MAR 19690013: NORTHEASTERN ALBERTA

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A REPORT ON A

HELICOPTER BORNE

GAMMA RAY SPECTROMETER SURVEY

QUARTZ MINERAL PERMITS

77, 78, 79, 80, 81 and 57

NORTHEASTERN ALBERTA

FOR

CITIZENS PIPELINE LIMITED

720 - 7 Avenue S.W.

CALGARY, ALBERTA

by

JOHN T. COOK, P. GEOL.

ROVING EXPLORATION SERVICES LTD.

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19690013 Map No. 1

MAJOR STRUCTURAL FEATURES RELATED TO THE LAKE ATHABASCA AREA

SCALE IN MILES
100 0 100 200 300

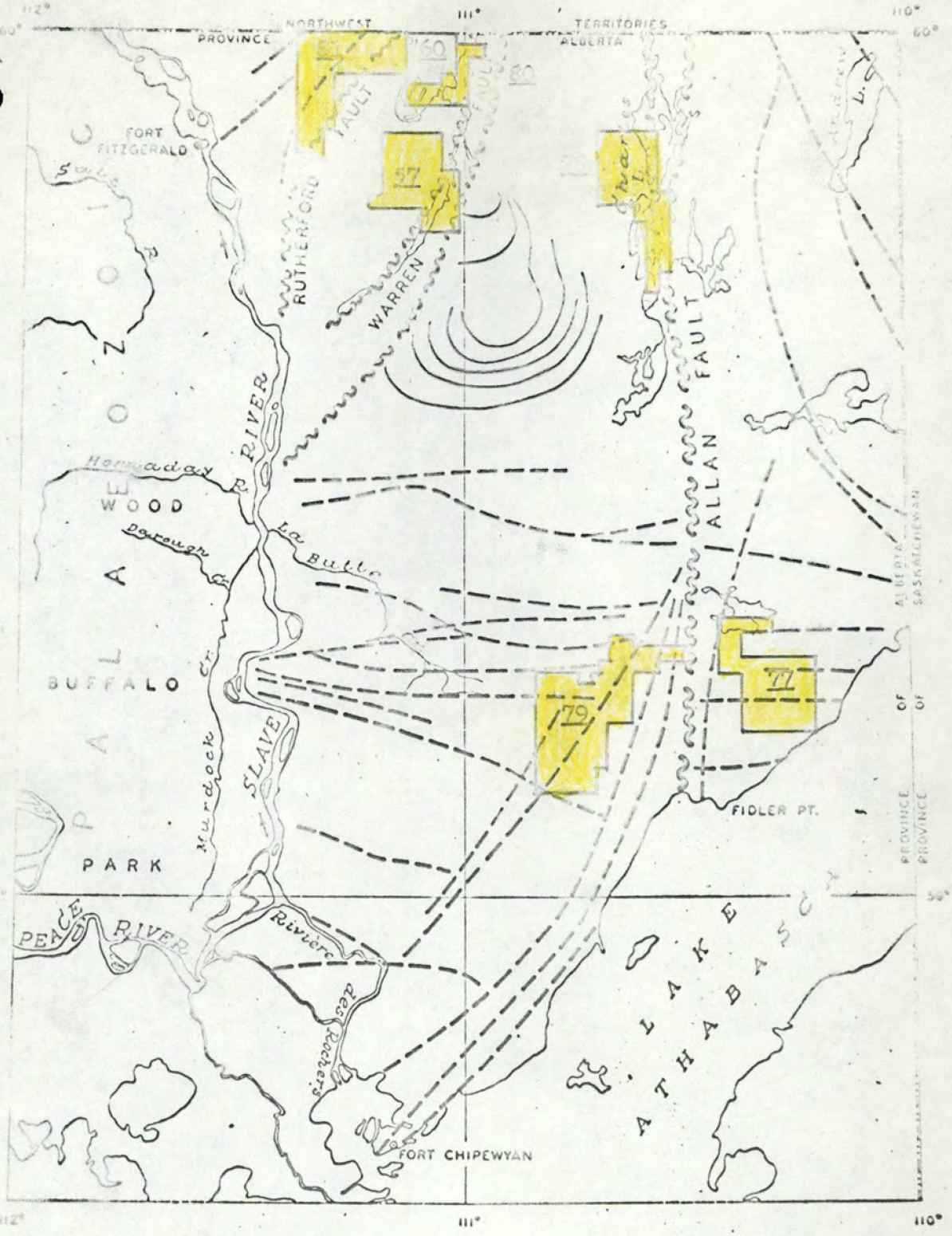
CITIZENS PIPELINE LIMITED
QUARTZ MINERAL PERMITS
Northeastern Alberta

LEGEND

- Highway
- Railway
- River
- International Boundary
- Provincial Boundary
- Park Boundary
- Settlement
- Mining Centre
- Major Fault Structures on Shield
- Reef Trends
- Grosmont Reef Complex
- Precambrian Shield

PART OF DATA FROM: H.R. BELYEA 1952, 1955, 1957.
D.R. DERRY ET AL 1950.

19690013 Map No. 2



PRINCIPAL STRUCTURAL ELEMENTS OF THE PRECAMBRIAN NORTH OF LAKE ATHABASCA

SCALE IN MILES
4 0 4 8 12 16

LEGEND

- Faults, major
- Faults, minor
- Sedimentary and Metamorphic Structures

CITIZENS PIPELINE LTD.
QUARTZ MINERAL PERMITS

77, 78, 79, 80, 81, 57

NORTHEASTERN ALBERTA

DRAWN BY
THE RESEARCH COUNCIL OF ALBERTA
EDMONTON, ALTA.

INTRODUCTION:

An airborne radiometric survey was conducted by Roving Exploration Services Ltd. over Quartz Mineral Permits 57, 77, 78, 79, 80 and 81 in Northeastern Alberta. The survey was flown between July 8 and August 1, 1969 on behalf of Citizens Pipeline Limited of Calgary, Alberta. Ground checks of the more interesting anomalies were carried out by the Roving field crew and by Mr. James Glass, P. Eng. whose report is included herewith.

PROPERTIES:

Quartz Mineral Permits 57, 77, 78, 79, 80 and 81 are all located in the Lake Athabasca area in Northeastern Alberta between Townships 117 and 126, and Ranges 2 to 8, West of the Fourth Meridian. Individual plats showing the precise area covered by each permit are included.

Total acreage included in the permits is 176,540 acres.

Permit No.	Acreage
57	29,440
77	29,760
78	28,160
79	49,920
80	9,600
81	29,760
Total Acreage	176,540

PERSONNEL:

Glen M. DuPre	Party Manager
Howard Stevens	Instrument Technician
Donald Buchanan	Helicopter Pilot
James Glass, P. Eng.	Ground Examinations

GENERAL GEOLOGY:

The permits on the north shore of Lake Athabasca and along the Slave River are situated near the western margin of the Precambrian Shield. The prevailing rock types are a complex of igneous and metamorphic rocks being predominantly granitic gneisses. Pegmatitic zones are frequent in some areas. The closest area covered by a detailed geological report is approximately 30 miles north. This is the Bayonet, Ashton, Potts and Charles Lakes District report (Research Council of Alberta, Preliminary Report 65-6) by John D. Godfrey.

The prevailing structural trend or "grain" of this mapped area is about N10^{o}E and the rocks are mainly biotite and hornblende granite gneisses as well as quartzites and biotite schists and other allied metamorphic types. Amphibolite and hornblendite are mapped in the Charles Lake area.

The rocks examined in the Report Area on the north shore of Lake Athabasca were exclusively granitic gneisses and pegmatitic granite gneisses.

A report "Aerial Photographic Interpretation of Precambrian

Structures North of Lake Athabasca" by John D. Godfrey of the Alberta Research Council (Geological Division Bulletin No. 1, 1958) covers the Report Area. A complex of faults and fractures is interpreted traversing the region of which the predominating trend is northeast-southwest. Strongest fault feature is the north-trending Allan fault which strikes north-south and traverses between Permits 77 and 79 and northward through Permit No. 78. Permit No. 81 is located on the Rutherford Fault, and Permits 57 and 80 are situated on the western flank of the Warren Fault. The Rutherford and Allan Faults belong to the northeasterly trending Lake Athabasca tectonic trend.

THE SURVEY:

All of the permits (77, 78, 79, 80, 81 and 57) were flown at flight line spacing of 6 lines per mile or 880 feet between lines. All lines were flown in a north-south direction.

Flying was conducted at approximately 175 to 200 feet above ground level and at air speeds of 50 to 60 miles per hour. Control of the flight lines was maintained by visual navigation with the assistance of air photo mosaics. Fiducial points were recorded during flight on the photo mosaics and simultaneously on the spectrometer chart with a mechanical marking device. Flight lines were plotted on 2" per mile scale enlargements of the photo mosaic.

Pre-flight checks were made with samples of Potassium, Uranium and Thorium immediately prior to each "take-off" to verify the proper functioning of the instrumentation. These "checks are shown on each flight chart.

No radioactive samples were carried in the Helicopter during survey and the aircraft was decontaminated with respect to radiation from luminous dials, etc.

The instrumentation was flown in a Hughes 269A Helicopter.

A Bonzer Altimeter (radar device) was used to record actual flight elevation above ground level. The Bonzer curve on the spectrometer chart shows the elevation above ground.

Ground examinations were carried out with the assistance of Helicopter, float equipped fixed wing aircraft.

The hand scintillometer utilized in the field was a Model 111B "scintillator" manufactured by Precision Radiation Instruments, Inc. of Los Angeles, California.

EQUIPMENT & INSTRUMENTATION:

The Model DGRS -1000 differential Gamma Ray Spectrometer has been developed to provide the mining and survey industry with a system to obtain precise radioactive quantative analysis from aircraft and ground vehicles.

The system has a maximum capacity of four channels. The four channels are: (1) Potassium -40, (2) Bismuth -214, (3) Thallium -208, (4) total count or integral. Spectral interaction has been eliminated by using specially developed techniques, which result in 100 per cent discrimination between the three radioactive elements in case of secular radioactive equilibrium.

The pulse height at the output of the detector is maintained constant as function of temperature by using spectrum stabilization techniques. As a reference element, the radioactive isotope Cesium -137 is used. The system conforms to the USAEC recommended standard instrument module and bin design as covered by TID - 20893.

Integrated circuits have been used throughout the system, which resulted in an unique and small package and also provides maximum reliability. All analogue and pulse processing circuitry has been temperature compensated by using the latest integrated circuits. Plug-in modular construction allows system building from one to four channels. Temperature compensated analogue computer circuits are used to eliminate spectral interaction resulting in 100 per cent discrimination. The system has been designed, incorporating nuclear instrumentation techniques, with an extended operating temperature range.

THE DETECTOR:

Exploranium Corporation of Canada Limited contracts the Harshaw Chemical Company for the manufacturing of thallium activated sodium-iodide crystals measuring 8" x 4", coupled to three photo-multiplier tubes and having guaranteed resolutions of 8.3% or better at .662 Mev at 1000 volts. The crystal is housed in a low background stainless steel housing and the photomultiplier tubes have high flux magnetic shields. The complete detector is mounted in a protective enclosure. This enclosure is necessary to protect the crystal from thermal shocks. Smaller crystals, in general, do not require any protection against sudden temperature changes but crystals with sizes of 8" x 4" and larger are extremely fragile. The larger crystal may be permanently destroyed if not properly protected. In general, it can be said that a 8" x 4" crystal may not experience a temperature deviation of more than 10^{o} C per hour. The enclosure is lined with six inches of polyurethane foam. It has been calculated that six inches will provide enough temperature reduction to prevent the 10^{o} C limitation being exceeded providing the unit does not experience more than the 100^{o} F atmosphere temperature change per hour.

THEORY:

Radioactive Equilibrium

Uranium and Thorium are determined indirectly by gamma spectrometry. The direct determination of the actual parents such as Uranium -238 is impossible in air-borne applications because Uranium -238 and Thorium -232 are alpha emitters.

The determination is accomplished by measuring the daughter products of both series.

One must assume therefore, secular radioactive equilibrium. Bismuth -214 is the only daughter product from the Uranium -238 series with major characteristic gamma emissions above the 1 Mev line. In air-borne applications, gamma emissions below the 1 Mev line are very difficult to resolve, due to the contributions of scatter, Compton, pair production and a much higher air attenuation coefficient. If radioactive equilibrium is not considered then the determination of Thorium and Uranium may give possible uncertainties, because Uranium -238 is determined by measuring a post Radon -222 daughter, Bismuth -214.

Uranium and to some extent Radium, have a tendency to migrate out of the upper layers of the soil during the soil forming and weathering processes, whereas Potassium and Thorium are more resistant to leaching.

The production of the gaseous daughter Radon -222 and its subsequent emanation into the soil, air and migration into the atmosphere or deeper into the ground before decay, provides another mode of removal of the gamma emitting daughters of Radium -226 from the upper layers of the soil.

A very similar process takes place in the Thorium series with the production of Radon -220, but its short half life (52 seconds) reduces the effect of its movement within the soil to small proportions. In general it can be said that appreciable precipitation, freezing or snow cover, will tend to seal the ground, causing a build-up of the radon concentration in the important uppermost layer, which results in an increase in gamma ray source strength in the ground. A reduction of the gamma emitting field at the surface may take place with heavy precipitation, because some of the radon will be washed down to deeper layers and the water will increase the effective gamma ray absorption coefficient in the ground.

Radio-Active Element Spectral Interaction

To obtain 100% discrimination between Thorium, Uranium and Potassium is impossible without introducing special techniques to eliminate the spectral interaction of the Thorium 232 series gamma spectrum into the Bismuth -214 and Potassium -40 spectrum.

In other words, if no correction is applied, when one would analyse a Thorium sample, the Thallium -208 series will contribute counts in the Bismuth -214, 1.76 Mev channel, and the Potassium -40, 1.47 Mev channel.

If one would only analyse Bismuth -214 or Potassium -40, no counts are contributed in the Thallium -208 channel, 2.62 Mev; and Bismuth -214 has its highest gamma emission at 2.43 Mev.

Since the spectra of the three elements are overlapping, certain proportions of each detected element has to be subtracted from the element which is being analysed.

In general, the determination of the exact amount for subtraction is complex and many variables are involved.

Gamma Ray Spectrometer for Aerial Surveys of Terrestrial Gamma Radiation Selection of Gamma Lines

Aerial quantative determinations of Uranium and Thorium, except Potassium are obtained by indirect gamma spectrometry.

Potassium has a single gamma line at 1.47 Mev and a quantative measurement can be made direct.

The 1.76 Mev gamma line of Bismuth -214 has been selected because it is the only gamma line with the highest peak - valley ratio of the Bismuth -214 series.

The 2.62 Mev Gamma line of Thallium -208 has been selected because this gamma line is higher than the highest gamma line of Bismuth -214, the 2.43 Mev line.

Therefore, Bismuth -214 and Potassium -40 will cause minimum interference.

Detection of Gamma Rays

To detect gamma rays, alpha or beta particles, a phosphor is required. When the gamma ray is absorbed by a phosphor, the result will be a light emission.

The intensity of this light emission is directly proportional to the energy in Mev or Kev of the incident gamma ray.

The phosphor is then coupled to a photo sensitive cathode of a photomultiplier which converts the light emission to an electrical pulse. Again, here the amplitude of the electrical pulse is proportional to the incident gamma ray. As phosphor, an inorganic material such as thallium activated sodium iodide NaI(TI) has been chosen. A very important parameter of the crystal is the stopping power. Only NaI(TI) has this high stopping power because of the high density, 3.67 gm/CC^3. It also has a relatively high light output or pulse height. As explained, the amplitude of the electrical pulse at the output of the photomultiplier is proportional to the incident gamma ray, which will enable us to differentiate between two different gamma rays. The differential between two gamma rays is not infinite. The detector, however, has a specific resolution which determines the detail in a gamma ray spectrum, or is the ability to record a specific energy interaction with a minimum spread of pulse height. The resolution, in per cent, is a very important parameter in gamma ray spectrometers. The resolution of most crystals is determined by using a Cesium -137 radioactive source. Cesium -137 has a single gamma line of .662 Mev and is therefore mono-energetic.

Another important parameter is the detection efficiency which is determined by the geometry of the crystal. When the source is far away from the crystal as in the case of air-borne surveys, the path of the gamma rays is more or less perpendicular to the surface of the crystal. When the distance is constant, but the thickness of the crystal is varied, the efficiency of the detector is about exponential. To obtain a sensitive system, it will be necessary to have a large volume crystal. In general, the prospector is interested in Uranium, Thorium as well as Potassium. This interest results in a wide range of energy to be used.

Since Thorium has the highest gamma line, the crystal must have a certain thickness which will ensure almost total absorption at 2.62 Mev. In general, a 4" thick crystal will absorb at 2.62 Mev only 75% of the gamma rays intersecting the crystal. While the thickness determines the absorption coefficient for a specific gamma line, the diameter determines the overall sensitivity. If the crystal diameter is increased twice, the crystal becomes 4 times more sensitive.

INTERPRETATION:

Xerox copies of the spectrometer charts with the more interesting anomalies are included in the report. One complete set of original spectrometer charts is provided.

The spectrometer charts show five curves, as follows:

Potassium - K40 0-100 c.p.s.

Bismuth 214 - Uranium 0-100 c.p.s.

Thallium 208 - Thorium 0-100 c.p.s.

Total Count - 0-800 c.p.s.

Altimeter - height above ground in feet.

The flight lines and anomalous areas are plotted at 2" = 1 mile on maps included with this report. The values of the Uranium anomalies plotted are given in counts per second above background. Intensity of the background varies, depending on the nature of the prevailing country rock types as well as the amount and kind of overburden.

Of the six permits flown significant Uranium counts were found on Permits 77, 78 and 81. The anomalies found on Permits 77, 78 and 81 range up to 35 counts per second above background. Clusters of anomalies occur in concentrations at several localities. These are labelled 81-2, 81-3, 81-4, etc. The anomalous localities which have been investigated on the ground are covered by a report that is included herewith. A number of other isolated occurrences of Uranium readings appear sporadically on most permits. These are relatively lower intensity anomalies and because of their isolated nature are considered less attractive.

PERMIT NO. 81

Locality 81-1, southwest corner Township 126, Range 8, West of the Fourth Meridian. Uranium readings up to a maximum of 35 c.p.s. were found on seven contiguous flight lines.

Locality 81-2 - five readings on contiguous flight lines were found with values up to 16 c.p.s. Uranium above background.

Locality 81-3 - Uranium readings up to 20 c.p.s. were found in three contiguous flight lines.

PERMIT NO. 80

Eight isolated occurrences ranging up to a maximum of 14 c.p.s. Uranium are mapped. None of these is thought to be of sufficient intensity or frequency to warrant further investigation.

PERMIT NO. 79

Six isolated anomalies up to a maximum of 14 c.p.s. Uranium radiation occur scattered through the permit. They are not considered worthy of further investigation.

PERMIT NO. 78

Two localities, 78-1 and 78-2, are considered worthy of investigation on the ground.

Locality 78-1 - contains six Uranium anomalous readings on contiguous flight lines. These range up to 18 c.p.s. Uranium above background.

Locality 78-2 is an isolated anomaly reading 18 c.p.s. Uranium above background. Nine other isolated occurrences of rather low Uranium intensity are scattered over the permit.

PERMIT NO. 77

Three localities are designated which may warrant ground examination. All are rather low intensity readings.

Locality 77-1 contains only one anomalous Uranium reading of 28 c.p.s. above background. This is the highest reading on Permit No. 77.

Locality 77-2 contains three readings of Uranium up to 14 c.p.s.

Locality 77-3 contains four readings up to 20 c.p.s. Uranium. A number of other rather low intensity Uranium anomalies and a number of Total Count anomalies are mapped. None of these are considered to have commercial significance.

PERMIT NO. 57

A total of nine Uranium anomalies with readings of up to a maximum of 16 c.p.s. above background are mapped. These are all rather low intensity anomalies and not considered worth further investigation.

GROUND EXAMINATIONS:

Permit No. 77 was visited July 27 by Glen M. DuPre in the area of Locality 77-3. Mr. DuPre examined the ground for showings and traversed with a hand scintillometer. He found no significant radioactivity nor other indications of Uraniferous mineralization.

Permit No. 81 was visited on July 15 in the area of Localities 81-1 and 81-2 by Glen M. DuPre. Some pegmatitic granites and gneisses were found outcropping but no significant radioactivity was measured with the hand scintillometer. Much of the area was found to be low and swampy.

CONCLUSIONS AND RECOMMENDATION:

The most attractive Uranium anomalies occur at Localities 78-1, 78-2, 81-1, 81-2, 81-3, 77-1, 77-2 and 77-3.

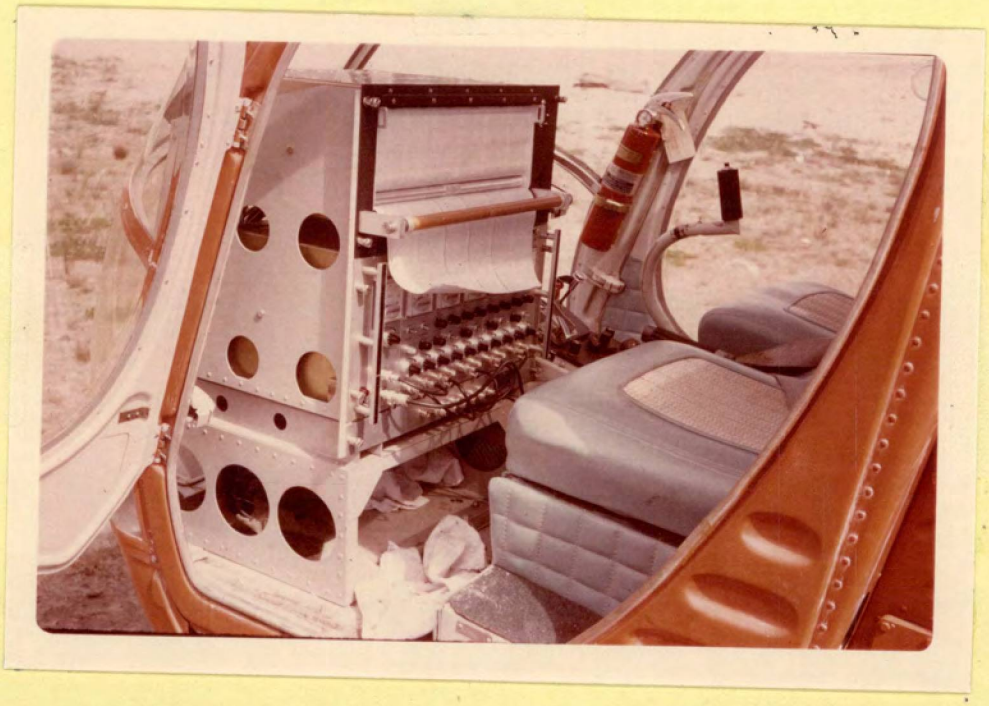
None of these anomalies is by any means spectacular. The limited ground examinations carried out did not reveal commercially interesting Uranium deposits. However, the examinations that were done were in the nature of "spot checks" only and exhaustive prospecting on the ground in each area cited should be seriously considered before abandoning hope. This work should be undertaken in the summer by experienced field crew equipped with hand scintillometer or spectrometer.

In attempting to assess the true merit of the airborne spectrometer anomalies mapped, it is cautioned that Gamma radiation can often be blanketed out completely, or subdued by certain types of overburden, muskeg, swamp, water or snow.

ROVING EXPLORATION SERVICES LTD.

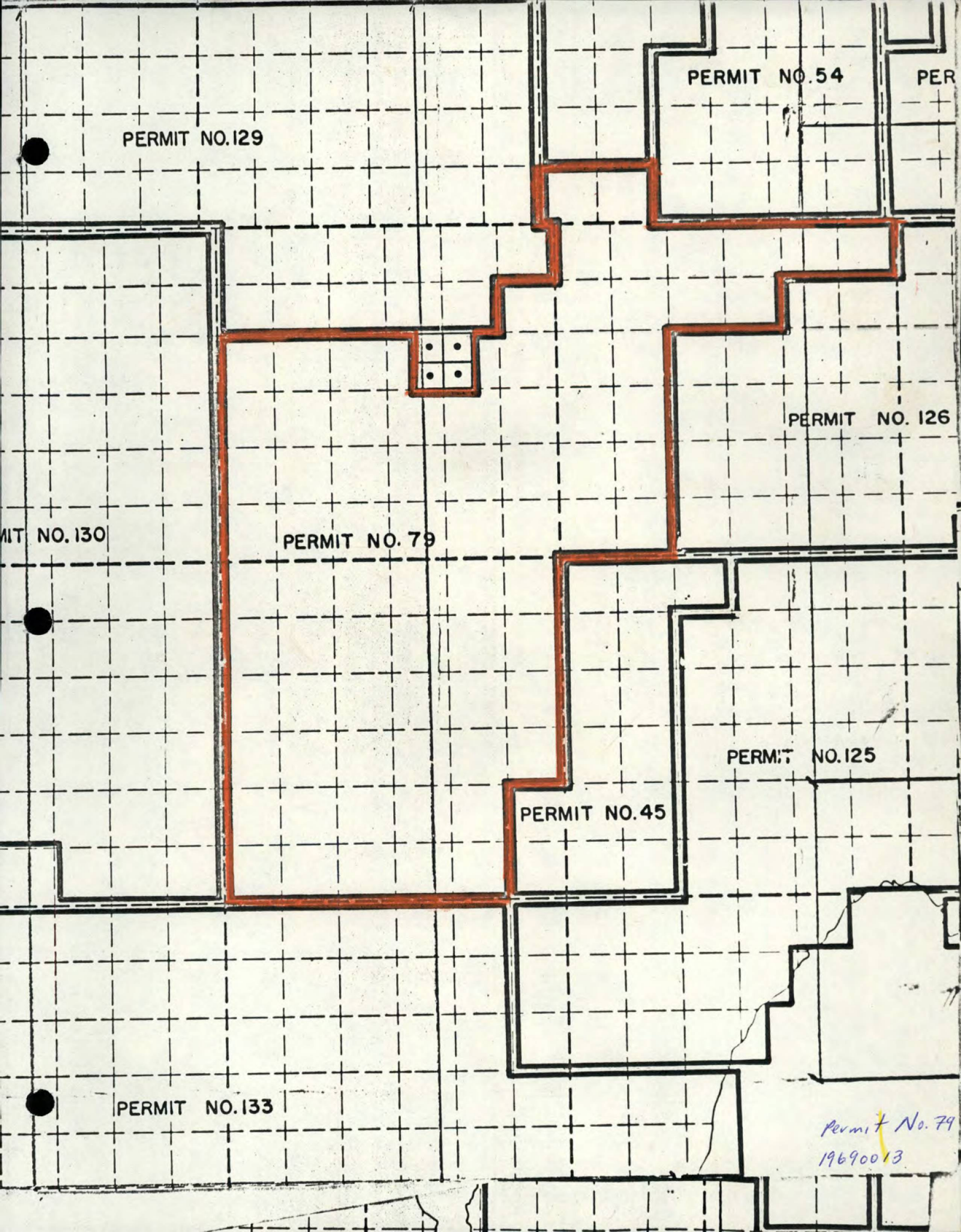
THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF ALBERTA
PERMIT NUMBER
P.22
ROVING EXPLORATION SERVICES LTD.

John T. Cook, P.Geol.



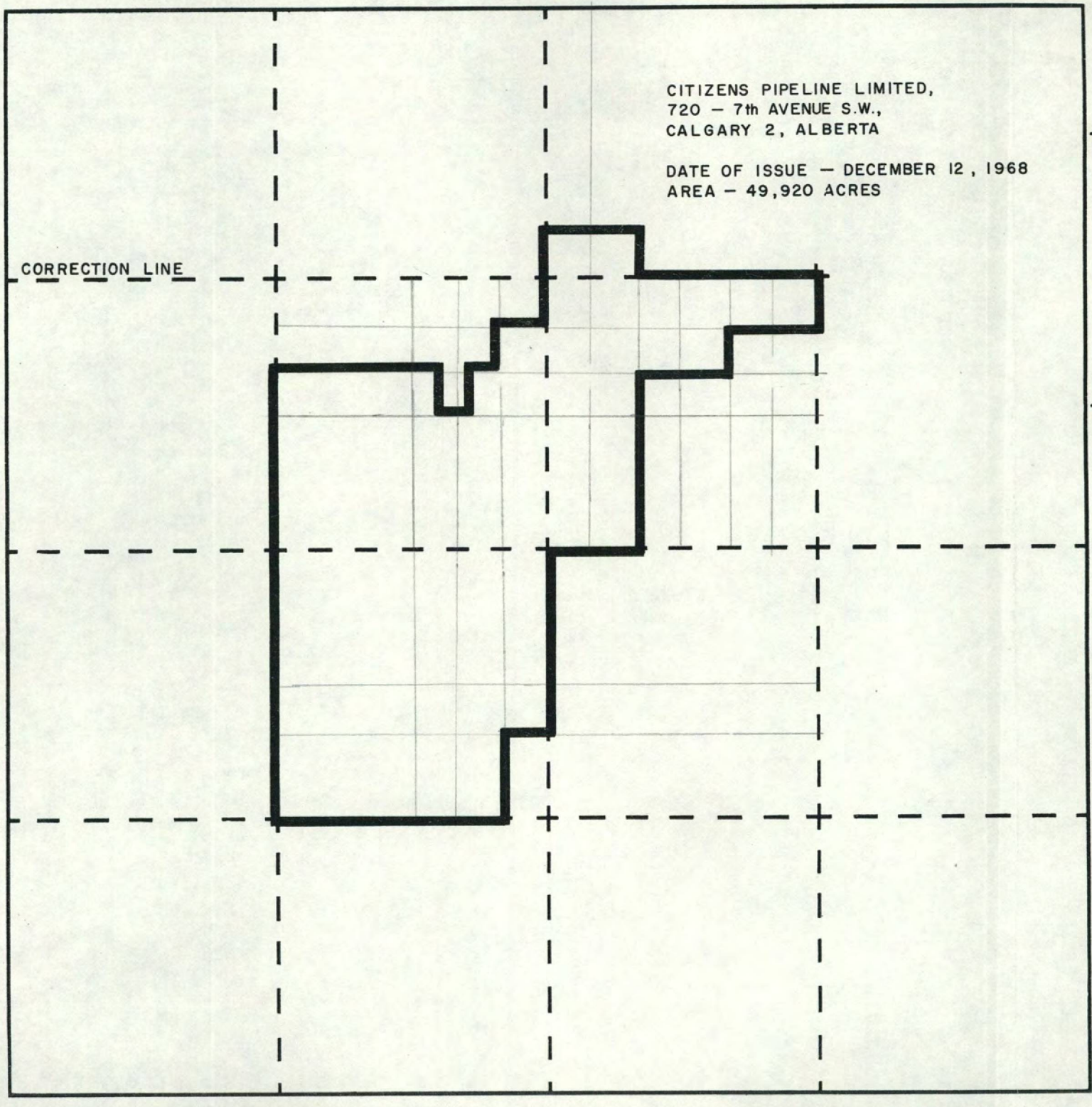
ROVING EXPLORATION SERVICES LTD. EXPLORANIUM DGRS 1000

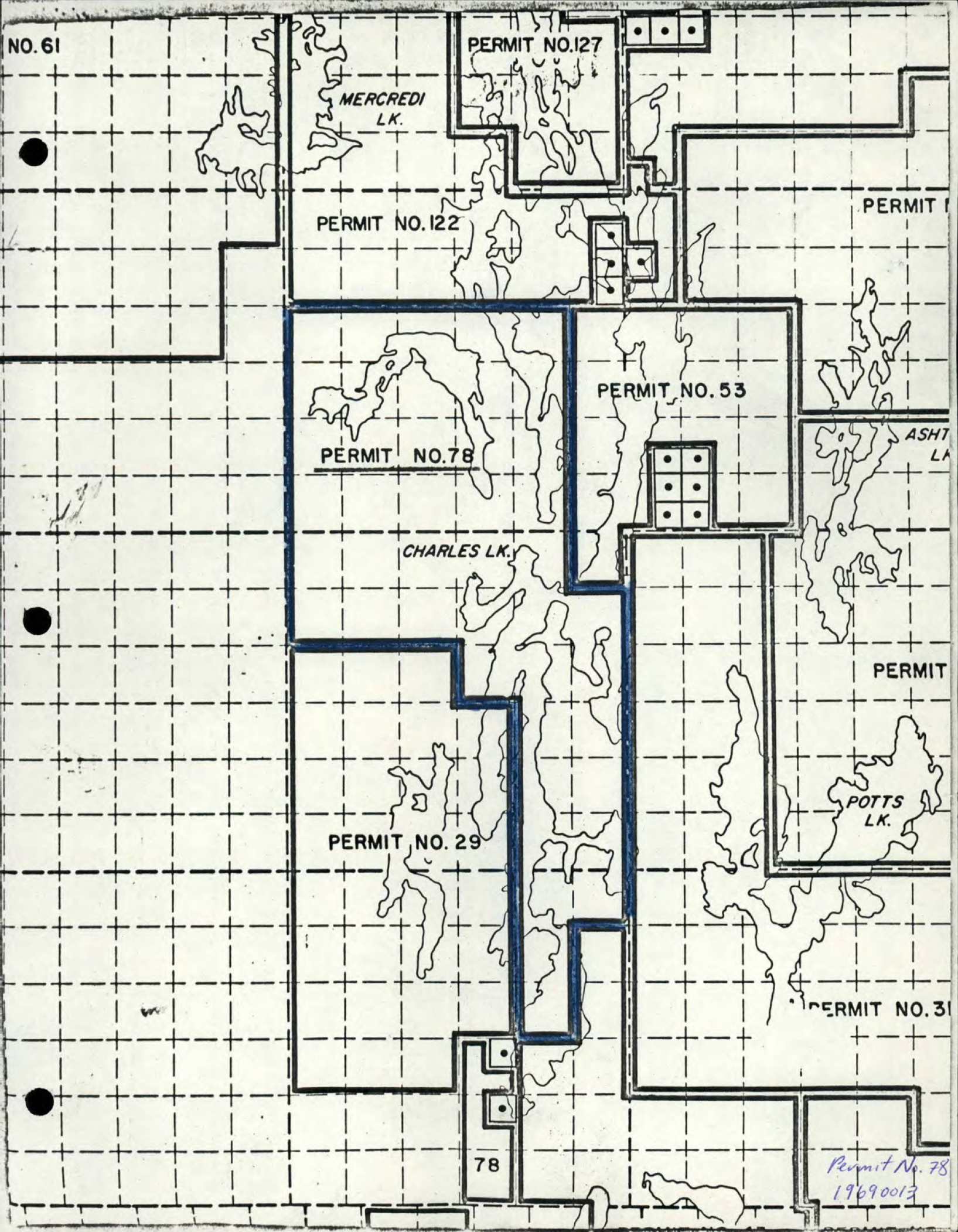
GAMMA RAY SPECTROMETER MOUNTED IN HUGHES 269A HELICOPTER



Permit No. 79
19690013

QUARTZ MINERAL EXPLORATION PERMIT No. 79





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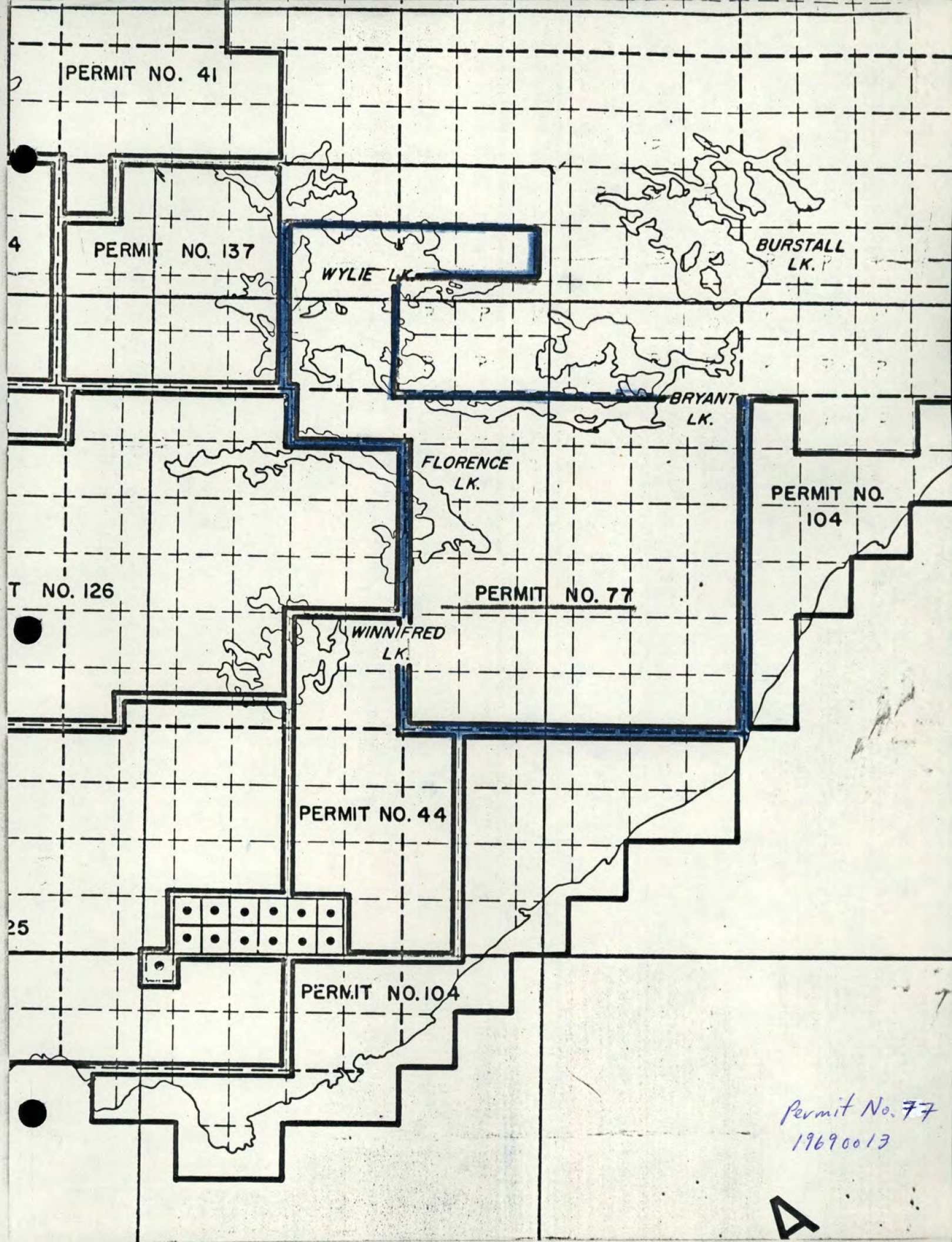

Permit No. 77
19690013

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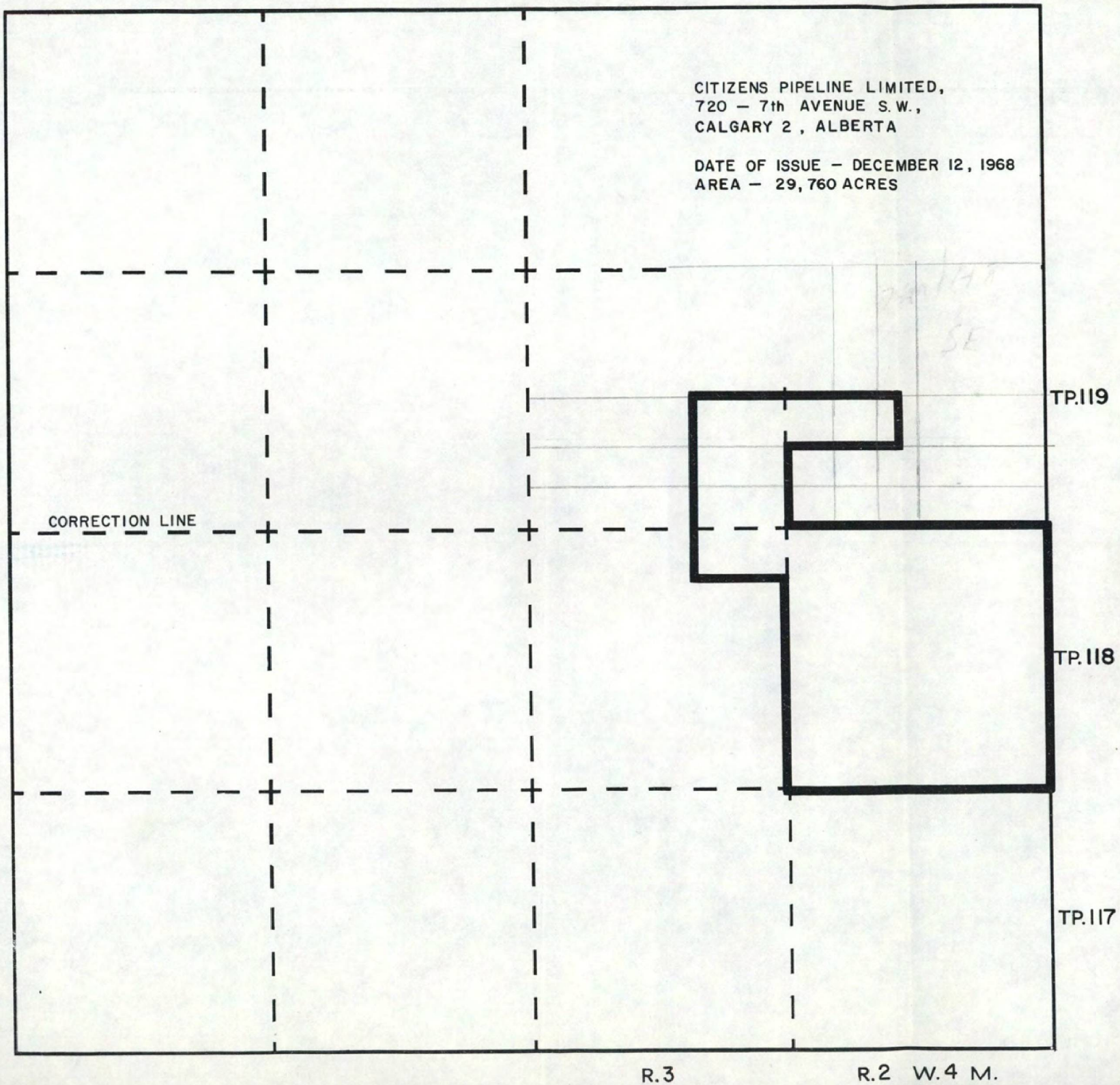
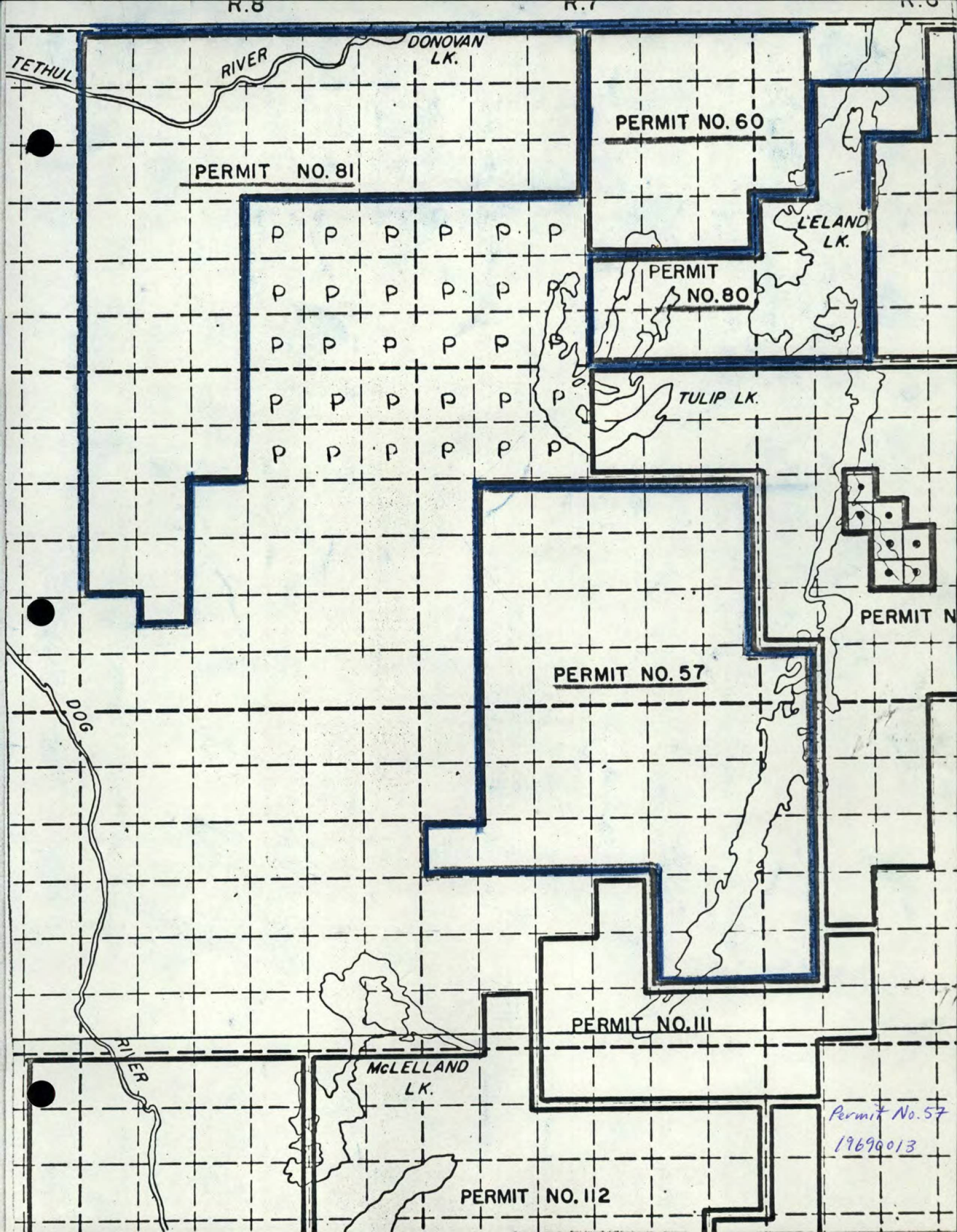
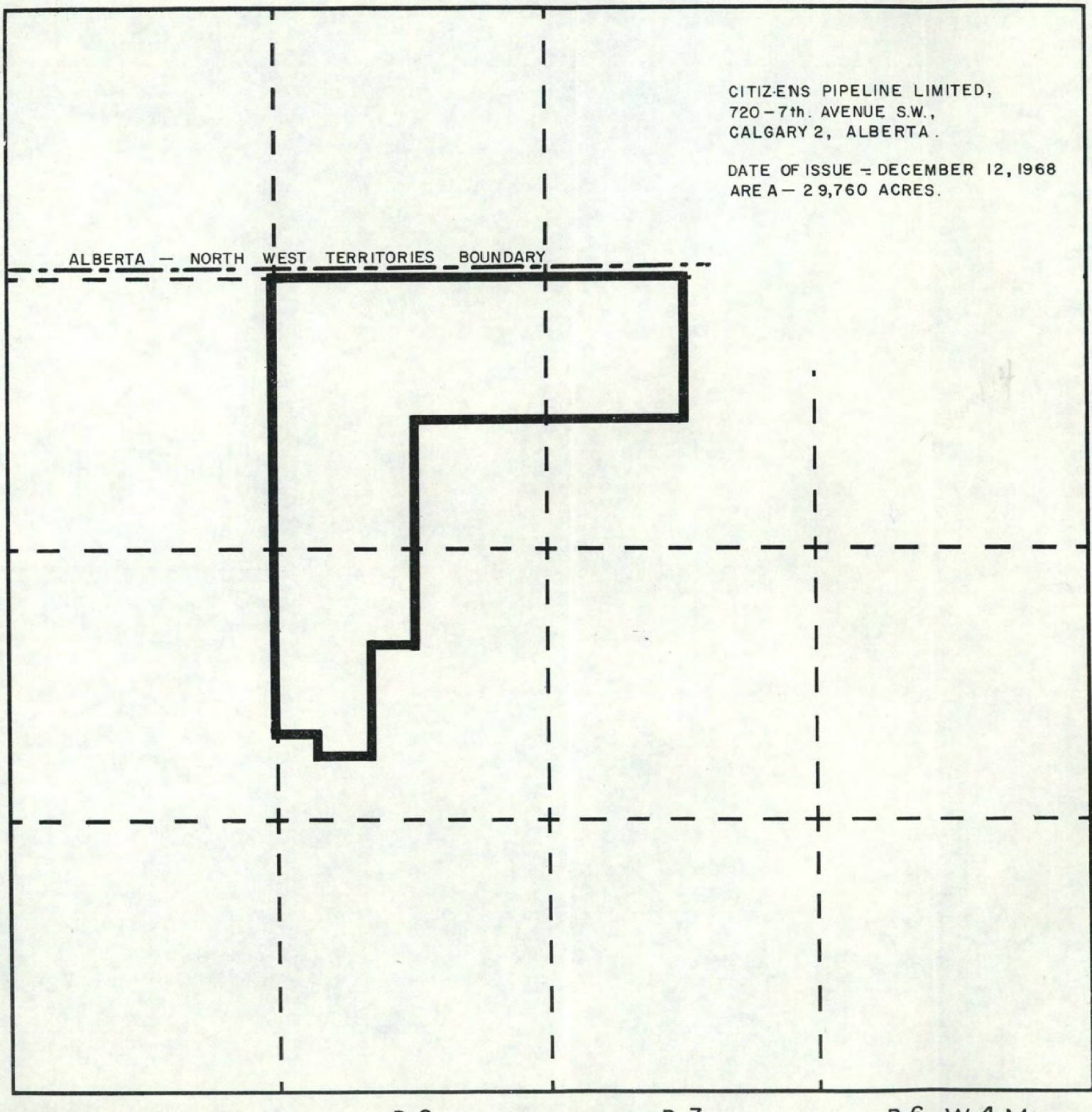
QUARTZ MINERAL EXPLORATION PERMIT No. 77





Permit No. 57
19690013

QUARTZ MINERAL EXPLORATION PERMIT No. 81



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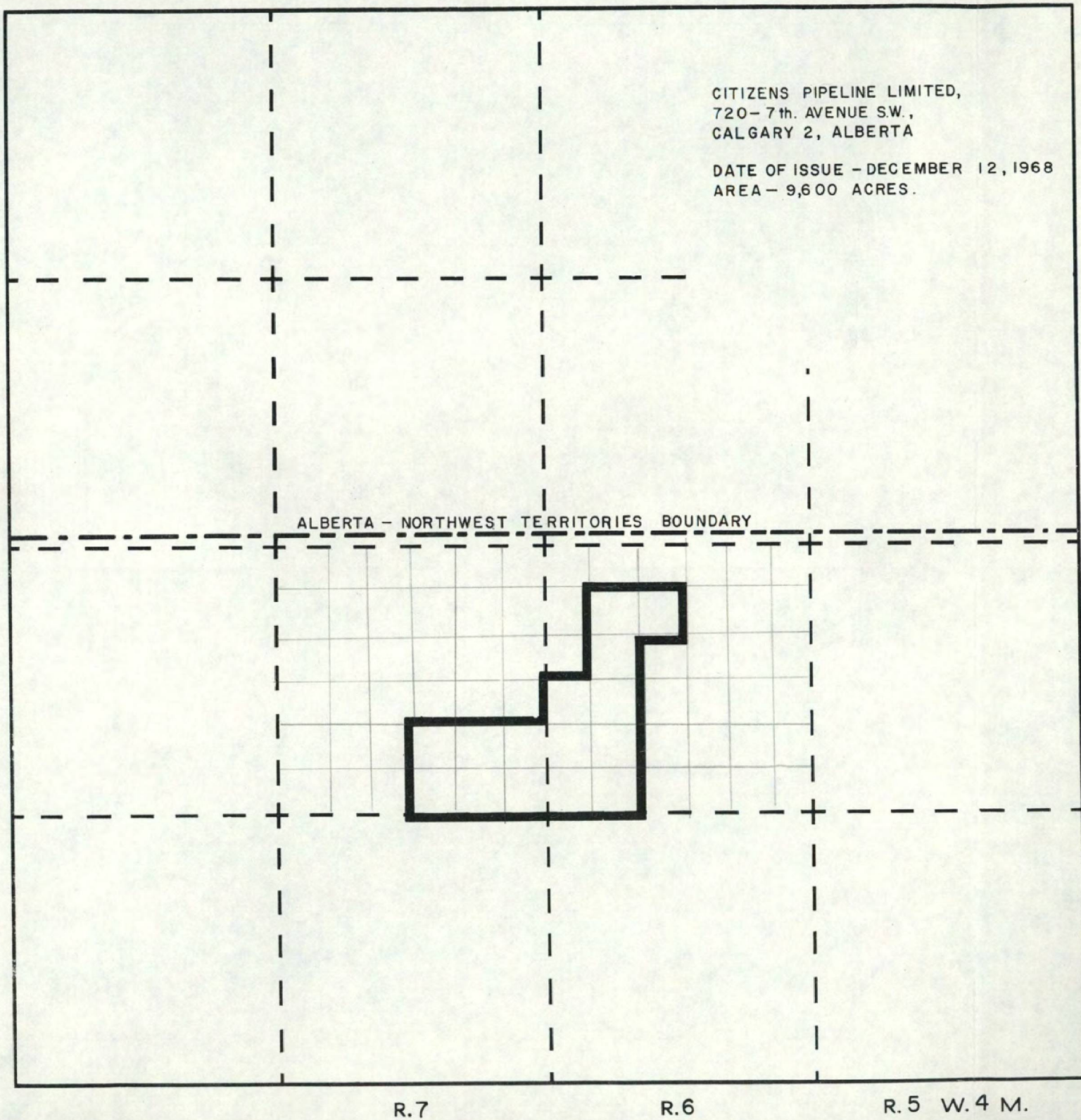
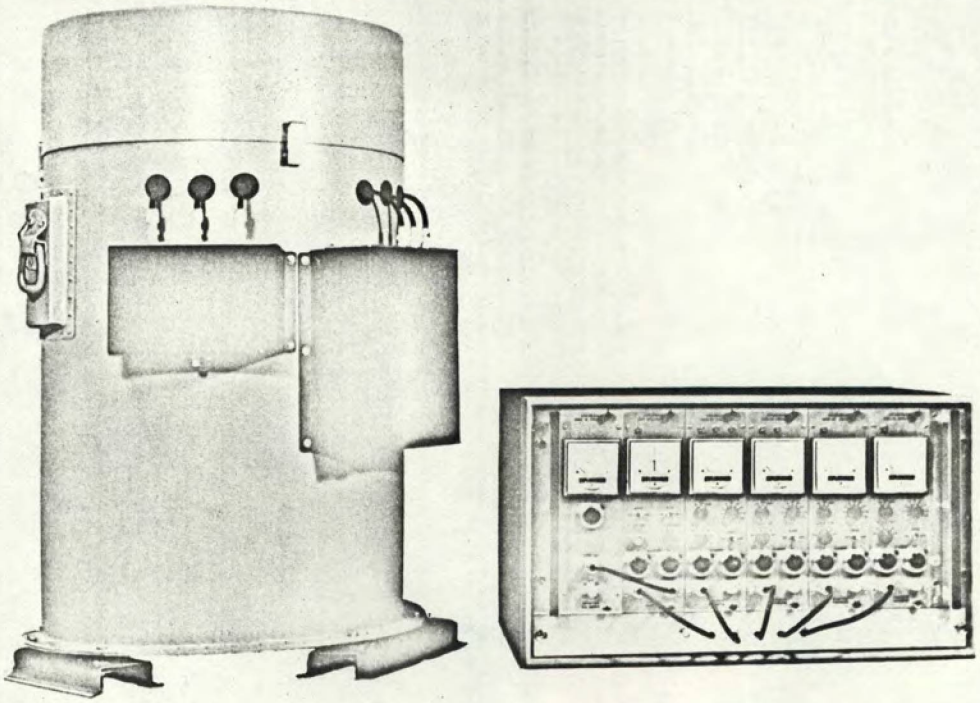


FOUR CHANNEL DIFFERENTIAL GAMMA RAY SPECTROMETER

Model DGRS - 1000



DESCRIPTION

The Model DGRS-1000, four channel differential gamma ray spectrometer has been developed to provide the survey and mining industry with a system to obtain precise radioactive quantative analysis from aircraft, and ground vehicles.

The system may be used for bore hole logging with a special detector, in laboratories, or at base camps.

The four channels are: 1. potassium –40 2. bismuth –214 3. thallium –208 4. total count or integral.

Spectral interaction has been eliminated by using specially developed techniques. which results in 100% discrimination between the three radioactive elements.

A large volume detector, 8'' x 4'' NaI (Tl) coupled to three matched photomultiplier tubes is used to obtain high sensitivity. The pulse height at the output of the detector is maintained constant as function of temperature by using spectrum stabilization techniques. As a reference element, the radioactive isotope Cesium –137 is used. The system conforms to the USAEC recommended standard instrument module and bin design as covered by TID-20893.

FEATURES

Integrated circuits have been used throughout the system, which resulted in a unique and small package and also provides maximum reliability. All analogue and pulse processing circuitry has been temperature compensated by using the latest integrated circuits. Each channel may be used for spectrum analysis by using spectrum scanning techniques. Plug-in modular construction allows system building, from one to four channels.

Temperature compensated analogue computer circuits are used, to provide spectral interaction elimination, resulting in 100% discrimination.

The system has been designed, incorporating nuclear instrumentation techniques, with an extended operating temperature range.

ROVING EXPLORATION SERVICES LTD.
520 - 5th AVENUE S.W.
CALGARY, ALBERTA

NUCLEAR INSTRUMENT DIVISION

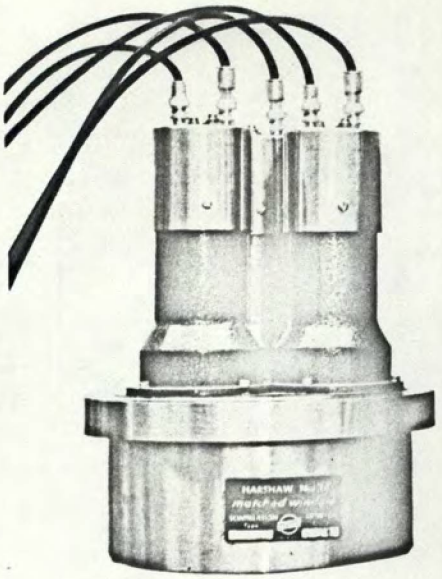
1415 LAWRENCE AVENUE WEST • TORONTO 15, ONTARIO, CANADA

TELEPHONE: 248-6463 (AREA CODE 416)

JANUARY, 1969

DETECTOR

The Harshaw Chemical Company selects specially for Exploranium Corporation sodium iodide thallium activated crystals with unique resolutions of 8.3% or better at .662 Mev at 1,000 volts. The diameter is 8" and the thickness is 4". Larger or smaller crystals to special order. The crystal is coupled to three selected photomultiplier tubes. The gain and focus of each photomultiplier tube can be varied individually. The crystal is mounted in a low background stainless steel case with a thin entrance window. The three photomultiplier tubes are magnetically shielded and are mounted with stainless steel tube bases. The crystal assembly is mounted in a protective enclosure, which is lined with 6" of polyurathene foam to protect the crystal from thermal shocks. An ambient temperature change of 75°C per hour will cause a change of temperature inside the enclosure of not more than 10°C per hour. The crystal is suspended in 6" of semi-hard foam.



Pre-Amplifier – Main pulse amplifier

The pre-amplifier is a low noise, low gain m.o.s. amplifier. The outputs of the photomultiplier tubes are summed at the input of the pre-amplifier. To prevent loading of the photomultiplier tubes, a very high input impedance is required. The pulse shape appearing at the output is R-C shaped, with a decay constant of about 30 μs. The main pulse amplifier consists of an amplifying section of which the gain can be selected, a pulse current limiter, a delay line pulse shaping network and a low impedance output buffer. The output pulse is gaussian shaped with a pulse width of about 1 μs. The maximum output is 10 volts. Both amplifiers are mounted on the detector enclosure.

PRE-AMPLIFIER SPECIFICATIONS

Input impedance: 1 M Ohms – negative going pulses.
Input capacity: 5 pf
Gain: X1.
Input pulse time constant: 30 μs.

SYSTEM SPECIFICATIONS

Power Requirement: 110 V.A.C. or 12 V.D.C., or 28 V.D.C. at 75 Watts.
Instrument Weight: 55 lbs.
Detector Weight: 8" x 4" crystal housing–75 lbs.

MAIN AMPLIFIER SPECIFICATIONS

Gain: 1 – 2 – 4 – 8 – 10.
Overload recovery: for 250 x overload about 20 μs.
Pulse shape: Gaussian – pulse width 1 μs.
Output: 0 to 10 volt maximum – positive going.
Maximum output load: 50 Ohms.
Stability: .1%/°C.
Differential linearity: ± 1%
Output impedence: .5 Ohms.

WARRANTY

The instrument is warranted free from material defects and poor workmanship for a period of one year from the date of shipment and defective material will be replaced free of charge during this period unless the equipment has been modified, adjusted and/or changed as a result of misuse, in which case this warranty is void.

Should repairs outside the warranty be required, then repairs will be made at our standard service rates.

RESERVED RIGHTS

Exploranium Corporation of Canada Ltd., reserves the right to adjust engineering specifications in the best interests of maintaining high quality instrumentation.

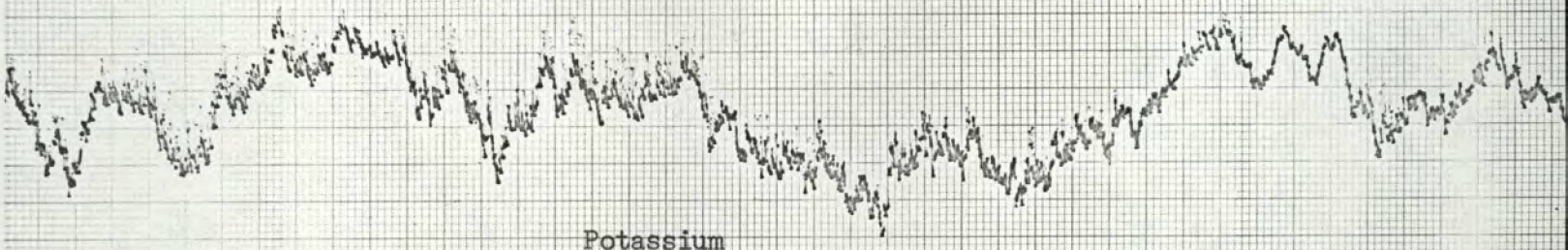
PRINTED IN CANADA

Altimeter

0 ft..above ground level

RONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

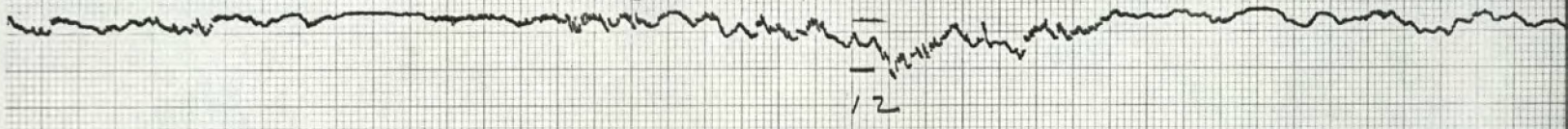


Potassium

100 cps.

RONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.



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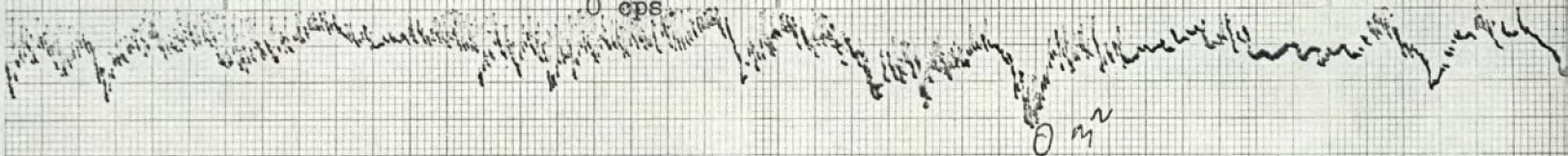
Uranium

100cps.

RONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.



0 m

Thorium

100 csp.

RONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

Total Count

Permit No. 57
Line No.13

800 cps.

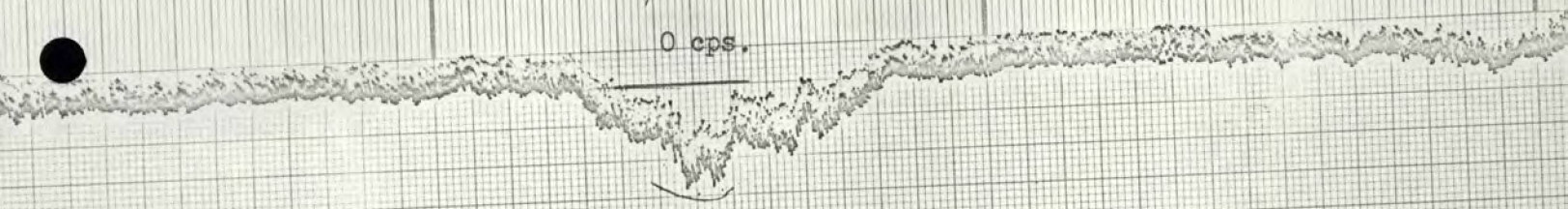
RONICS, INC. CAMBRIDGE, MASS., U.S.A.

#1

19690013

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.



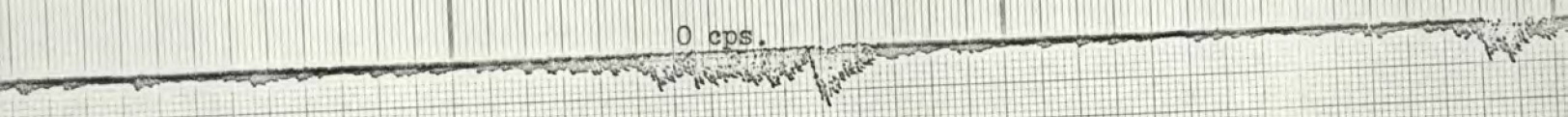
30

Uranium

10 0 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

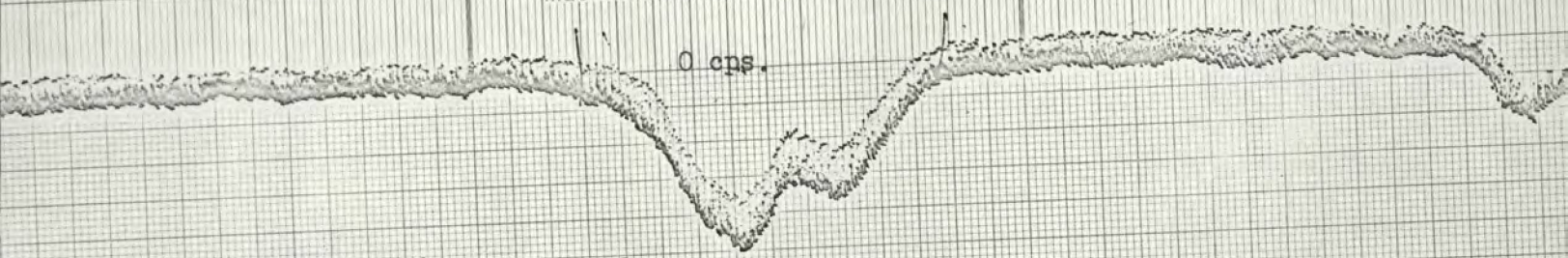


Thorium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.



Permit 77
Line 13

Total Count

800 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

Locality 77-1
Permit No. 77
Line No. 13

Loc 77-1

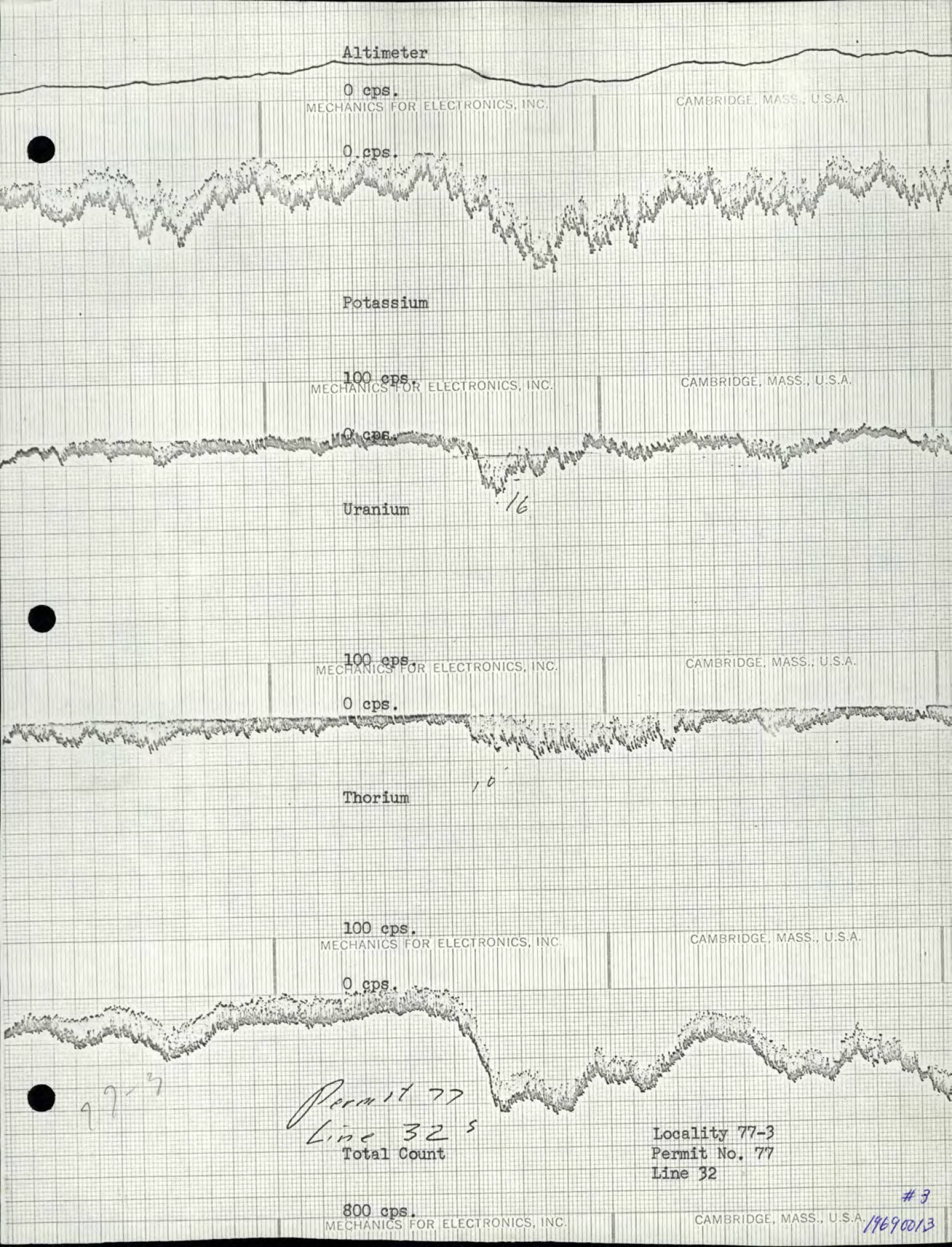
Total Count

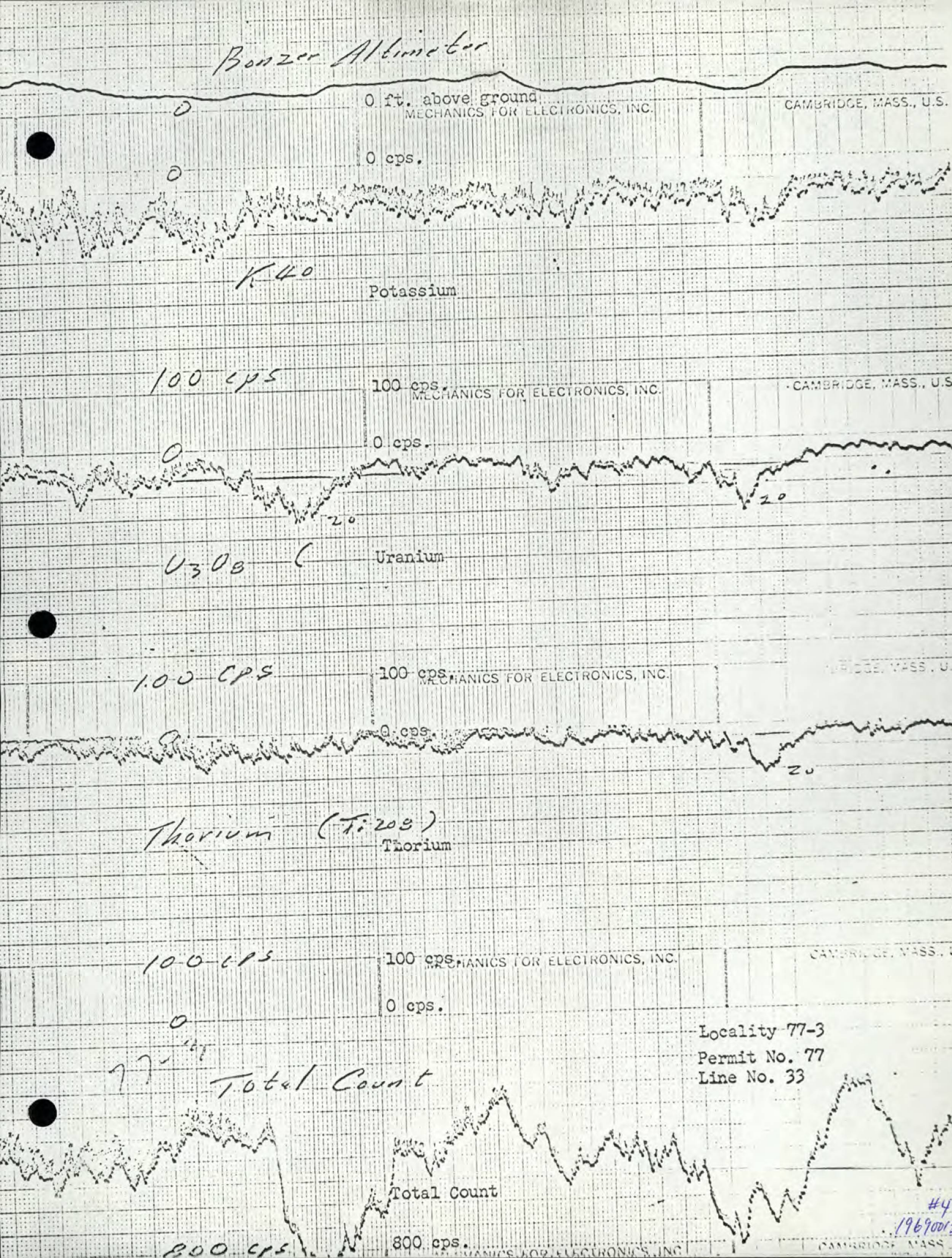
MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

I

#2

1969013


Altimeter
0 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Potassium
100 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Uranium
16
100 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
10
Thorium
100 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
77-3
Permit 77
Line 32
Total Count
Locality 77-3
Permit No. 77
Line 32
#3
800 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
19690013


Bonzer Altimeter
0 ft. above ground
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.
0
0 cps.
0
K40
Potassium
100 cps
100 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.
0 cps.
0
20
20
U3O8
Uranium
100 cps
100 cps.
MECHANICS FOR ELECTRONICS, INC.
0 cps.
0
20
Thorium (Th 208)
Thorium
100 cps
100 cps.
MECHANICS FOR ELECTRONICS, INC.
0 cps.
0
Locality 77-3
Permit No. 77
Line No. 33
Total Count
Total Count
800 cps
800 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS.

#4
19690013

MECHANICS FOR ELECTRONICS, INC.

0 cps.

14

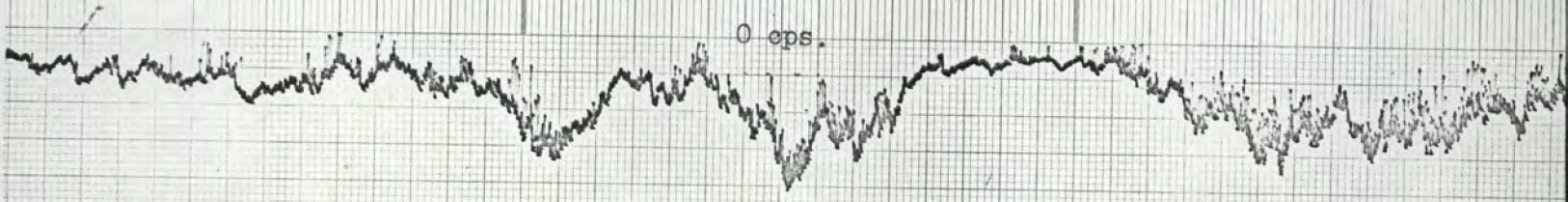
Uranium

100cps.

m

MECHANICS FOR ELECTRONICS, INC.

0 cps.

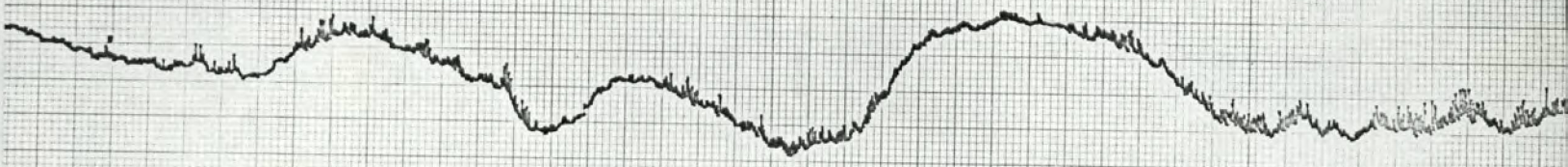


Thorium

100 cps.

MECHANICS FOR ELECTRONICS, INC.

0 cps.



Total Count

Locality 78-1
Permit No.78
Line No. 2

100 cps.

78-1

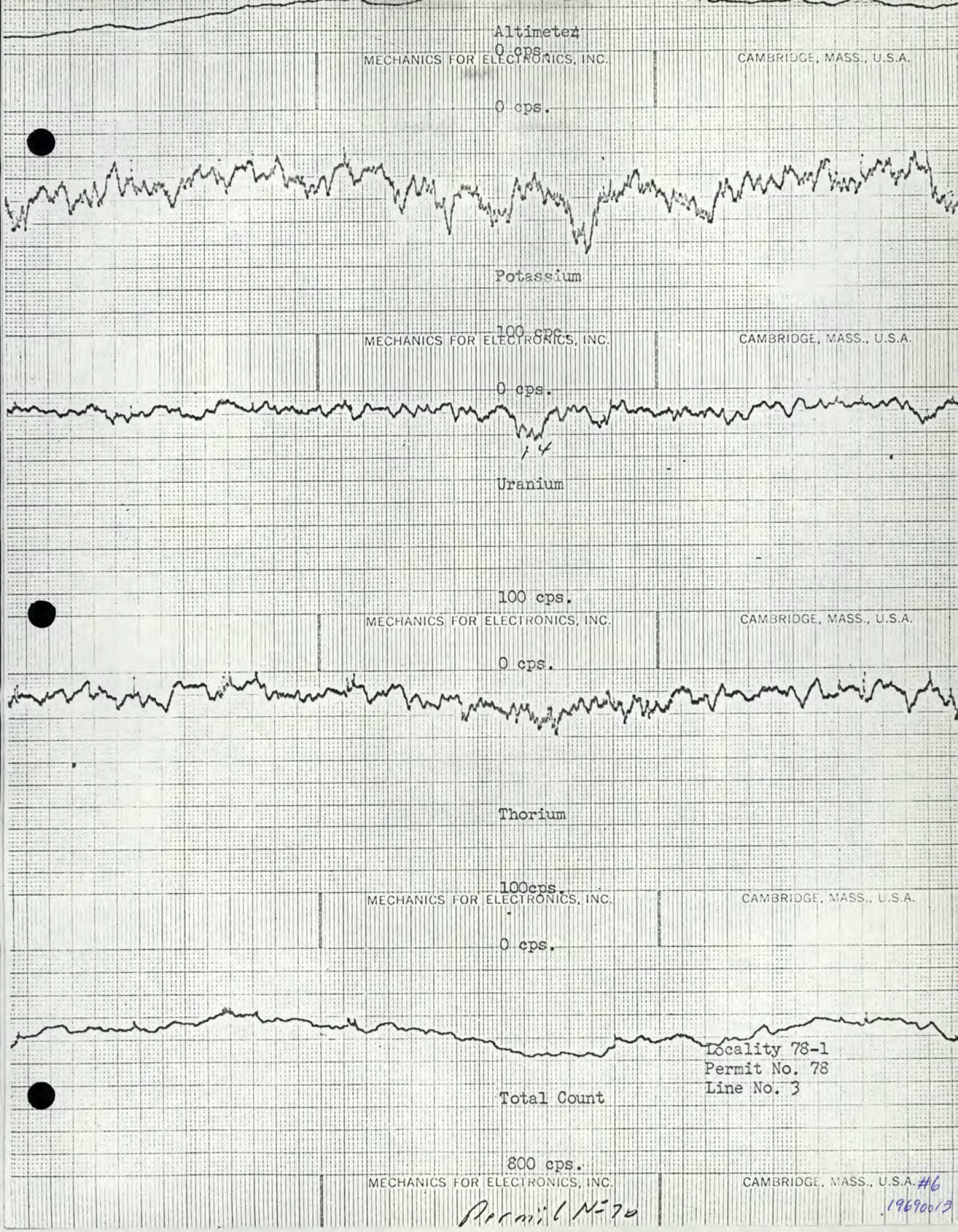
MECHANICS FOR ELECTRONICS, INC.

Permit #78
Line 1 S

#5
1969013

1 A

MECHANICS FOR ELECTRONICS, INC.

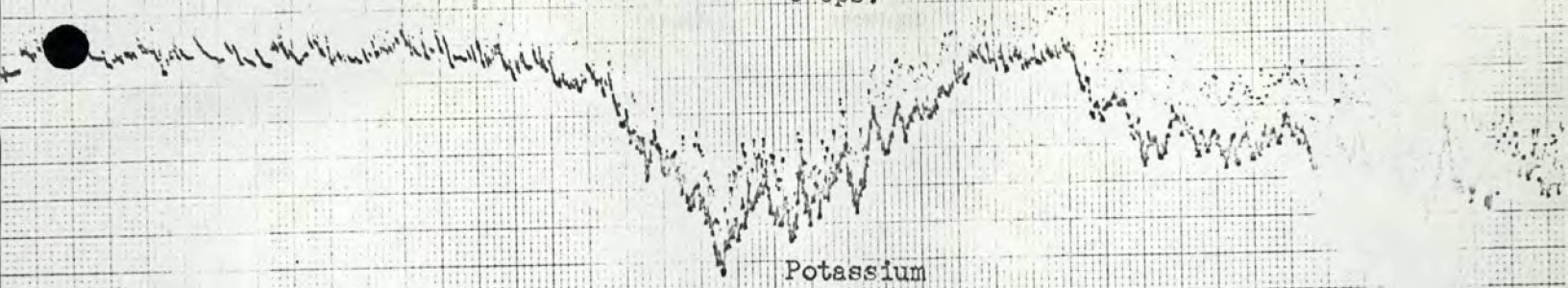

Altimeter
0 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Potassium
100 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Uranium
100 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Thorium
100cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Locality 78-1
Permit No. 78
Line No. 3
Total Count
800 cps.
MECHANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
#6
19690013
Permit 78-70

Altimeter

0 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

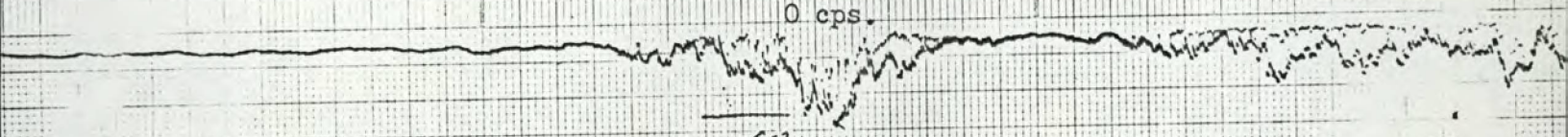


Potassium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

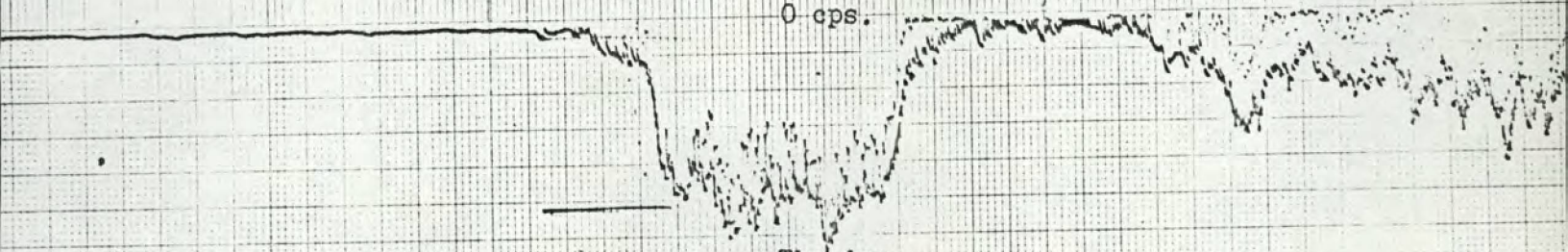


Uranium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

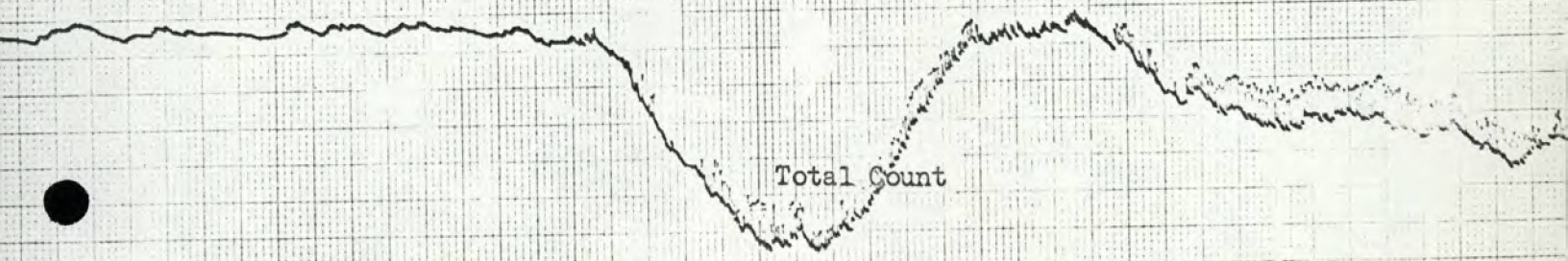


Thorium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.



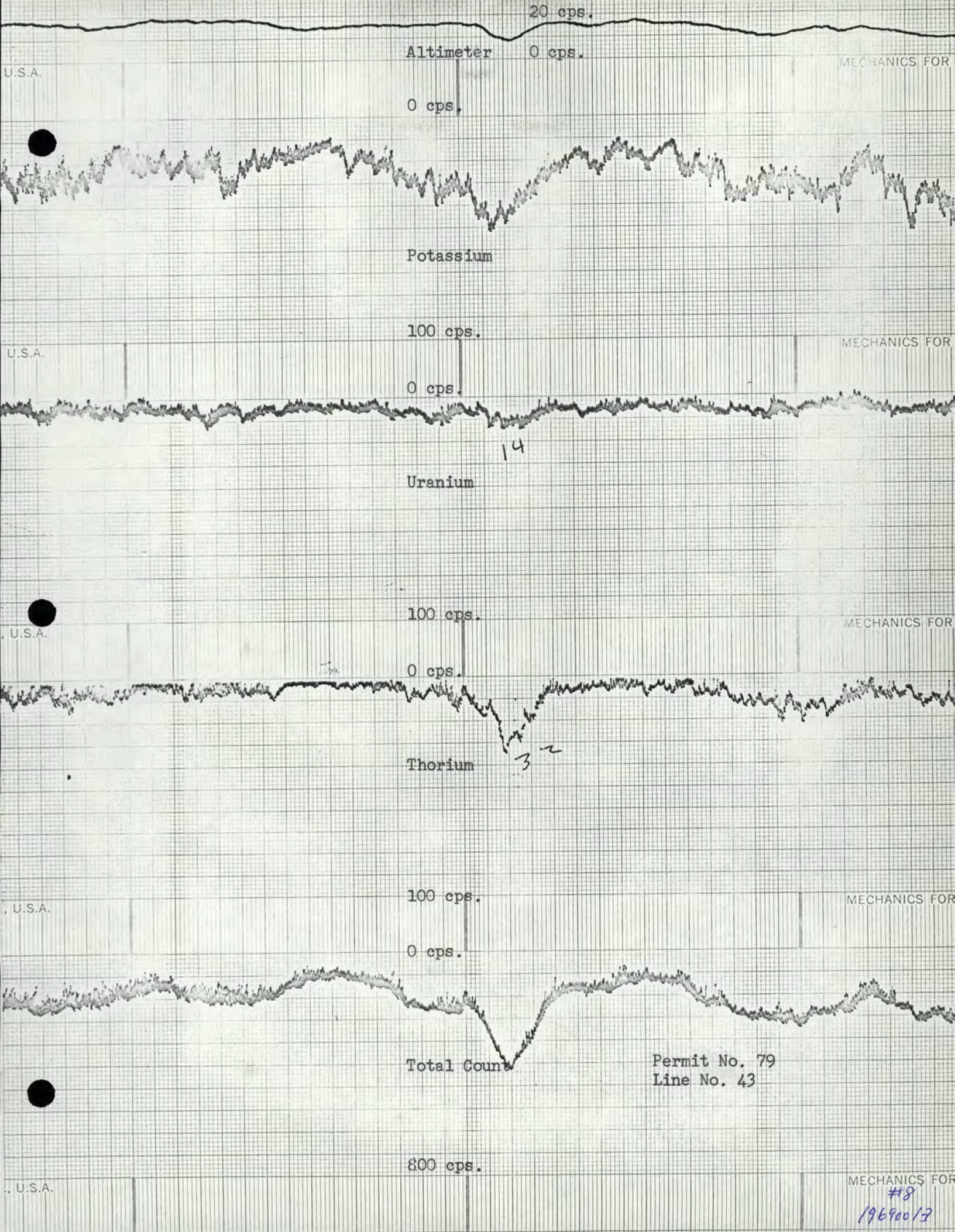
Total Count

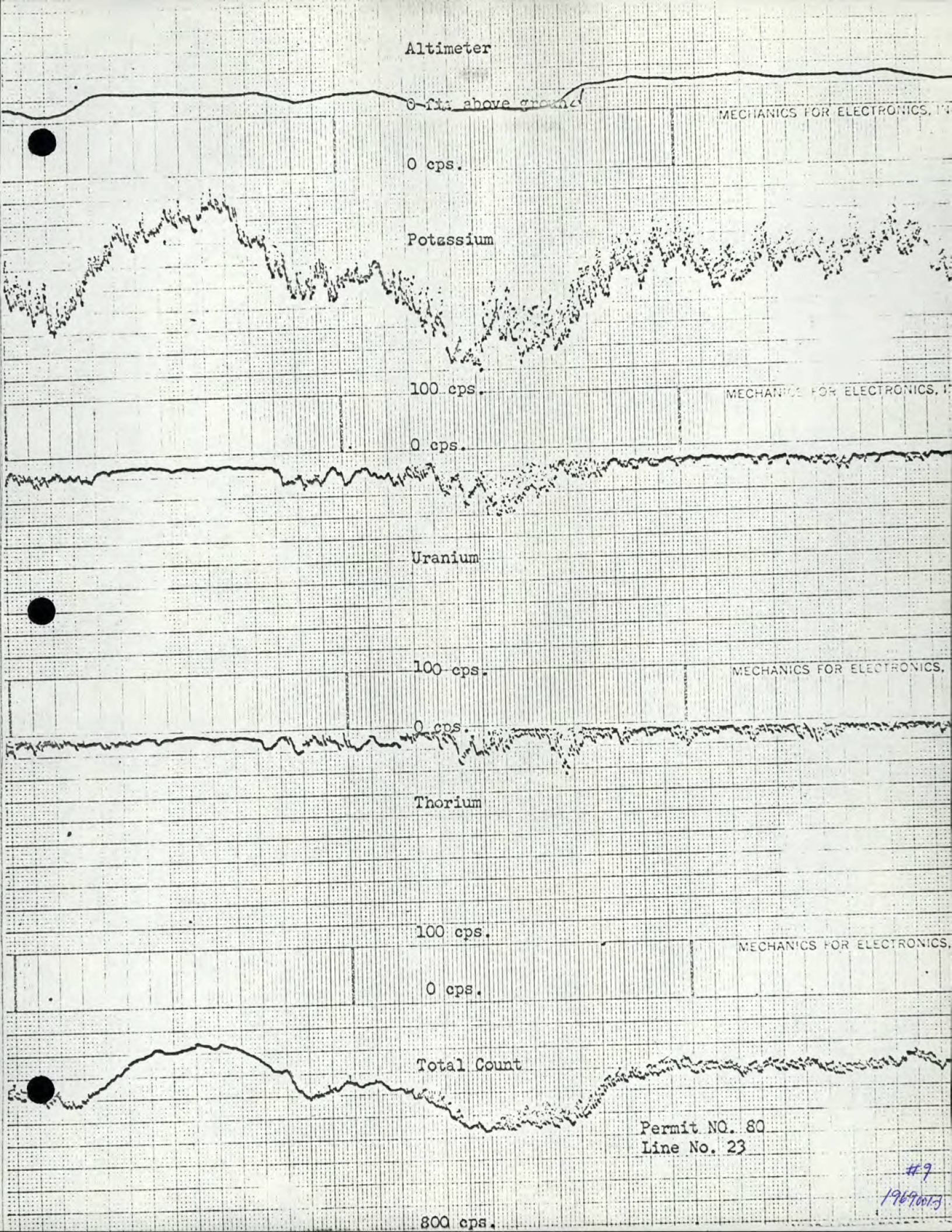
800 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

Permit No. 78
Locality No. 79-2
Line No. 26

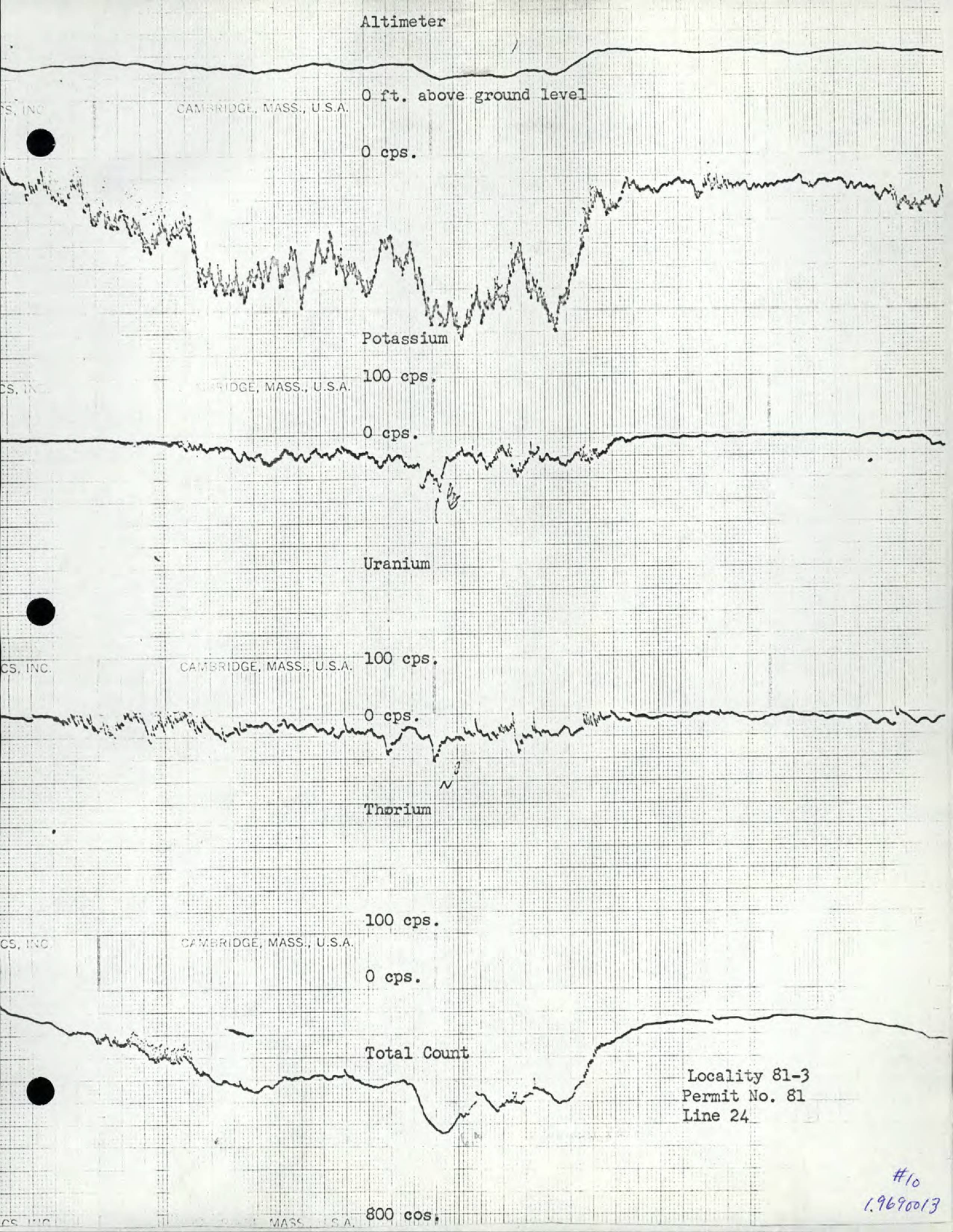
#7
19690013


20 cps.
Altimeter
0 cps.
U.S.A.
MECHANICS FOR
0 cps.
Potassium
100 cps.
U.S.A.
MECHANICS FOR
0 cps.
14
Uranium
100 cps.
U.S.A.
MECHANICS FOR
0 cps.
Thorium
3-2
100 cps.
U.S.A.
MECHANICS FOR
0 cps.
Total Count
Permit No. 79
Line No. 43
800 cps.
U.S.A.
MECHANICS FOR
#8
19690017



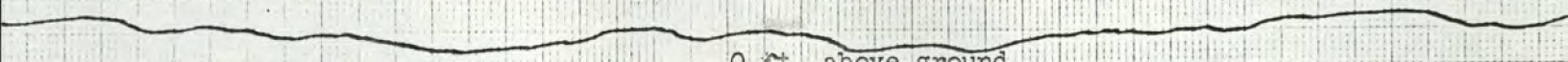
Permit NO. 80
Line No. 23

#9
1969013



#10
1.969013

Altimeter

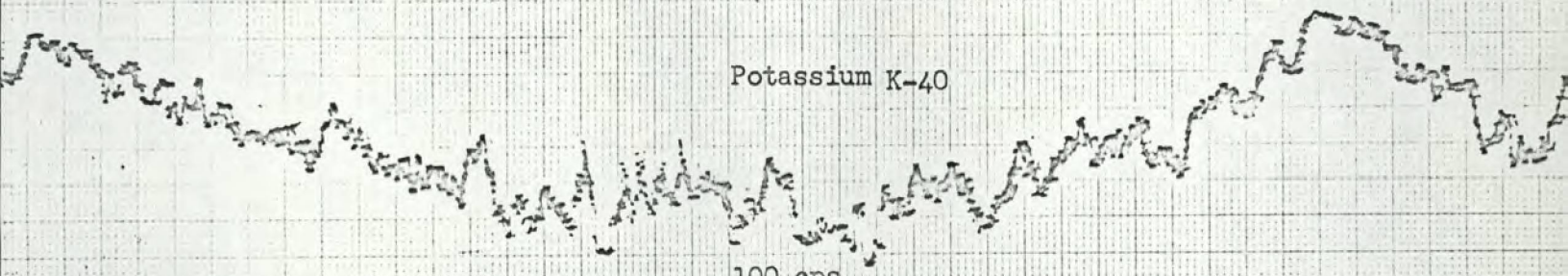


0 ft. above ground

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 c.p.s.

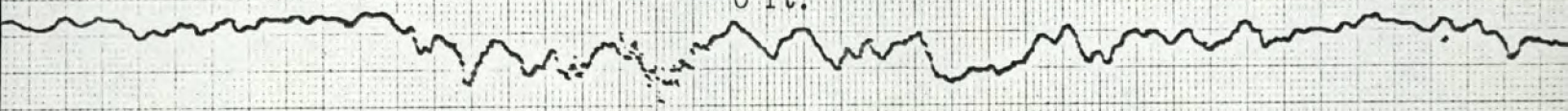
Potassium K-40



100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 ft.

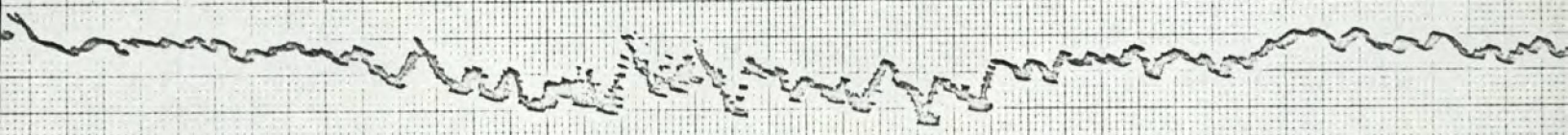


Uranium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.



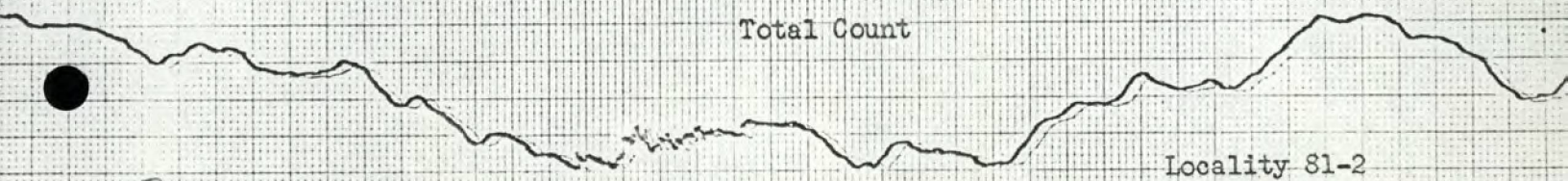
Thorium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

Total Count



81-2

Locality 81-2
Permit No. 81
Flight Line No.33

#11
1969003

100 cps.

81-2

#12

19690013

Altimeter

0 ft. above ground

CAMBRIDGE, MASS., U.S.A.

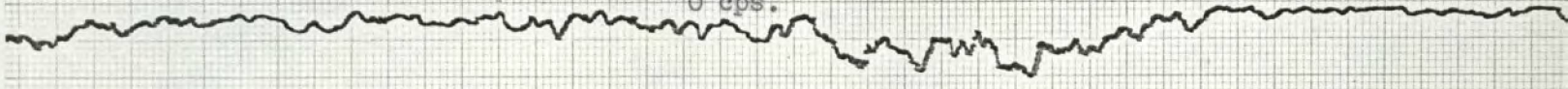
0 cps.

Potassium

100 cps.

CAMBRIDGE, MASS., U.S.A.

0 cps.

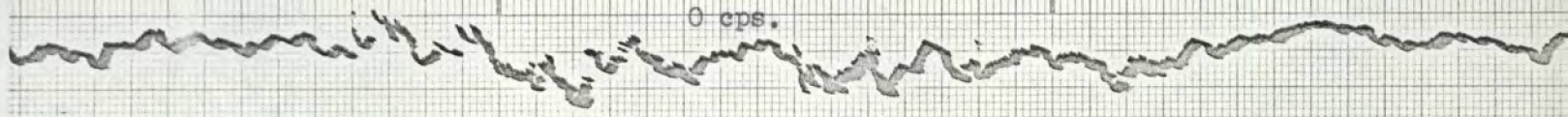


Uranium

100 cps.

CAMBRIDGE, MASS., U.S.A.

0 cps.

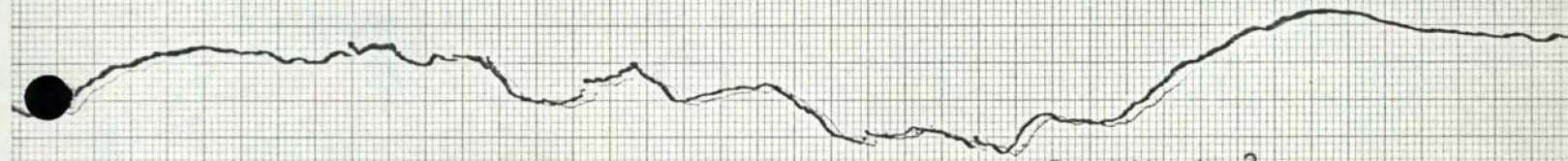


Thorium

100 cps.

CAMBRIDGE, MASS., U.S.A.

0 cps.



Total Count

Locality 81-2

Permit No. 81

Line No. 35

#14

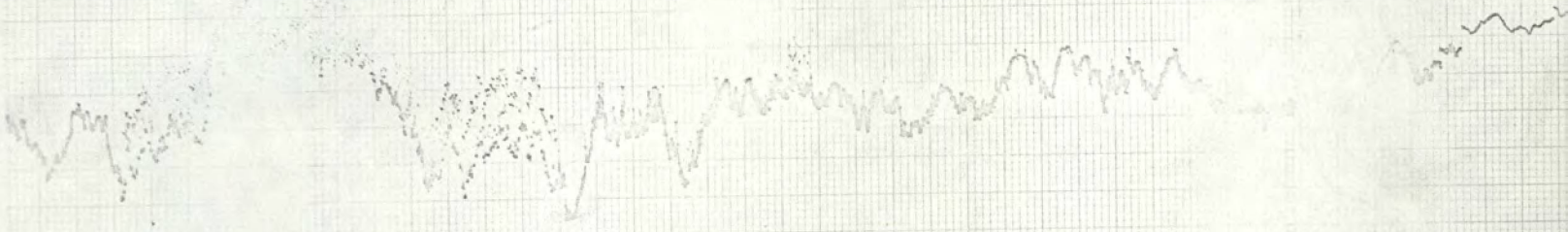
19690013

100 cps.

Altimeter

0 ft. above ground level

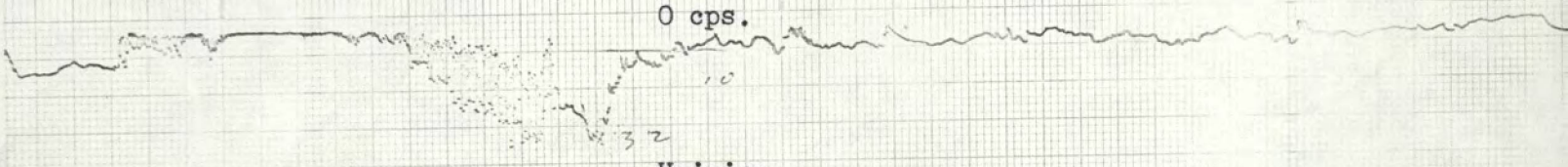
0 cps.



Potassium

100 cps.

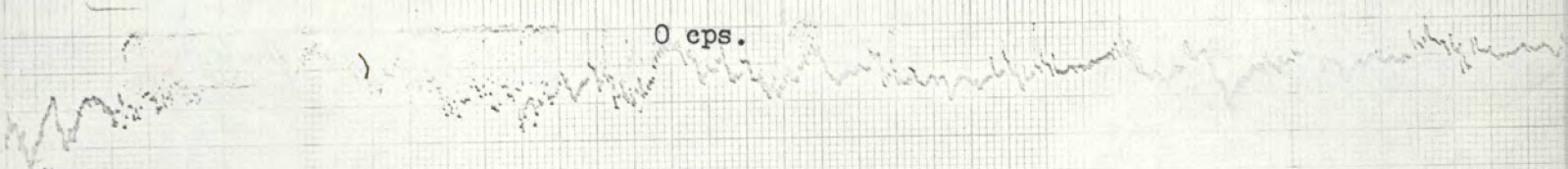
0 cps.



Urinium

100 cps.

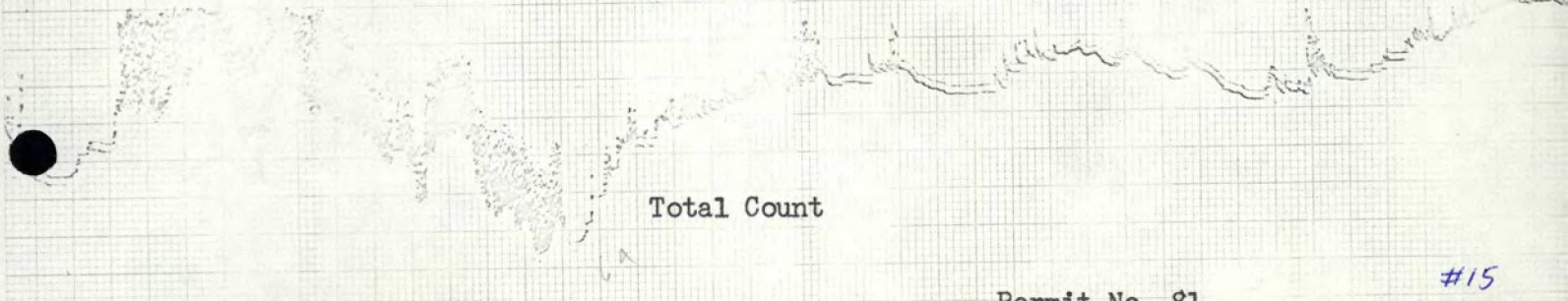
0 cps.



Thorium

100 cps.

0 cps.



Total Count

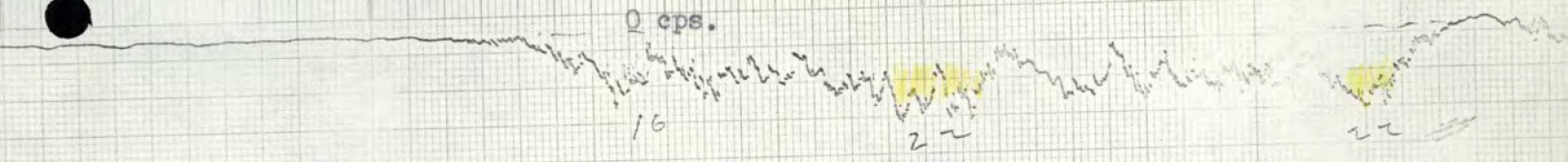
800 cps.

Permit No. 81
Line No. 45

#15
19690013

Potassium

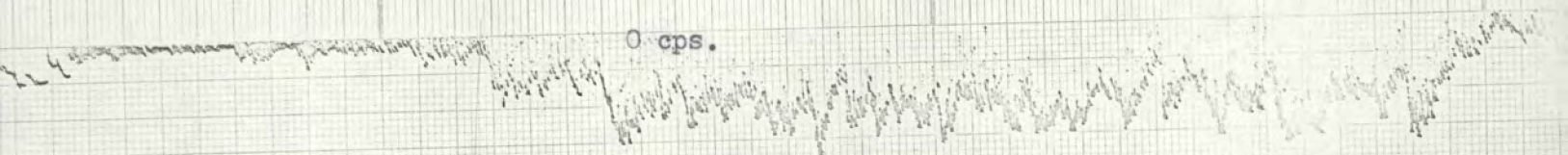
0 cps.



Uranium

100 cps.

0 cps.



Thorium

100 cps.

0 cps.

Total Count

800 cps.

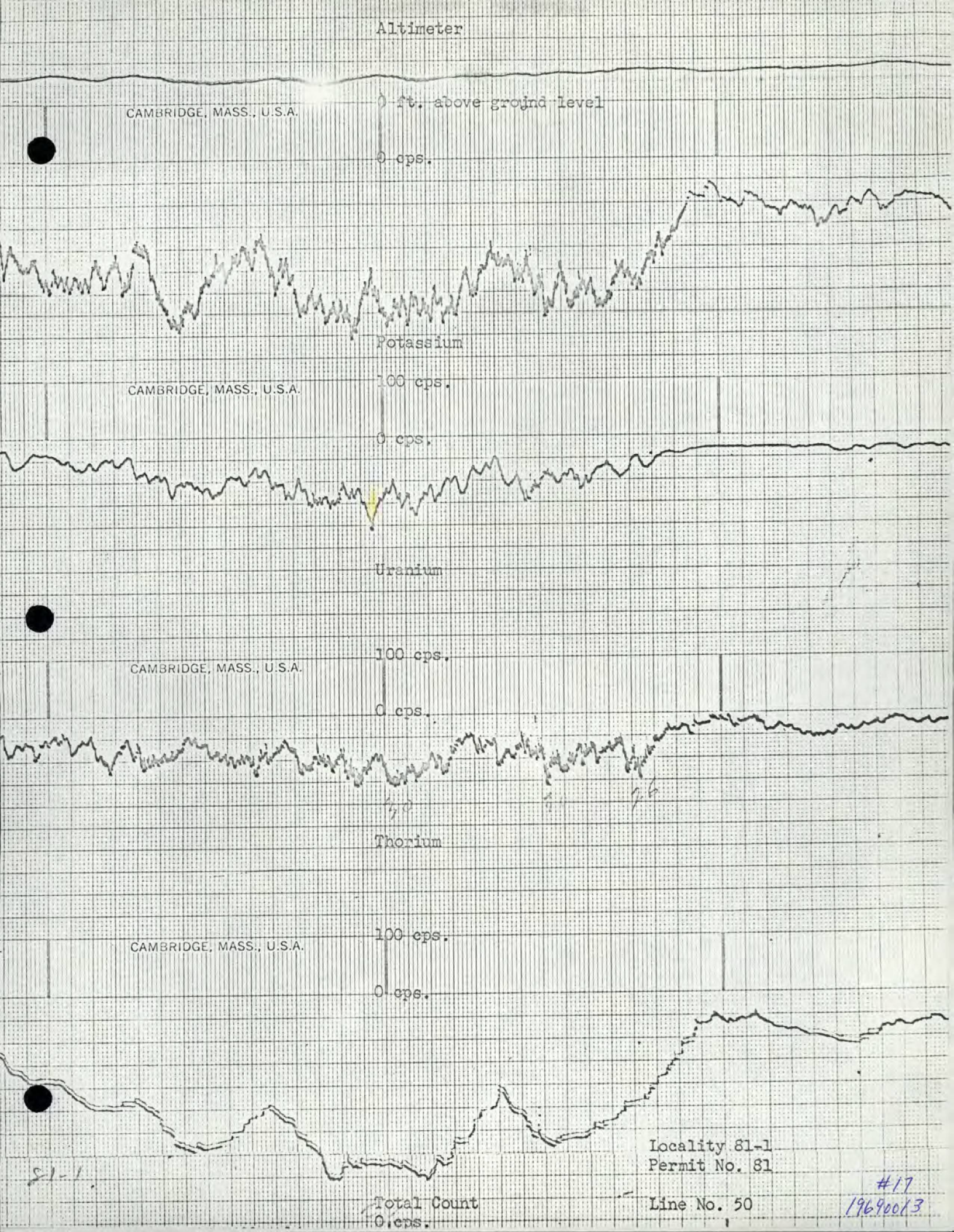
Permit 81
Line 49

Locality 81-1
Permit No. 81
Line No. 49

81-1

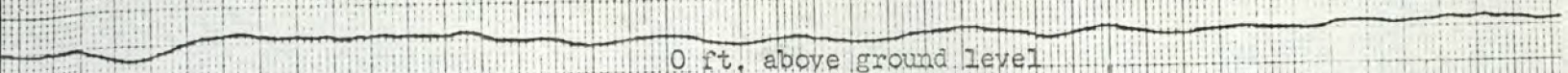
#16

19690013


Altimeter
CAMBRIDGE, MASS., U.S.A.
0 ft. above ground level
0 cps.
Potassium
CAMBRIDGE, MASS., U.S.A.
100 cps.
0 cps.
Uranium
CAMBRIDGE, MASS., U.S.A.
100 cps.
0 cps.
Thorium
CAMBRIDGE, MASS., U.S.A.
100 cps.
0 cps.
Total Count
0 cps.
81-1
Locality 81-1
Permit No. 81
Line No. 50
#17
19690013


Altimeter
0 ft. above ground level
CAMBRIDGE, MASS., U.S.A.
0 cps.
Potassium
100 cps.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Uranium
100 cps.
CAMBRIDGE, MASS., U.S.A.
0 cps.
40
40
40
Thorium
100 cps.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Total Count
800 cps.
Locality 81-1
Permit No. 81 #18
Line No. 51 1969017

Altimeter

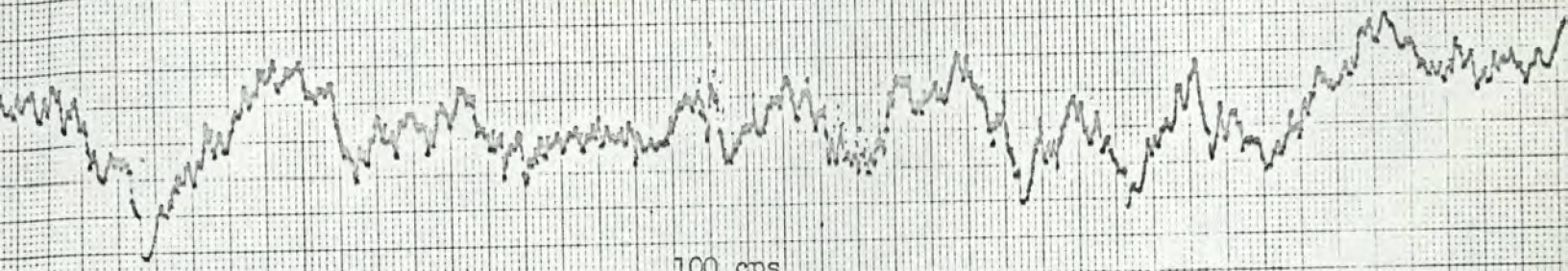


0 ft. above ground level

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

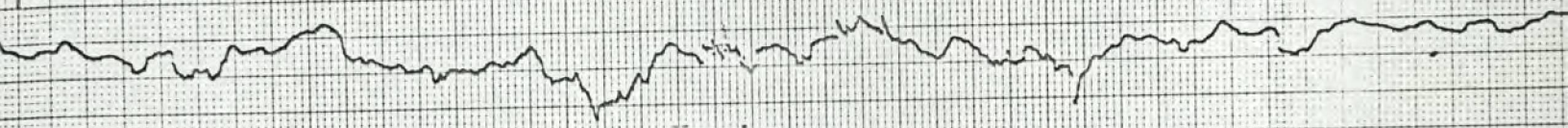
Potassium



100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

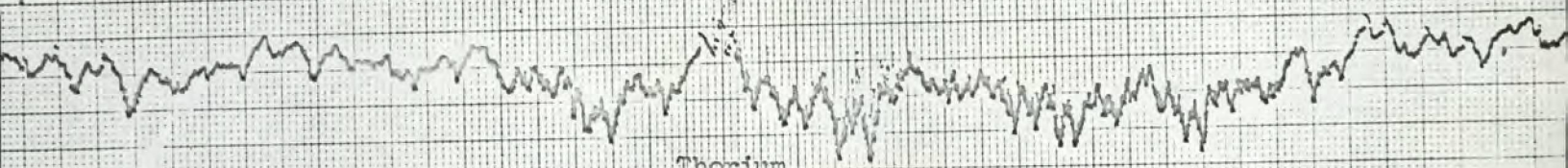


Uranium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

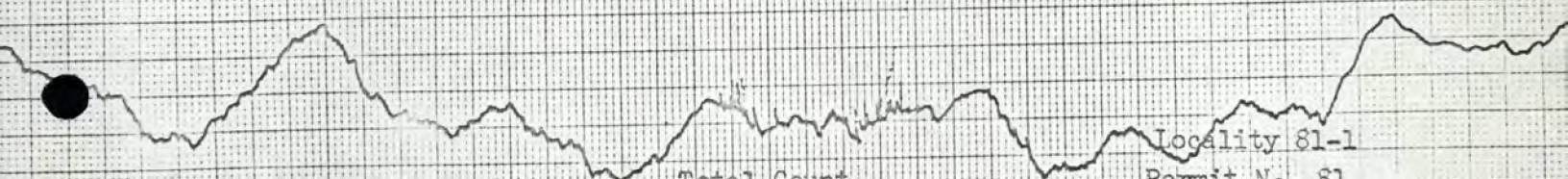


Thorium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.



Total Count

Locality 81-1
Permit No. 81
Line NO. 52

#19
19690013

800 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.


Altimeter
0 ft. above ground level
NICS, INC. CAMBRIDGE, MASS., U.S.A.
0 cps.
Potassium
100 cps.
NICS, INC. CAMBRIDGE, MASS., U.S.A.
0 cps.
Uranium
100 cps.
NICS, INC. CAMBRIDGE, MASS., U.S.A.
0 cps.
Thorium
100 cps.
NICS, INC. CAMBRIDGE, MASS., U.S.A.
0 cps.
Total Count
800 cps.
Locality 81-1
Permit No. 81
Line No. 53
#20
1969.0013

500 ft.

Altimeter

0 ft. above ground level

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

Potassium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

Uranium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

Thorium

100 cps.

MECHANICS FOR ELECTRONICS, INC. CAMBRIDGE, MASS., U.S.A.

0 cps.

Total Count

Locality 81-1

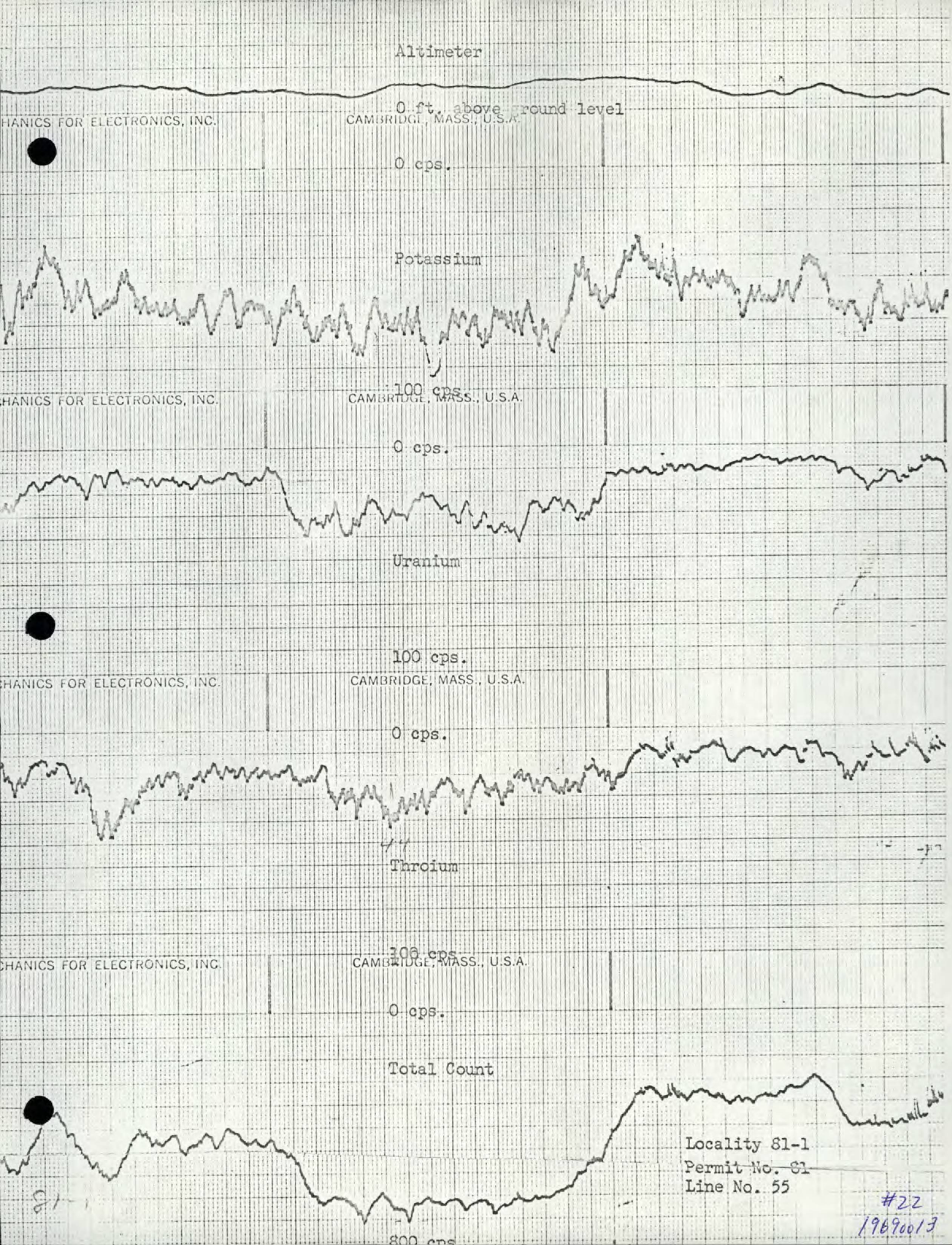
Permit No. 81

Line no. 54.

#21

19690013

800 cps. CAMBRIDGE, MASS., U.S.A.


Altimeter
0 ft. above ground level
HANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Potassium
100 cps.
HANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Uranium
100 cps.
HANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Throium
100 cps.
HANICS FOR ELECTRONICS, INC.
CAMBRIDGE, MASS., U.S.A.
0 cps.
Total Count
800 cps.
Locality 81-1
Permit No. 81
Line No. 55
#22
19690013

R.8 R.7 R.6

T. 126

T. 125

T. 124

81-1 81-2 81-3

PERMIT No. 81

PERMIT No. 80

PERMIT No. 57

DONOVAN LK.

TULIP L.

LE LAND LAKE

N

Flight Line

Anomaly — counts per seconds

U_3O_8 — Gamma radiation above background

CITIZENS PIPELINE LTD.

Helicopter Borne

GAMMA RAY SPECTROMETER SURVEY

Exploranium DGRS 1000

QUARTZ MINERAL PERMIT No. 57, 80, 81 N.E. ALBERTA

JULY 1969

SCALE: 2" = 1 Mi.

PARTY CHIEF: G.M. DUPRE

APPROVED: J.T.COOK P.Geologist

ROVING EXPLORATION SERVICES LTD.

1969 0013 FL 57/80/81

80' 81' 82

R. 5

R. 4

R. 3

TP. 119

TP. 118

TP. 117

PERMIT NO. 79

NORTH CANADIAN OILS LTD.

12 11 10 9 8 7 6 5 4 3 2 1

24 23 22 21 20 19 18 17 16 15 14 13

36 35 34 33 32 31 30 29 28 27 26 25

42 41 40 39 38 37

73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43

N

Flight Line

Anomaly — counts per seconds

U_3O_8 — Gamma radiation above background

CITIZENS PIPELINE LTD.

Helicopter Borne — Exploranium

GAMMA RAY SPECTROMETER SURVEY — DGRS 1000

QUARTZ MINERAL PERMIT NO. 79 N.E. ALBERTA

JULY 1969 — PARTY CHIEF: G. M. DUPRE

SCALE: 2"=1 Mi — APPROVED: J.T. COOK P.Geologist

ROVING EXPLORATION SERVICES LTD.

19690013 FL-79

R. 5 | R. 4 | R. 3

T. 125

T. 124

T. 123

78 -1

78 -2

PERMIT No. 78

CHARLES LAKE

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 15 17 18

19 20 21 22 23 24

25 26 27 28 29 30 31

32 33 34 35 36 37

N

Flight Line

Anomaly — counts per seconds

U_3 O_B — Gamma radiation above background

CITIZENS PIPELINE LTD.

Helicopter Borne — Exploranium

GAMMA RAY SPECTROMETER SURVEY — DGRS 1000

QUARTZ MINERAL PERMIT No. 78 N.E. ALBERTA

JULY 1969 — PARTY CHIEF: G.M. DUPRE

SCALE: 2"=1 Mi. — APPROVED: J.T. COOK P.Geologist

ROVING EXPLORATION SERVICES LTD.

19690013 FL-78

R. 3 | R. 2 | R. 1 W. 4 M.

TP. 119

WYLIE LAKE

52 53 54 55 56 57 58 59 60 61 62 63 64 65 66

77-1

77-2

1 2

BRYANT LAKE

3 4 5 6 7 8 9 10 11 12 13 14

FLORENCE LAKE

PERMIT 77

PERMIT NO. 104

TP. 118

77-3

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

ATHABASCA

LAKE

NORTH CANADIAN OILS LTD.

PERMIT NO. 104

TP. 117

Flight Line

Total count = TC anomaly only

Anomaly — counts per seconds

U_3O_8 — Gamma radiation above background

CITIZENS PIPELINE LTD.

Helicopter Borne — Exploranium

GAMMA RAY SPECTROMETER SURVEY — DGRS 1000

QUARTZ MINERAL PERMIT No. 77 N.E. ALBERTA

JULY 1969 — PARTY CHIEF: G. M. DUPRE

SCALE: 2" = 1 Mi — APPROVED: J.T. COOK P. Geologist

ROVING EXPLORATION SERVICES LTD.

19690013 FL-77