COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF SUPPLY AND SHIPPING.

MINERAL RESOURCES SURVEY.

REPORT No. 1945/30 .

Plans Nos. 1220-1222, 1232, 1237.

PRELIMINARY REPORT OF GEOPHYSICAL WORK AT MOUNT PAINTER USING GEIGER-MULLER EQUIPMENT.

By

J.C. Dooley,
Geophysicist.

CANBERRA. 2nd July, 1945.

1220. By Authority: L. F. JOHNSTON, Commonwealth Government Printer, Canberra.

DEPARTMENT OF SUPPLY & SHIPPING.

Mineral Resources Survey Branch.

PRELIMINARY REPORT ON GEOPHYSICAL WORK AT MT. PAINTER USING GEIGER-MULLER EQUIPMENT.

Report No. 1945/30.
Plans Nos. 1220-1222, 1232, 1237.

INTRODUCTION.

The work described in this report forms part of the uranium investigation being conducted by the Commonwealth Government for the British Government. It was carried out at the request of Mr. S.B. Dickinson, Director of Mines of South Australia, who is the delegate of the Controller of Minerals Production and in charge of the investigation. The work was carried out at Mt. Painter from 7th February to 26th March, 1945, but, prior to this, geophysical work had been carried out at Mount Painter on two separate visits to the area. The first visit was made by R.F. Thyer (1944) in August/September, 1944, and the work consisted of radioactivity surveys using Geiger-Muller equipment in the vicinity of the No.6 workings, and also of the "Smiler" and "Bentley" deposits. The second visit (November/December, 1944) was made by R.F. Thyer (1945) and the writer, and a radioactivity survey was carried out in Greenwood's Camp Area, East Painter. The equipment used on the latter survey was an improvement of the earlier model, being designed especially for convenience and portability in field work.

The possibility of using Geiger-Muller equipment for estimation of uranium content of samples had been considered, and a set of equipment was made up for this purpose and taken to Mount Painter on the second visit. However, as no samples were ready for testing at the time, this equipment was not used except for testing some hand specimens for radioactivity. The Director of Mines, South Australia, on 4th January, 1945, wrote to the Director, Mineral Resources Survey, asking that Geiger-Muller equipment be made available for preliminary assay work, since a large proportion of the Mount Painter samples were found by chemical assay to contain little or no uranium. As there are limitations to the accuracy of the Geiger-Muller method as discussed below, it was proposed to make only approximate estimates with a view to eliminating detailed assay work on very low-grade samples.

Some preliminary work was carried out in Canberra by J.M. Rayner, Chief Geophysicist, Mineral Resources Survey. He made radioactivity tests on samples of Mount Painter ore which had been assayed chemically, and established that there was an approximately linear relation between count-rate and uranium content.

This report covers work including setting up and calibrating the assay equipment, and testing 100 samples from the Mount Painter No.6 workings and 12 samples from East Painter No.1 adit. In addition, some field work was carried out on Radium Ridge using a new type of portable equipment. The report is divided into two parts, the first dealing with the assay work and the second with the field work.

PART 1 - ASSAY WORK.

THEORETICAL CONSIDERATIONS.

Several difficulties are encountered in making estimates of uranium content on the basis of radioactivity measurements. These prevent the method from being used for accurate assay work, but provided due precautions are taken, approximate estimates can be made.

Uranium as found in natural deposits is accompanied by a series of radioactive disintegration products, and radioactivity measurements as made in the present work represent the total activity from all these products. If the uranium has been in situ and no member of the series has been removed by weathering or other causes for a period exceeding about a million years, the series will have reached radioactive equilibrium, and each element will be present in a constant proportion. In these circumstances the total radioactivity will be proportional to the uranium content. According to R. Grenfell Thomas's (1942) measurements the Mount Painter secondary ores are not in equilibrium, the ratio of radium/uranium being about 2.7×10^{-7} : 1 instead of 3.4×10^{-7} : 1, the latter being the ratio which would be attained at radioactive equilibrium. In considering deposits in a given locality, if it can be taken that the deposits are of about the same age and have been subject to similar conditions of weathering, etc., the relative composition of the radioactive series as found in such deposits would not vary greatly. Hence there would exist an approximately linear relation between the total radioactivity and the uranium content of samples from a given area such as Mount Painter. It should be noted, however, that Dr. Stillwell (1944) states that the uranium/lead ratio of Mount Painter ores varies between wide limits, which may indicate that the ores are not all of the one age.

The equilibrium of the radioactive series may be upset by the escape of the gas radon. This gas is present only in extremely small amounts and is normally occluded in the solids. However, Beers and Goodman (1944) claim that radon is driven off when the sample is pulverized prior to testing, and that samples should be kept sealed for 30 days before testing. The activity of one Mount Painter sample was measured 7 hours after pulverizing, and again 7 days after pulverizing. As the half-value period of radon is 3.86 days, this should have allowed ample time for an indication of any change, however no increase in activity was shown. Later, the activity of another Mount Painter sample, which had been kept sealed in a bottle for 5 months, was tested in the bottle. The sample was then removed from the bottle, thoroughly stirred and shaken, and after two hours was replaced in the bottle and tested again. If any radon had escaped while the sample was exposed to the air, a decrease of activity should have been shown, as the two hours was sufficient to allow for the decay of the short-life products radium A, B, C, C' and C". However no decrease in activity was found. From these tests it was concluded that no radon was lost from the samples tested.

The total radiation emitted by the sample in the appropriate direction does not all reach the Geiger-Muller tube owing to absorption of the rays by the sample itself. Thus samples with different coefficients of absorption give different activity measurements for the same uranium content. This effect is more marked with the alpha and beta rays, which are far more highly absorbed than the gamma rays. As each sample to be tested was placed in iron tubes of wall thickness about 2 mm., all the alpha rays and beta rays were absorbed, together with the weaker gamma rays. Thus the measurements depended on the more penetrating gamma radiation, and discrepancies due to absorptive effects were reduced. These discrepancies could be further lessened by ensuring that no great thickness of sample was traversed by the rays. The maximum thickness in the tests described in this report was equal to the internal tube diameter, i.e. about half an inch.

Moreover, according to Hevesy and Paneth (1938), the gamma ray absorption coefficients for any substance are very nearly proportional to the density of the substance. In the tests described below, a given weight of material was always packed into the same space; thus the effective density of samples under test was constant, and the absorption effects should be the same for all samples.

It should be noted that uranium itself emits practically no gamma-rays; these all come from disintegration products. Hence the necessity for a constant ratio of the amounts of these products to the amount of uranium present is emphasized.

With thorium minerals present in a sample the activity reading would be high in relation to uranium content. Monazite, which contains some thorium, is reported by Dr. F.L. Stillwell (1944) as being "scattered sparsely through all the prospects". However the thorium content of the Mount Painter monazite is low as is shown by the results of assays on these specimens quoted by Sir D. Mawson (1944) as 0.3, 0.2 and 0.15% ThO_2. Moreover R.G. Thomas (1942) reported that ore from the No.6 deposit treated for radium contained only traces of thorium. It may be assumed therefore that the thorium content of the samples tested was very low.

Thus it will be seen that accurate determinations of uranium with a Geiger-Muller counter are not possible. However, if measurements are based on comparisons with samples from the same area which have been chemically assayed, and if gamma rays are used, very approximate estimates of uranium content can be made, though checks should be made by chemical assay on any results considered important.

DESCRIPTION OF EQUIPMENT.

The equipment used for assay work is fundamentally the same as that used for field work at East Painter and described by R.F. Thyer (1945), but has been designed essentially for bench tests rather than as a portable set for field work. It was made up in the workshop of the Mineral Resources Survey, Canberra, and it comprises three chief items - The Geiger-Muller tube with supporting cradle, the amplifier chassis, and the meter panel. Voltages are obtained from batteries, the high voltage required for the Geiger-Muller tube being obtained from 10 extra light duty 135½v. batteries in series with 4 light duty 45 v. batteries, a total of 1215v. A circuit diagram of the equipment is attached (fig. 5).

Pulses from the Geiger-Muller tube pass through two stages of amplification. They are then rectified, and develop a voltage across a 12MF condenser with a 2 meg. bleed resistor. As the voltage across the condenser increases, its rate of discharge through the resistor increases, and eventually a state of equilibrium is reached when the rate of discharge of the condenser is equal to its rate of charging. Its voltage then remains steady, and is measured by a vacuum-tube voltmeter arrangement, the meter being kept on zero reading by a compensating voltage controlled by a potentiometer with a calibrated scale. The reading of this scale is taken as a measure of the activity, and experiment has shown that it is proportional to the count-rate.

The support for the Geiger-Muller tube is such that five iron tubes, each about one foot in length and ¾-inch diameter, can be arranged around the Geiger-Muller tube parallel to its main axis. These tubes are filled with the samples to be tested.

PROCEDURE.

Each sample to be tested was crushed, pulverized and thoroughly mixed, and each of the iron tubes was filled with 72.5 gm. of the pulverized sample, making a total of 362.5gm. or about 0.8 lb. The material in each tube was packed down just sufficiently to allow insertion of the stopper. While measuring the activity of the sample, the five tubes were placed in position in the support as described above. It was found that the normal reading of the instrument with the five empty tubes in position was about 13 per cent. lower than when the tubes were removed. Hence all readings were taken with five tubes in position, empty ones being replaced with full ones as required.

The activity of any sample was measured by taking a series of readings with and without the sample in position. The reading for the sample was then taken as the difference between the mean of the normal readings and the mean of the readings with the sample in position.

In actual practice the meter reading did not remain steadily at zero having once been set there, but fluctuated continuously owing to random variations in the count-rate. Hence it was found necessary in taking a reading to set the meter as near to zero as possible, then to find the mean of the meter fluctuations over a period and apply a corresponding correction to the scale-reading. This random variation of the reading determined the smallest quantities of uranium which could be detected, as samples whose activity was less than the mean variation in the normal reading gave no effect which could be measured reliably.

The sensitivity of the instrument varied considerably, probably due chiefly to variations in voltage caused by ageing of batteries and by temperature changed. One iron tube was filled with 72.5 gm. of the standard sample containing 2.0% UO_3, and this was used as a check on the sensitivity of the instrument. The standard reading for this sample was taken as 2.5 scale divisions, other readings being reduced in proportion to its actual reading. This standard sample was used in preference to the normal reading to determine the sensitivity, as it gave a reading over that portion of the scale which is used for measurements on samples, and it would be available if the equipment should have to be moved to another site where the normal reading might not be the same. It was found, however, that the ratio of standard sample reading to normal reading was reasonably constant, and measurements of the standard were made only occasionally.

There was a noticeable decrease in sensitivity during any set of readings. Hence measurements of the sample and normal readings were alternated in a symmetrical arrangement, so that when averages of the readings were taken, errors due to a steady decrease of sensitivity were eliminated. The procedure finally adopted was as follows: normal, sample, sample, normal; then repeat. It was found necessary to wait about two minutes between readings when there was any change of reading, to ensure that the condenser had charged or discharged to its new equilibrium voltage.

CALIBRATION.

Two sets of standard samples were used in calibrating the instrument. The first set was prepared by Mr. Dalwood, South

Australian School of Mines Assayer, from clean torbernite, presumably free from thorium, diluted with crushed quartzite, there being about 1-lb. of each sample. Samples were supplied in intervals of 0.1% from nil to 1%, and also 1.5% and 2.0% UO_3. The second set consisted of seven samples from the Mount Painter mines which had been assayed. There was 100 gm. of each sample, values being .05, .10, .17, .25, .36, .40 and 1.44% U_3O_8.

With the first set of samples, readings were taken from 0 to 0.4% with all five tubes filled with the sample; from 0.1% to 1.0% with only three of the five tubes filled and from 0.1% to 2.0% with only one of the five tubes filled. Each set of readings gave a linear relation between scale reading and percentage, as shown in the graphs fig. 1, the ratio of the slopes of the graphs being 4.7; 3.1 : 1.0.

Owing to smaller quantities of the second set of samples being available, measurements were made with the sample in only one of the five tubes. The readings gave an approximately linear graph (it should be remembered that when using one tube with small percentages, the experimental error is relatively great). However, the mean ratio of reading to percentage was about 1.5 times greater than with the first set of samples (see graphs fig.2). The difference due to expressing percentages in terms of UO_3 or U_3O_8 is only 2%. As most of the gamma radiation measured came from the transformation of Ra C to Ra C' it is evident that the Ra/U ratio of Set No.2 exceeds that of set No.1. If the ages of the secondary uranium minerals in the mine samples (Set No.2) is the same as that of the torbernite used by Mr. Dalwood in Set No.1, then it may be assumed that the mine samples contain radium in excess of that produced from the uranium they now contain. The high Ra/U ratio of the No.2 Set relative to the No.1 Set of samples is supported by the results of an absorption test in which, after suitably screening to absorb all the softer rays, the absorption curves of a typical sample of each of Sets No.1 and No.2 were compared with the theoretical curves of the two hardest gamma rays from the uranium series, namely from the transformations of UX_2 and Ra C with absorption coefficients of 0.72 cm. and 0.50 cm. Pb, respectively. The sample from Set No.1 gave hard gamma radiation of which 62 percent was from Ra C and 38 per cent from UX_2 while the corresponding figures for the No.2 sample were 71 and 29 per cent respectively, thus demonstrating the greater proportion of radium in Set No.1. As radium salts are very insoluble it is concluded that the excess of radium in the mine samples (Set No.2) has been produced from uranium that was previously in the samples and has been removed in solution. This would explain why two mine samples tested by Mr. Rayner assayed nil for uranium and yet showed appreciable activity and why many of the hematite outcrops in the Mount Painter area are relatively strongly radioactive and yet contain no visible uranium minerals.

As it was anticipated that most of the mine samples to be tested would be of low grade, five tubes were filled with each sample in order to obtain readings as high as possible. These readings were compared with the 5-tube graph of the first set of standard samples, but estimates of percentage were based on the results from the second set of standard samples, a correction factor being applied in accordande with the graphs of fig. 2. This gives a ratio of reduced reading to percentage of 9.0 : 1.

TESTS ON MINE SAMPLES.

The activity measurements had a mean uncertainty corresponding to about 0.01% U_3O_8. Hence this was the lowest quantity that could be detected, though not always reliably. Samples tested

were classified as follows -

U_3O_8 Content deduced from the activity readings.	Class.
0 (No measurable activity)	N - Nil. No measurable activity; very probably less than 0.01%. U_3O_8 if any.
0.01%	T - Trace, of the order of 0.01%
0.02 to 0.07%	L - Less than 0.1%
0.08 to 0.12%	C - About 0.1%
0.13% and higher	M - More than 0.1%

Samples in the last two classifications were recommended for assay. A summary of the results is given below.

Class.	Mount Painter No.6	East Painter No.1 Adit.
N	44	-
T	14	-
L	32	4
C	9	5
M	1	3
Total :	100	12

All samples from the No.6 workings were channel ones, while those from East Painter were bulk samples. Samples submitted for test were as follows -

Mount Painter No.6 Workings -

50 ft. Cross cut : 16 samples taken along the wall over 3 ft. sections. Traces found in nearly all samples.

80 ft. Sub-level : 18 samples at 3 ft. intervals, 8 ft. to 59 ft. Definite radioactivity all along, rising towards the end with a maximum at No.16, at 53 ft.

100 ft. Drive : 25 samples at 3 ft. intervals. Very few indications of activity for the most part. Definite but small activity from No.19 onwards.

100 ft. Cross-cut : 10 samples taken along the wall over 3 ft. sections. Traces in some.

Winze from 100 ft. level : 12 samples at 3 ft. intervals, depth of 18 ft. to 51 ft. Only one sample showed a trace of activity.

150 ft. Sub-level : 2 samples only, no indications of activity.

South Portal Drive : 17 samples at 3-ft. intervals. Definite indications of activity from samples Nos. 1-10, after which the drive is reported to cross a shear, and no further trace is found. Best samples are near the beginning of the series.

East Painter No.1 Adit:

12 bulk samples, from 12 ft. to 50 ft. Definite indications of radioactivity in every sample, highest reading from sample No.8 (32 ft. 9 in. to 36 ft.)

Details of the measurements are appended, together with the assay results of those samples which were recommended for assay.

It will be noticed that the samples from East Painter No.1 adit give good agreement between estimates from activity measurements and uranium content, determined by assay, whereas the assay results for samples from the No.6 workings were all considerably lower than the estimates. The activity measurements for the latter samples have been repeated and confirmed. Possible explanations for the high activity of these samples must be of the same nature as those discussed under "Calibration".

PART II - FIELD WORK.

DESCRIPTION OF EQUIPMENT.

In previous field work at Mount Painter the equipment used required at least three men to operate it satisfactorily, and some time was involved in taking measurements owing to the slow charging of the condenser. A large proportion of the areas covered gave low readings which were of no special interest. It was suggested by R.F. Thyer (1945) that for preliminary field work an extra light Geiger-Muller equipment could be used, with headphones as the detector. The chief purpose of this would be to eliminate detailed surveys of areas of low activity, and to locate areas of high activity which would warrant further investigation with the other equipment.

Such an equipment was made in the Mineral Resources Survey workshop, being a modification of a model described by R.B. Taft (1940). The high voltage (1280 v.) is obtained from a Ford coil driven by two 1½v. torch cells in series, and feeding a rectifier circuit. Only one stage of amplification is necessary to render the pulses audible on the phones. The amplifier valve is maintained beyond cut-off to eliminate variations in the voltage supply due to insufficient filtering; the pulses from the Geiger-Muller tube are large enough to be amplified when the interference is cut out. A circuit diagram of the equipment is shown in Fig.4.

The whole equipment is built in a box about 15" x 9" x 8" and can be operated by one man. Harness is provided for carrying the equipment on the chest of the operator.

FIELD WORK.

Some traverses were quickly made in company with R. Sprigg, geologist, over several ironstone outcrops on and near Radium Ridge as shown on the attached plan. High activity was detected over the shaded areas, more particularly where the ironstone was manganiferous. Traverses over some non-ironstone outcrops showed no detectable change in activity from surrounding areas. Mr. Sprigg knapped over the ironstone but could find no torbernite, and took a sample of the manganiferous ironstone for analysis.

The results of the assay are not known.

A more detailed survey was not carried out because suitable equipment was not available on the field.

PERFORMANCE OF INSTRUMENT.

The normal count-rate of the Geiger-Muller tube used was about 240 pulses per minute. When the count-rate rose to about three times this value, it was practically impossible to distinguish any

further increase in the count-rate, as an almost continuous series of clicks could be heard in the headphones. Thus while a general area of high activity could be located, it was impossible to locate a maximum within the area, or to compare activities of different "high" areas. If a Geiger-Muller tube with a normal count-rate of say 15-20 pulses per minute were available, the instrument would be of more general use, and might eliminate the need for a survey by the more detailed method, as in many cases detailed contour lines of activity have little meaning.

J.C. Dooley

(J.C. Dooley)
Geophysicist.

CANBERRA.
2nd July, 1945.

REFERENCES.

Beers, R.F. and Goodman, C (1944). Distribution of Radioactivity in Ancient Sediments. Bull. Geol. Soc. Amer., Vol.55, No.10.

Dooley, J.C. (1945). Preliminary Report On Radioactivity Tests on Radium Hill Samples. Comm. Min. Res.Surv. Report No.1945/51.

Hevesy, G. and Paneth, F.A. (1938). A Manual of Radioactivity, 2nd Edition P.51, Oxford Uni. Press.

Mawson, Sir D. (1944). The Nature and Occurrence of Uraniferous Mineral Deposits in South Australia. Trans. Roy.Soc.S.A. Vol.68 (2).

Stillwell, Dr. F.L. (1944). Uranium minerals from Mount Painter. Mineragraphic Investigations of C.S.I.R. Report No.515.

Taft, R.B. (1940). Two Small Portable Geiger-Muller Counters. Rev. Sci. Inst. Vol.11, No.8.

Thomas, R.G. (1942). Processing of Radium in South Australia. Aust. Chem.Inst. J. & Proc., Vol.9, No.6.

Thyer, R.F. (1944). The Mount Painter Field (Geophysical) Comm. Min. Res. Surv. Report, Sept.1944.

Thyer, R.F. (1945). Report on Geiger-Muller Survey, Greenwood's Camp Area, Mount Painter East, Comm. Min Res. Surv. Report No. 1945/9.

RESULTS OF ACTIVITY TESTS ON MINE SAMPLES.

The numbers and positions of the samples are those supplied by the Mine Manager.

N - Nil, T - Trace, L - Less than 0.1%, C - about 0.1%, M - More than 0.1%.

Sample No.	From.	Reduced Reading.	Estimated % U_3O_8	Class.	Recommended for assay.	Assay result
MOUNT PAINTER NO.6 WORKINGS.						
100 ft. Drive.						
1		.01	0	N	No	
2		-.02	0	N	"	
3		-.03	0	N	"	
4		0	0	N	"	
5		-.04	0	N	"	
6		+.02	0	N	"	
7		-.02	0	N	"	
8		+.02	0	N	"	
9		-.04	0	N	"	
10		+.05	0	N	"	
11		.15	.02	L	"	
12		.02	0	N	"	
13		-.01	0	N	"	
14		.01	0	N	"	
15		.05	.01	T	"	
16		-.04	0	N	"	
17		0	0	N	"	
18		.10	.01	T	"	
19		.19	.02	L	"	
20		.37	.04	L	"	
21		.28	.05	L	"	
22		.24	.05	L	"	
1A		.29	.05	L	No	
2A		.30	.05	L	"	
3A		.28	.05	L	"	
100 ft. Cross-Cut.						
1 x	0 to 3 ft.	.12	.01	T	No	
2 x	3 to 6 ft.	.30	.03	L	"	
3 x	6 to 9 ft.	.16	.02	L	"	
4 x	9 to 12 ft.	.06	.01	T	"	
5 x	12 to 15 ft.	.03	.0	N	"	
6 x	15 to 18 ft.	.06	.01	T	"	
7 x	18 to 21 ft.	-.03	0	N	"	
1A	22½ to 25 ft.	.05	0	N	"	
2A	25 to 28 ft.	.04	0	N	"	
3A	28 to 31 ft.	-.03	0	N	"	

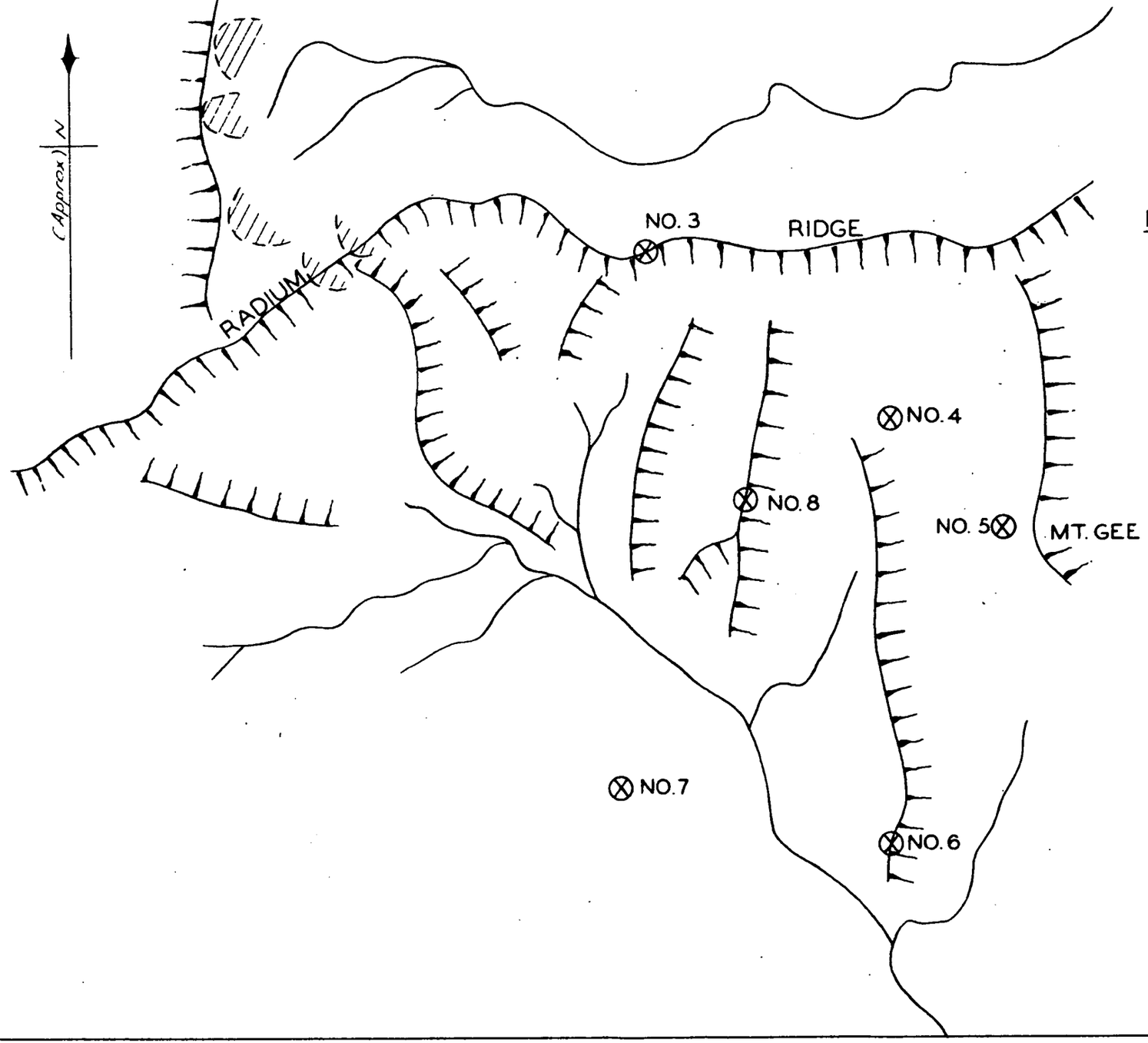
Sample No.	From.	Reduced Reading.	Estimated % U_3O_8	Class.	Recommended for assay.	Assay result
50 ft. Cross-Cut.						
1	0 to 3 ft.	.08	.01	T	No	
2	3 to 6 ft.	.08	.01	T	"	
3	6 to 9 ft.	.09	.01	T	"	
4	9 to 12 ft.	.18	.02	L	"	
5	12 to 15 ft.	.01	0	N	"	
6	15 to 18 ft.	.06	.01	T	"	
7	18 to 21 ft.	.18	.02	L	"	
8	21 to 24 ft.	.07	.01	T	"	
9	24 to 27 ft.	.05	0	N	"	
10	27 to 30 ft.	.17	.02	L	"	
1A	36 to 39 ft.	.12	.01	T	"	
2A	39 to 42 ft.	0	0	N	"	
3A	42 to 45 ft.	.12	.01	T	"	
4A	45 to 48 ft.	.15	.02	L	"	
5A	48 to 51 ft.	.07	.01	T	"	
6A	51 to 55 ft.	-.03	0	N	"	
80 ft. Sub-Level.						
1	8 ft.	.49	.05	L	No.	
2	11 ft.	.47	.05	L	"	
3	14 ft.	.41	.05	L	"	
4	17 ft.	.41	.05	L	"	
5	20 ft.	.55	.06	L	"	
6	23 ft.	.37	.04	L	"	
7	26 ft.	.54	.06	L	"	
8	29 ft.	.51	.06	L	"	
9	32 ft.	.82	.09	C	Yes	.02
10	35 ft.	.35	.03	L	No	
11	38 ft.	.65	.07	L	"	
12	41 ft.	.24	.03	L	"	
13	44 ft.	.84	.09	C	Yes	.02
14	47 ft.	.72	.08	C	"	.05
15	50 ft.	1.00	.11	C	"	.02
16	53 ft.	1.38	.15	M	"	.07
17	56 ft.	.70	.08	C	"	.02
18	59 ft.	.83	.09	C	"	.06

Sample No.	From	Reduced Reading	Estimated % U_3O_8	Class	Recommended for assay	Assay result
100 ft. Winze.						
1	18 ft.	.02	0	N	No	
2	21 ft.	.02	0	N	No	
3	24 ft.	.08	0.01	T	No	
4	27 ft.	.01	0	N	"	
5	30 ft.	-.01	0	N	"	
6	33 ft.	+.02	0	N	"	
7	36 ft.	.02	0	N	"	
8	39 ft.	0	0	N	"	
9	42 ft.	-.04	0	N	"	
10	45 ft.	.04	0	N	"	
11	48 ft.	.05	0	N	"	
12	51 ft.	.05	0	N	"	
150 ft. Sub-level.						
1		.03	0	N	No	
2		-.01	0	N	"	
South Portal Drive.						
1		.72	.08	C	Yes	.02
2		1.10	.12	C	"	.07
3		.51	.06	L	No	
4		.75	.08	C	Yes	.04
5		.51	.03	L	No	
6		.37	.04	L	"	
7		.50	.06	L	"	
8		.24	.03	L	"	
9		.21	.02	L	"	
10		.28	.03	L	"	
11		.02	0	N	"	
12		0	0	N	"	
13		.03	0	N	"	
14		-.03	0	N	"	
15		-.03	0	N	"	
16		-.02	0	N	"	
17		-.01	0	N	"	

EAST PAINTER.

No.1 Adit (Bulk Samples)

1	12 to 15½ ft.	.32	.09	C	Yes	.11
2	15½ " 18½ ft.	.31	.09	C	"	.08
3	18½ " 20½ ft.	.78	.09	C	"	.12
4	20½ " 23 ft.	.48	.05	L	No	
5	23 " 25 ft.	.59	.07	L	"	
6	25 " 28½ ft.	1.25	.14	M	Yes	.17
7	28½ " 32½ ft.	1.55	.15	M	"	.17
8	32½ " 36 ft.	2.28	.25	M	"	.22
9	36 " 39 ft.	0.99	.11	C	"	.15
10	39 " 42 ft.	1.10	.12	C	"	.15
11	42 " 45 ft.	0.60	.07	L	No	
12	45 " 50 ft.	.38	.04	L	"	



SKETCH PLAN
- OF -
RADIUM RIDGE AREA
SHOWING
RESULTS OF GEIGER-MÜLLER SURVEY

Scale (Approx.) 1" = 1200 ft.
(From Aerial Photographs)

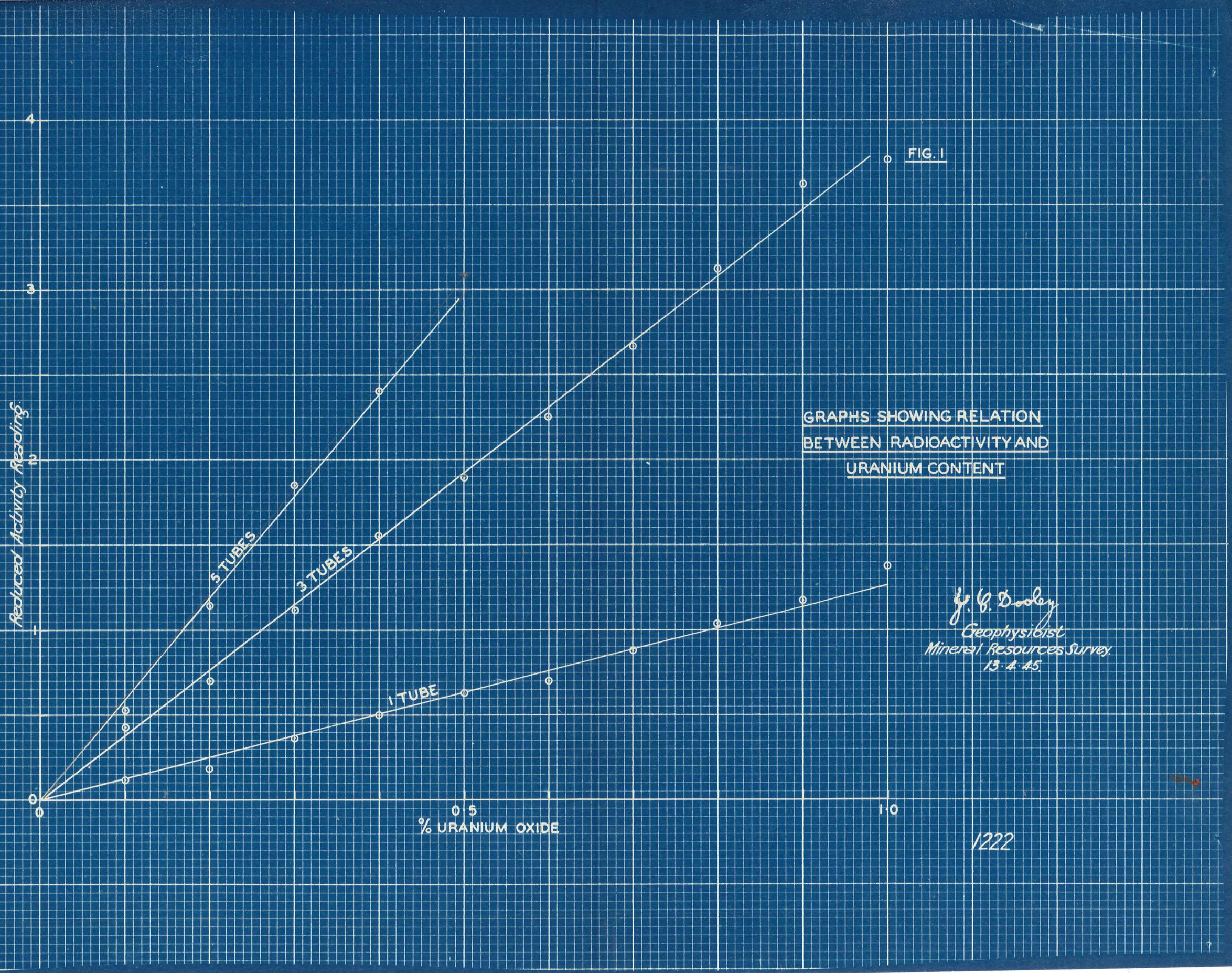
— Reference —

- *Ridges*
- *Creeks*
- *Ironstone outcrops*
- *High activity areas*
- ⊗ No.5 *Workings*

J. C. Dooley
Geophysicist
Mineral Resources Survey
13·4·45

1221

FIG. 1

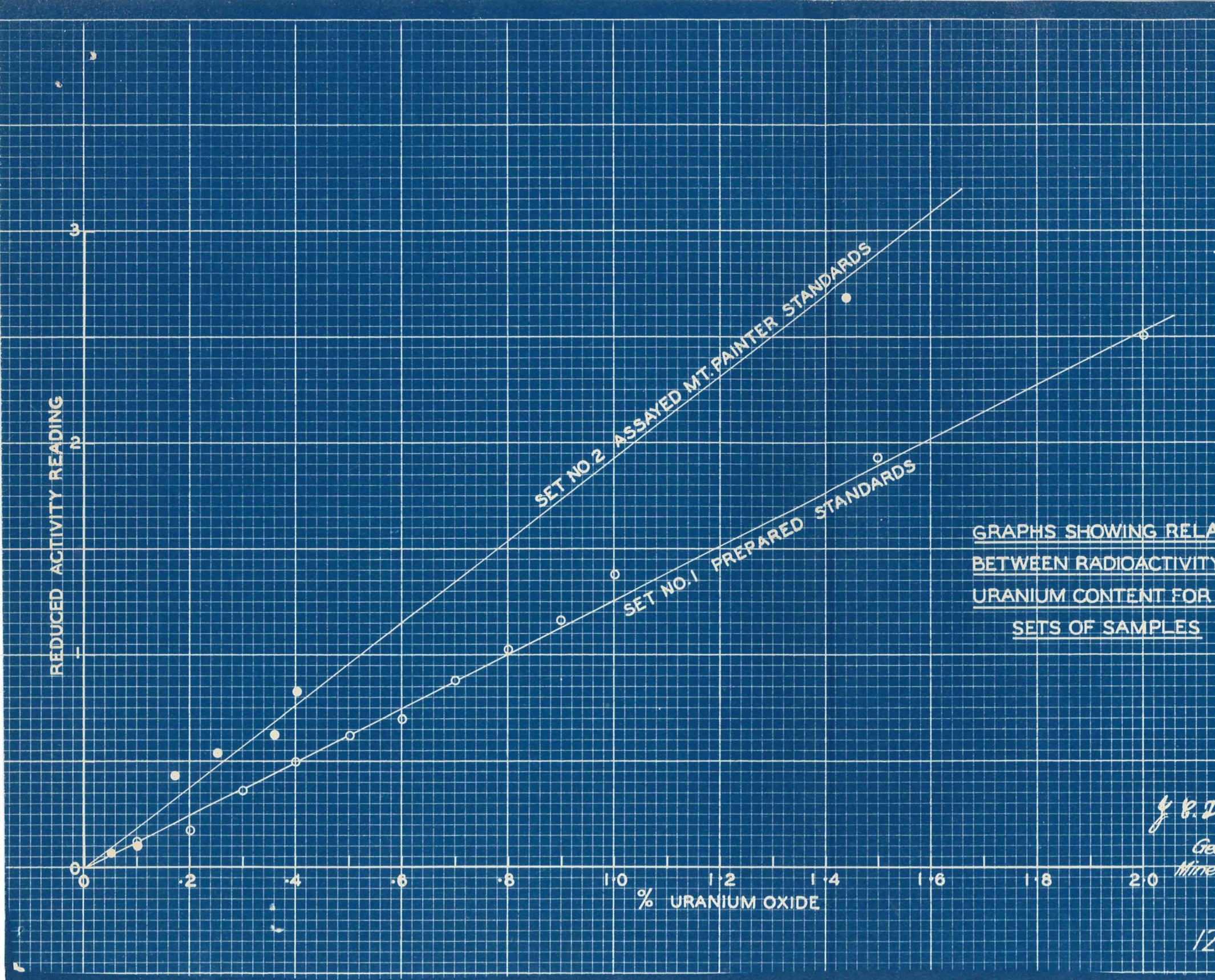


GRAPHS SHOWING RELATION BETWEEN RADIOACTIVITY AND URANIUM CONTENT

J. G. Dooley
Geophysicist
Mineral Resources Survey
13·4·45

1222

FIG 2

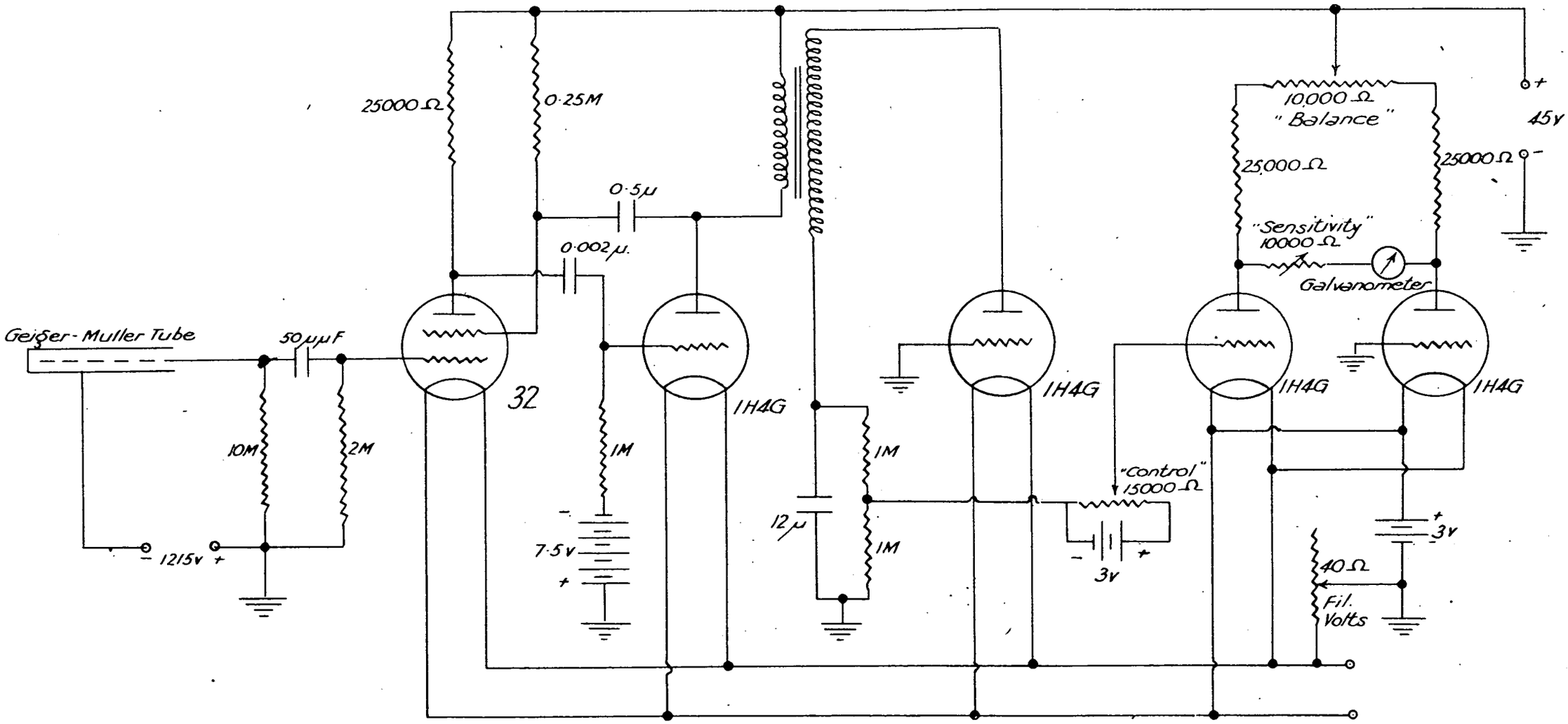


GRAPHS SHOWING RELATION BETWEEN RADIOACTIVITY AND URANIUM CONTENT FOR TWO SETS OF SAMPLES

J. B. Dooley
Geophysicist
Mineral Resources Survey.
13.4.45

1220

FIG. 3

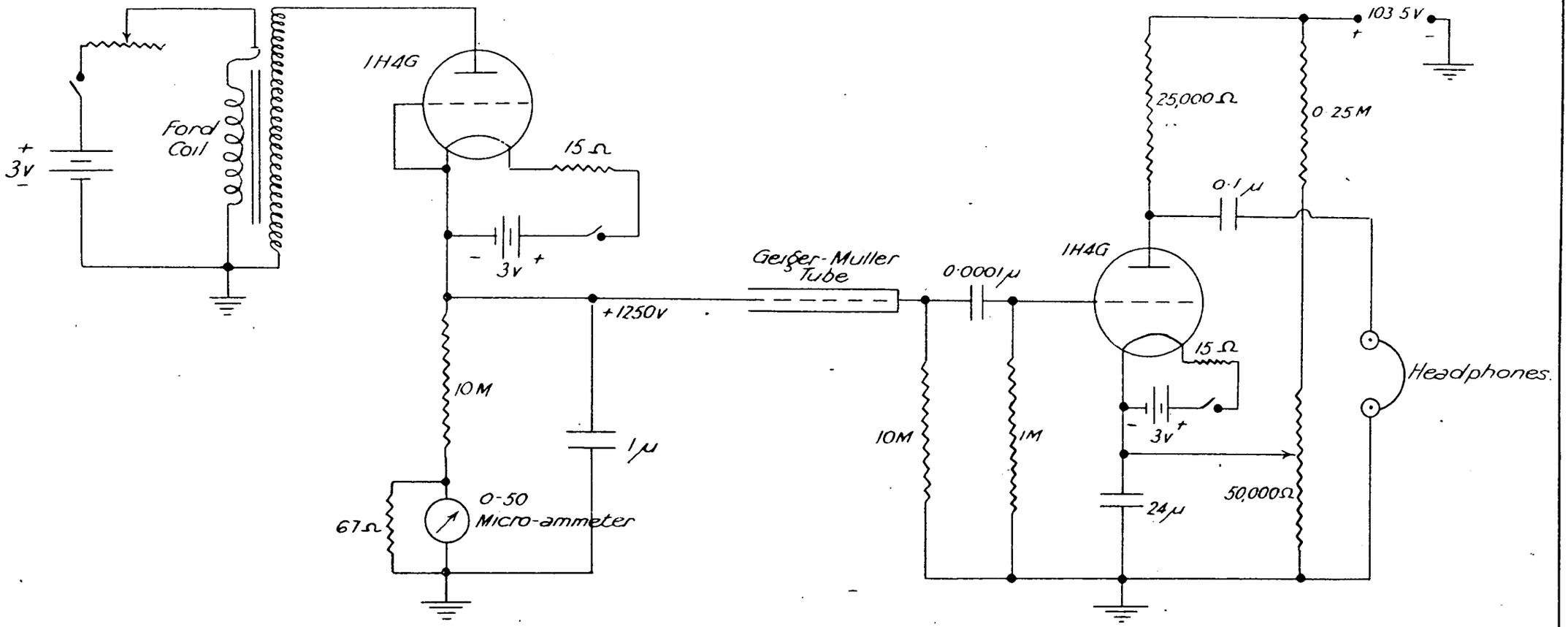


GEIGER-MULLER DETECTOR, ASSAY MODEL
CIRCUIT DIAGRAM

J.C. Dooley.
6/6/45

1237

Fig 4.



PORTABLE GEIGER-MÜLLER HEADPHONE DETECTOR

CIRCUIT DIAGRAM

J C Dooley.
6·6·45

1232