 37
Mineralogical Qualifier	61 - 63	36
Texture	64	36
Alteration	65	38
Porosity, Grains to Matrix Ratio	66	38
Permeability, Grain Angularity	67	38
Cement or Matrix	68	39
PETROLOGY REFERENCE CARD	-	39
AGE-DETERMINATION GROUP MASTER CARD	-	39
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