CARNOTITE EXPLORATION
VIXEN MINING DISTRICT
MONTROSE COUNTY, COLORADO

The Purpose

The purpose of the investigation described in this report was to determine the most promising areas for exploration work on a certain group of twenty-four Uranium-bearing mining claims.

Where

This group of twenty-four mining claims lies in Montrose County, Colorado, in the northeast quarter of Township 47 North, Range 17 West, known as the Vixen Mining District. The area is covered by a radius of five miles southeasterly from the town of Uravan, Colorado, which town is a buying point for the Atomic Energy Commission.

Who

The above group of claims is owned by the Uranium Development Corporation, a corporation organized under the laws of the State of Colorado. The field examination was made at the corporation's request, in the Summer of 1952, by the undersigned.

Scope of the Investigation

The investigation described in this report included an examination on the ground of the above group of claims. The objective kept in mind, at all times during the examination was: "Does the evidence on this area indicate production-probability that is sufficiently high to justify major capital expenditures for extended exploration?" In other words, does the evidence on hand indicate that it will pay out?

Conclusion

It is my studied opinion that this area contains important ore bodies of carnotite and allied uranium-bearing minerals. I believe that an exploration program, conducted along the lines described in the body of this report, will discover sufficient tonnage of commercial-grade carnotite to more than justify capital expenditures for such exploration.

Reasons for the Above Conclusions

The reasons for the above conclusions are developed in the following pages. Highly technical terms are avoided, as far as possible, and occasionally simple analogies or comparisons are given in order to make clear the problems or features described. The examination was made, the report was written,

and the conclusions were drawn as an integration of the important and controlling features of profitable carnotite mining. Experience and training can increase the probability of successful exploration, but they cannot guarantee the existence of natural resource treasures below the surface of Mother Earth. This is no alibi on my part. This is simply to assure you that my conclusions are based on the best information I have or could obtain.

Signed Paul H. Keating

Paul H. Keating
June 1952

Following is a list of reasons for the conclusions reached on the area investigated. Maps, drawings, plates, etc., follow, to illustrate various points.

I. The Vixen Mining District is Geographically within the carnotite-producing area of southwestern Colorado. (See Plate 1, which is a map of the carnotite-producing portion of Montrose County, Colorado.)

II. The area within the Vixen Mining District that is owned by the Uranium Development Corporation is Geologically within the carnotite producing section of sedimentary formations. (A brief discussion of the geological occurrence of carnotite in southwestern Colorado is appended.)

III. The most convincing evidence is that low grade "ore" is actually visible at the surface, or in the cliffs, or in the limited underground workings. Surface outcrops, or mineral "stains" of vandium oxide, and/or carnotite, are all over the area. On or about June 7-10, while I was making part of this survey and examination, a bulldozer cleared off about a foot of surface rock and dirt. In less than a day four men shoveled off from the exposed small area ten tons of ore. This was loaded into a truck, and

taken to the mill of the Vanadium Corporation of America, about ten miles distant. It assayed .22% U_3O_8, and 1.77% V_2O_5. This is above minimum "ore" demands by the VCA.

There are several other similar areas within a radius of a mile which are of equal promise from surface indications. THESE AREAS SHOULD BE EXPLORED BY a bulldozer or wagon drill, and in some cases, by diamond drill. All of the areas are on the claims owned by the corporation.

IV. Important production of carnotite has been made from properties in every direction from the Corporation's holdings in that area. The famous "Forty-Five-Ninety" Mine, (labeled on the U. S. G. S. Topographic "Uravan" Quadrangle), is about 4,000 feet from the present underground workings of the Corporation, and approximately half a mile west of the southerly portion of the Corporation's holdings.

Since the position of carnotite deposits is, in effect, horizontal, over a given area, there is no reason to assume that such deposits have all been exposed, and mined to exhaustion. The unexplored area is as potentially productive as areas already producing.

To summarize, up to this point:

I. The area is geographically favorable.

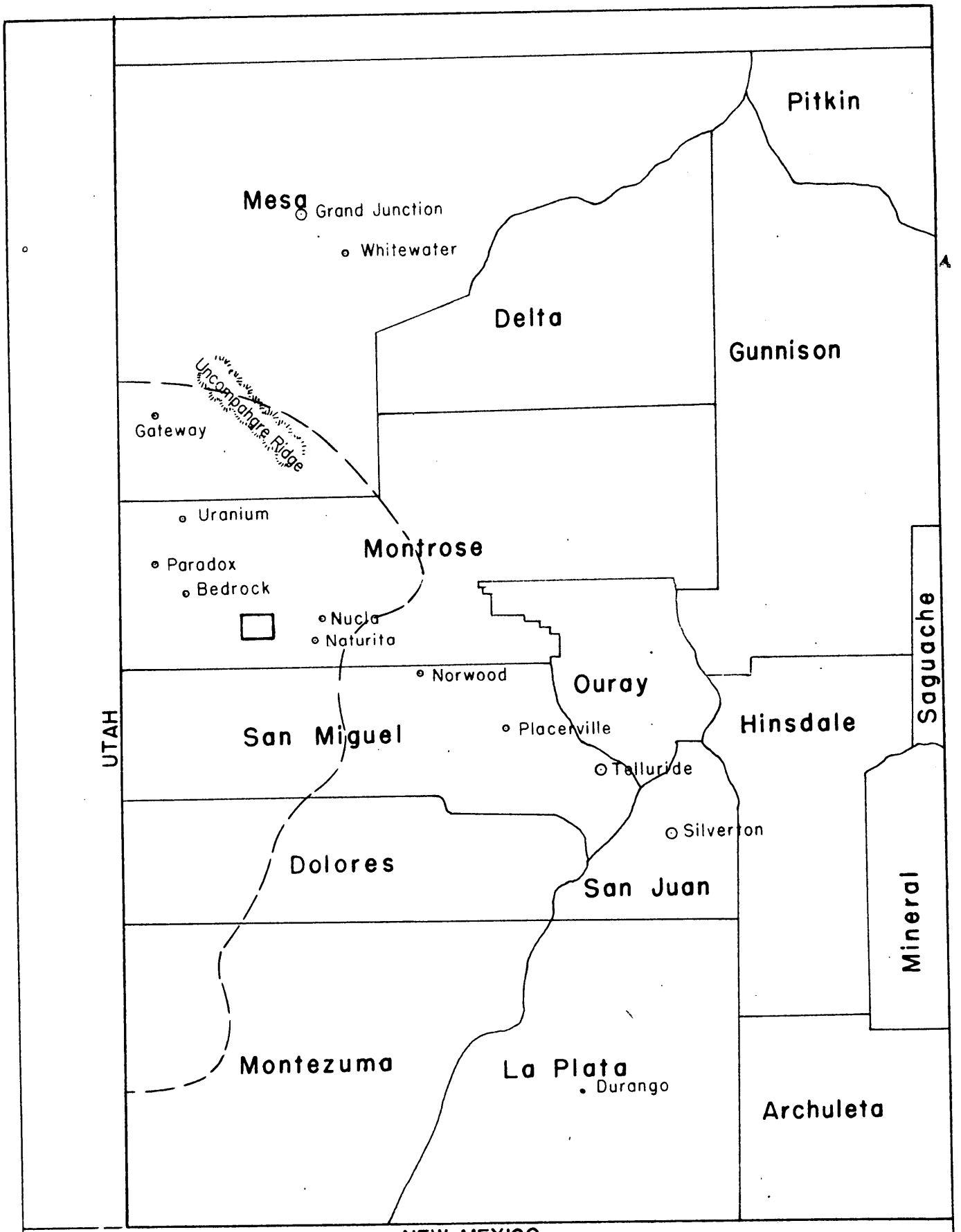
II. The area is geologically favorable.

III. The area has shipping-grade ore showing on the surface, and is producing from surface and underground workings at this time.

IV. The area is within boundaries of important production of the present and past, in all directions and at short distances.

The U. S. G. S. is now drilling exploration holes on the property. (The term "area" refers specifically to the claims owned by the Corporation.)

It seems to me that the foregoing data is sufficient to justify the first sentence of my conclusions: ". . . . . this area contains important ore bodies of carnotite and allied uranium-bearing minerals."



Map of Colorado, showing approximate boundary of carnotite producing area (dashed line), and position of the area described in this report.

GEOLOGY OF CARNOTITE

IN MONTROSE COUNTY, COLORADO

The estimated two billion years of the Earth's history as a planet has been broken down into a number of more or less separate intervals, which for convenience are called Geologic Periods, or Ages. These periods are separated from each other by evidences of marked changes in climate, or life forms, or erosion as land areas, or by signs of having existed as sea bottom.

This sequence of Geologic Periods is known as the "Geologic Column, and the various intervals along this column are given certain names.

The particular interval from which most carnotite production is obtained in the western part of the U. S. is known as the Jurassic Period. It lasted from about 150,000,000 to 120,000,000 years ago. (It is interesting to note that Uranium-bearing minerals serve as a clock by which these very ancient events can be dated with remarkable accuracy.)

During that 30-million year interval there was being deposited in the western part of the country a series of sedimentary beds which are called the "Morrison formation".

The singular texture and stratigraphy of, and the processes by which the Morrison was deposited, have an important bearing on

the occurrence of carnotite as we find it today. Hence a brief description of these features will lend more meaning to the conclusions and recommendations of this report.

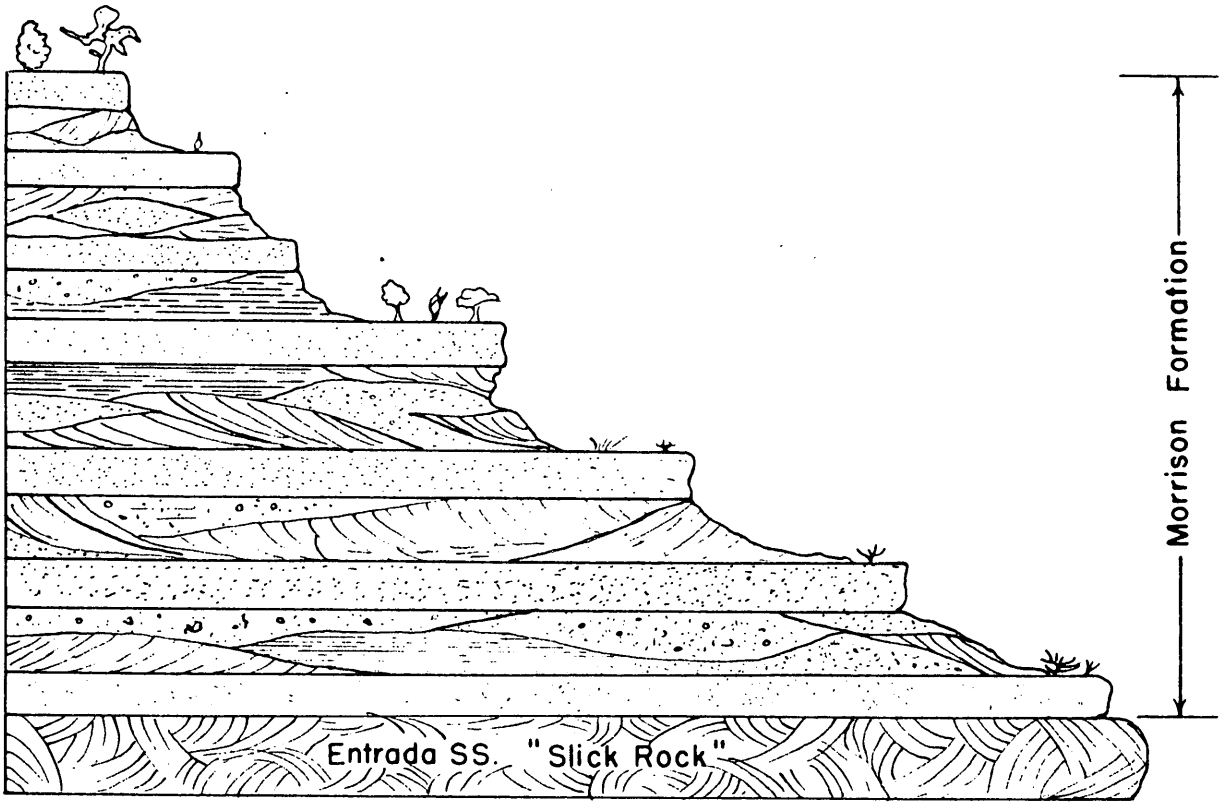
PHYSICAL APPEARANCE OF THE MORRISON

The Morrison formation consists of irregularly-shaped beds of red and white sandstone, red and blue clay, sometimes sandy clay and shale, and occasional beds of red to white to yellowish sandstone of considerable thickness and of wide extent.

These heavier beds of sandstone do not erode as rapidly as the softer material between them. Hence they form a series of benches or "rims".

The deposits of softer material between these heavier beds of sandstone are somewhat erratic in size and area extent. They pinch and swell unpredictably. There is every evidence that they were formed as low sand bars in a very shallow sea or as very flat beaches.

The Jurassic Period of 30 million years duration was probably a period of somewhat lush vegetation, of mild climate, and with prevailing winds from the West. Dinosaurs wandered over what is now Montrose County. The Rocky Mountains had not yet been formed, and that area was probably covered with a set of conditions somewhat similar to the Everglades in Florida of today.



Idealized cross-section of the Morrison (Carnotite-bearing) Formation. The benches or rims are the heavier and rather continuous layers of sandstone described in the preceding pages. The intervening, and generally softer layers are made up of lenticular deposits of cross-bedded sandstone, clay, and sandy shale-and-clay.

The heavier bench-forming layers of sandstone are from 15 to 30 ft. thick. The intervening softer beds are 20 to 50 ft. thick, in the area investigated.

Carnotite may be found in any one of these vertical steps. The step-like topography makes portions of each rim accessible for exploration by wagon- or diamond-drill methods.

We are fairly certain of all this from fossils, the typical cross-bedding of sand bars now exposed, and the remains of ancient trees or logs now replaced by carnotite.

In many localities there is a remarkable parallelism of a group of logs within a small area. They are found near the top of a rounded sand bar, and often so arranged as to indicate that they were washed ashore to the high water mark of the seas of their day.

THIS IS IMPORTANT TO AN EXPLORATION PROGRAM for the following reasons:

When logs are discovered, either in outcrops along cliffs, or in underground tunneling, they can be mapped and studied for the re-discovery of that ancient shore line, within reasonable limits. In general, the highest grade ore occurs in these logs. It is a thoroughly tenable assumption that the shore lines of the Jurassic Age accumulated driftwood of that time, just as do the present shore lines of today. Hence, on any given stratigraphic level the re-discovery of an ancient shore line increases the chances of finding additional replaced logs or driftwood.

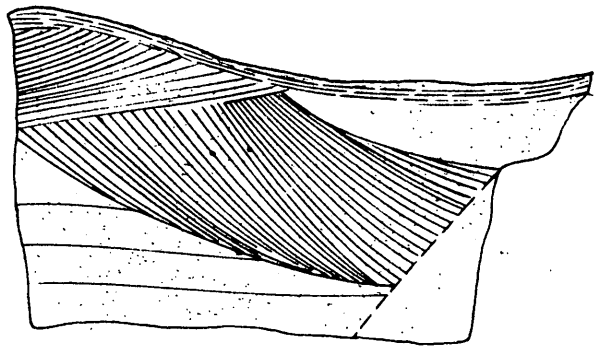
Let us refer back to the benches or rims described above. These benches, or rims, represent periods in which the entire area was covered by relatively deeper water. A lot of things can happen in 30 million years, and this interval of Jurassic time

witnessed a half-dozen or more "cyclic repetitions" of similar recurring conditions.

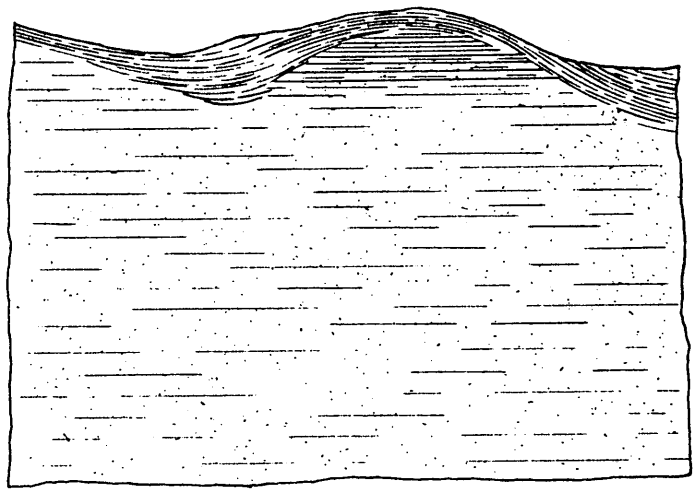
During a period of shallow seas, exposed sand bars and small low islands above the high water level, vegetation developed, died off, and the driftwood was washed ashore. Then the entire region sank below low-tide level, and only sand was washed into the sea from the continental mass of that time. This continued for a long long time, and this ever-increasing layer of sand finally became one of the "occasional beds of red to white to yellowish sandstone of considerable thickness and of wide extent".

The area then rose again to form a very shallow sea, with sand bars, low flat beaches, similar to those of the first such interval. And, vegetation again appeared, and the process was repeated. This occurred at least half a dozen times or more.

Please keep in mind that such a series of beds would not necessarily be uniform in the degree to which they would be compacted. The clay beds would immediately become compact, tight, and impervious to circulating ground water. The sand bars, and beach sands would have variable amounts of open spaces between the sand grains, through which subsequent ground water could seep. Some of these sandy masses would eventually become cemented into a hard, dense, and impervious sandstone. Others



Typical detail showing the variability of a small exposure, approximately 10 ft. long by 7 ft. high. Any one of these beds could be an ore-bearing deposit, depending upon its porosity or sponge-like properties.



would remain more or less unconsolidated, --- and these beds would act as a sponge. Buried logs would always act as a sponge. Thus:

As subsequent ground water seeped and crept its way through these minute pores or openings in the ancient sand bars, and into the logs occasionally lying on them, any uranium-bearing minerals in solution in that water would have space in which to come out of solution.

You can perform a simple kitchen experiment to confirm this: Place a fine-grained sponge in a saucer containing salt water. If the top of the sponge is above the level of the solution, you will find, in a very few hours, that tiny grains of salt begin to form on the top of the sponge.

The sponge represents a bed of porous sand, or perhaps a more blotter-like log. The salt water represents ground water containing uranium-bearing minerals.

The above comparison is sufficiently close to give an idea of the formation of a carnotite deposit. There must have been circulating ground water carrying uranium-bearing salts; there must have been spaces between the grains of sand in ancient beaches and sand bars to allow this water to circulate; and there must have been room in the more highly porous masses of those buried sands for the water to evaporate and leave the mineral we are now producing as carnotite deposited in that porous bed (or log).

If this picture is essentially correct, (and I believe that it is), we have here an important indicator for spacing of exploratory drill holes. Specifically:

There is greater probability of finding ore bodies in areas where the beds of sandstone are loosely consolidated. Drill operators become very skillful in recognizing the type of ground they are putting a hole into. When a dozen holes within a small area uniformly show dense, hard, "tight" sandstone, and impervious clay beds, the spacing should be stretched out, until more porous beds of sandstone are found.

A porous bed of sandstone does not mean that it contains ore. BUT IT DOES MEAN THAT CONDITIONS FOR CARNOTITE DEPOSITION ARE FAVORABLE. In such a local area, the drill holes should be spaced even as close as 20 ft. apart.

EXPLORATION, DEVELOPMENT, AND PRODUCTION

Certain equipment and installations are either a present need or will be in the very near future, as well as limited technical and accounting personnel. These are described briefly.

A broad but rather specific pattern of exploration development is proposed, in which I have kept in mind the topographic and geologic limitations of the ground itself.

The last section is a report on labor and personnel problems, and other features pertinent to actual production of carnotite from the Corporation's claims.

MECHANICAL EQUIPMENT

The most important item of equipment needed for exploration and development of the area investigated is a "wagon drill". A "wagon drill" consists of a gasoline engine and an air compressor mounted on a heavy-duty truck body. There is a frame upon this same truck body in which is mounted a jack-hammer, ---an air-operated drilling tool.

This jack-hammer drilling tool can quickly and cheaply drill holes from 40 to 60 ft. deep. The truck upon which it is mounted can carry this exploring drill to any point accessible to a four-wheeled vehicle. In conjunction with a bull-dozer, almost any area can be thoroughly explored to a depth of 60 ft. or more, quickly and far more cheaply than by any other existing method.

Under this general heading of mechanical equipment is included certain other installations, to wit:

a. There should be an "office" building, - or tent, of some sort, in which could be kept on-the-ground records, maps, surveying equipment, time-keepers records. This "office" would require a drafting table, filing cabinets for records and maps, a wood-burning monkey stove, and minor furnishings. A 10 x 20 tent, stretched over a 2 x 4 framework with a floor would be adequate as a beginning.

b. Contingent upon adequate discoveries of new ore bodies, by means of the wagon drill exploration over the area, I would recommend that living quarters be established for one resident (family). This should be built in such a way and place that it would become a nucleus for a full-time resident crew of workmen engaged in production.

c. A reasonable amount of work should be done on the wonderful spring near the southerly end of the Blackfoot claim. This flow of clear cold water is a priceless asset to the property, --but it isn't very sanitary at this time. In hot weather, one becomes so famished for water at any price, that wild animal tracks around the spring, or dead bugs floating in it are of no consequence. However, for resident personnel this spring should be cleaned out, enclosed, and conditioned for normal human consumption.

TECHNICAL HELP

For exploration, development, and mining operations, there should be a resident engineer on the ground. There are many reasons why this is essential.

For example, on several of the claims now owned by the Corporation, there have been drilled perhaps 40 or 50 or more diamond drill holes. The only existing "record" of what was found is in the memory of the driller himself. These holes were drilled before the Corporation acquired the property, but the fact remains that that much expensive drill hole is now a dead loss.

Some of these old drill holes might be cleaned out and examined for radioactivity with a Geiger counter or some similar instrument. But in any event, for sound management, these old and all future holes should be mapped, and the elevation of the top of the hole recorded.

A detailed map of existing underground workings must be made. Simple chemical equipment should be available and used by the resident engineer, for making qualitative tests on the cuttings from wagon drill or diamond drill operations.

Existing corners of the claims owned by the Corporation should be marked with metal plates upon which the data should be stamped. Lost, missing, or destroyed corners should be re-established as far as possible. Discovery cuts should be marked with metal tags similar to those on the claim corners.

In many places the benches or rims described in the geological report on this area are obscured by soil, rock and detrital matter. Hence there is need for a stratigraphic survey and map, and such a project should be undertaken soon.

This stratigraphic map would not be expensive nor take long to make. But it would immediately outline the areas to be explored by the wagon drill, and the areas that only a diamond drill could effectively reach. In other words, it would get the proper tools working in the right places.

Another highly important function of a resident engineer would be the physical preservation of the wagon drill holes, regardless of the showing. The reason is this: If it becomes necessary or desirable to explore a deeper "rim" or suspected ore horizon, a wagon drill hole say 50 ft. deep already represents about $200 in drilling costs for the diamond drill.

There are many other functions that a resident engineer could perform, into full-time employment. They need not be expanded upon any further here.

ACCOUNTING HELP

There is scarcely a self-supporting individual in this country today who is not aware, by March 15th of each year, of the accounting pomplexities of our society. A corporation's problems and responsibilities along this direction are enormous.

Up to the present time the operating crew has been small, and the accounting has been done, --- at the operation site at least --- by Mrs. Leo Fagan, wife of the mine superintendent. This has been a gratis service on her part up to this time.

The time lag in mail between Nucla and Denver may require nearly a week for a request to be made and a reply to be received. When a workman quits, the Superintendent has paid him off, personally, and then waited for re-imbursement from the Denver office. When a machine part breaks and immediate replacement is urgent, the Superintendent finds a new or usable such part, buys it, and is later reimbursed.

The picture is a bit extravagant. The Superintendent's function is directing exploration, keeping development ahead of production, and then directing that actual production and delivery of the ore to the buying point. Keeping time books, withholding income tax, social security tax, workmen's compensation insurance, and a host of other accounting and purchasing-agent functions, are simply too much for one man to do effectively.

If the Corporation plans on any expansion of Exploration, Development, or Production of carnotite, a qualified accountant-purchasing agent and mine-level business manager is an immediate need.

I would recommend that before the accounting system is established that discussions with the local ore buying agencies take place. The cash received from these ore-buying agencies is the only thing that will keep the Corporation in business. Hence:

Mutually-understandable accounting methods are a <u>must</u>.

The accountant engaged for this post should be authorized to issue pay-roll checks, purchase-orders, and should be given authority in proportion to responsibility, within the limits of his office.

EXPLORATION PATTERN

By "EXPLORATION" is meant finding the ore and determining the approximate size and grade of any given body that may be located.

The unpredictable manner in which carnotite occurs in buried sand bars, logs, et al, is best described as "at random".

THE GREATEST PROBABILITY of finding a horizontal ore body of this nature lies in drilling exploratory holes in a systematic network, --- like a checkerboard pattern.

I would recommend that as far as physical accessibility will allow, and for a first-effort, that wagon-drill holes be put down on 100-ft. horizontal intervals, in a straight line. These holes should be carefully located by the resident engineer before drilling starts. As a beginning run, 11 holes would explore a line 1000 ft. long. The depth of the holes may vary a few feet due to surface irregularities.

The resident engineer should determine from the "stratigraphic map" mentioned above, the stratigraphic elevations of all ore-stains, discovery deposits, and/or mined deposits within 300 to 500 ft. on each side of the proposed line of drilling. These elevations, plotted on cross-section paper, would establish a "zone of occurence", based on visible evidence or mining experience. THEN, plot the profile of the existing surface along this "first-run" exploration line. The drilling depth, to the bottom of the zone of occurence can be read directly from

such a map. The wagon drill holes should, in every case, exceed this depth by at least 5 ft., up to its total depth capacity. For local variations in surface elevations, which make the zone of occurence too deep for the wagon drill, I would recommend that the wagon drill go to its maximum depth anyway, and leave the hole prepared for the diamond drill to complete the exploration.

In the event that any ore is found along this line of "first-run" exploratory holes, I strongly recommend that the line be completed, and that a parallel set of holes be completed, --- and further still that a third parallel set of holes be completed, before closer drilling is attempted.

For the wagon drill, this amount of drilling is cheap, and rapid, and may give the resident engineer much evidence upon which to plan future work.

Then, closer-spacing of holes is in good order around the original exploration holes showing ore or "stain".

This procedure would outline an area 200 ft. wide and 1000 ft. long, --- somewhat less than a fifth of the area of a single claim. The presence of highly porous beds, even though they are barren should be recorded by the driller. Closer spacing of holes around such porous beds would be warranted later on.

FURTHERMORE: Whatever ore may or may not be found in such a first-run set of holes, this means that that particular area

has been explored ONLY WITHIN A GIVEN VERTICAL INTERVAL. The very nature of the Morrison Formation, in its series of rims and benches may be barren in a given local area on one rim, and still retain potential production on another stratigraphic plane.

TO SUMMARIZE:

1. I recommend that a set of 30 to 35 holes be drilled, in a regular checker-board network, on 100-ft. horizontal centers, and to such a depth as to include the surrounding "zone of occurence" referred to above.
2. I would recommend for this first-run exploration, the flat covered by the "Fairy King" be worked on first.
3. After the proposed network is completed, the wagon drill (or diamond drill), should return to or near such holes as showed ore or ore-stain, and outline the extent and thickness of each such body.

DEVELOPMENT PATTERN

By "DEVELOPMENT" of a mineral deposit is meant: "Making a body of ore physically accessible, so that it may be taken out of the earth, relatively free of waste rock, and be quickly put into economic and industrial channels". A "developed" ore body, of any mineral resource, implies that it is accessible and simply awaiting the whim or need of the owner to tram or hoist it out of Mother Earth and channel it into waiting markets. "Development" also infers a measured knowledge of how much ore, and of what grade and value, may lie underground.

The Development program of any discoveries that may be made by the Exploration work depends largely upon the topography of the area concerned.

Any ore body is reached by either tunnel (horizontal), shaft (vertical), or incline (sloping) entry.

The nearly-horizontal position of carnotite deposits requires nearly-horizontal workings for all cases. Hence a tunnel, within reasonable distance of a discovery, the entrance to which tunnel is in the face of a cliff, is the preferred approach to "development". An incline is next in choice. A shaft, with levels branching off from it is generally least desirable, and the most expensive to operate.

Development tunnels to be driven toward any discovered ore bodies should be started so that when the ore is reached it will be in the "back" (roof), wherever feasible.

However: This suggestion is limited to the practicability and good judgment of the operating personnel.

PRODUCTION

Until the check for an ore shipment is deposited, all of the foregoing is little more than wishful thinking. Beyond the mechanical techniques and equipment for mining ore bodies, there are human problems that cannot be solved by an arbitrary decision from the management of this or any other present day industry.

No matter what production policy may be chosen, --- IT IS GOING TO COST MONEY TO GET THAT ORE OUT OF THE GROUND. The less it costs, per pound of uranium or vanadium, the greater will be the profit in the operation.

The current wage scale is very high at this time, for common labor as well as for skilled miners and craftsmen. Competition for manpower is keen in the carnotite area of western Colorado. There are two jobs open for anyone who will take manual labor. The prevailing rate is from $1.75 to $2.50 or more per hour, with overtime bonuses. However, despite this relatively high rate of pay, the $14 to $30 per day buys manual labor. IT DOES NOT BUY A DYNAMIC OBJECTIVE INTEREST ON THE PART OF THE WORKMAN IN THE JOB HE IS DOING. In other words, in most cases, the laborer is "working for $1.75 an hour", rather than "working for the company".

This is not intended as an indictment of Labor. It is simply a realistic view of conditions as they are, And, these conditions are vital to industry in general AND TO CARNOTITE MINING IN PARTICULAR.

On this investigation I saw quite a number of miners and muckers working, at several localities in the region. A shovelful of muck would be thrown into the truck or the mine car. To the laborer it was simply "a shovelful of muck", and the fact that some of it was ore and some of it was waste meant nothing to him.

It occurred to me then that if he could be sure that he was getting a fair "cut" out of that shovelful of muck, it would immediately create that objective interest in him --- an interest that $1.75 per hour cannot buy. It would immediately become a matter of concern to him to reach down and throw out a piece of waste rock, or to reach farther and make sure a chunk of good-looking ore got into the truck.

Now, let me repeat: IT IS GOING TO COST MONEY TO GET THAT ORE OUT OF THE GROUND, regardless of method or policy.

It is my belief that more ore of better grade will be taken out of the area and in less time, under a policy that stimulates personal concern of the laborer, than by any other approach.

I believe the solution lies in leasing and granting work contracts. This does not mean that the corporation is to develop an ore body and then invite a group of miners or contractors to walk in and skim off the cream. A thoroughly equitable leasing program, or work-contract arrangement can be developed that will have many advantages to both labor and the corporation.

To wit:

1. It would provide the personal incentive to produce more and better grade ore as rapidly as possible, --- and to select for shipment all of it, with care and interest.

2. It would relieve the corporation of most of the payroll, time-keeping, tax-withholding, insurance of various kinds, and a host of other fixed charges. Contractors would furnish their own tools, equipment, powder and other supplies, and transportation. Use of company-owned equipment would be paid for at fair rates and mutually satisfactory terms. It would end the labor shortage and the occasional "temperamentalism" found among mining personnel. There is competition between laborers themselves for what they term "good leases".

There isn't a great deal of itinerant labor in the carnotite area. The reputations and records of performance of most of the personnel are known to most of the operators.

Such a policy as is suggested above will again allow management to become a bit "choosey", --- an attitude that has been out of vogue for several years.

RECAPITULATION

It is my firm belief that:

1. There are substantial bodies of carnotite and vanadium-bearing minerals in many places and at several levels, lying within the limits of the Corporation's property in the Vixen Mining District, Montrose County, Colorado.
2. That these bodies can be discovered by systematic prospecting with a wagon drill and/or diamond drill.
3. What the uranium and vanadium production from these ore bodies can be most profitable on a leasing or work-contract basis of operation.

In closing this report I wish to add one more recommendation:

The three phases of mineral production should be kept "in balance". Exploration, Development, and Production should be co-ordinated at all times. After the discovery of half a dozen separate pockets has been made, drifting or sinking to them should be started, so that as one area is being exhausted, another will be accessible when the end-point of the first is reached.

Signed:

Paul H. Keating

Paul H. Keating
Golden, Colorado
June, 1952

CONCERNING THE MAP ON THE FOLLOWING PAGE

AND HOW TO READ IT

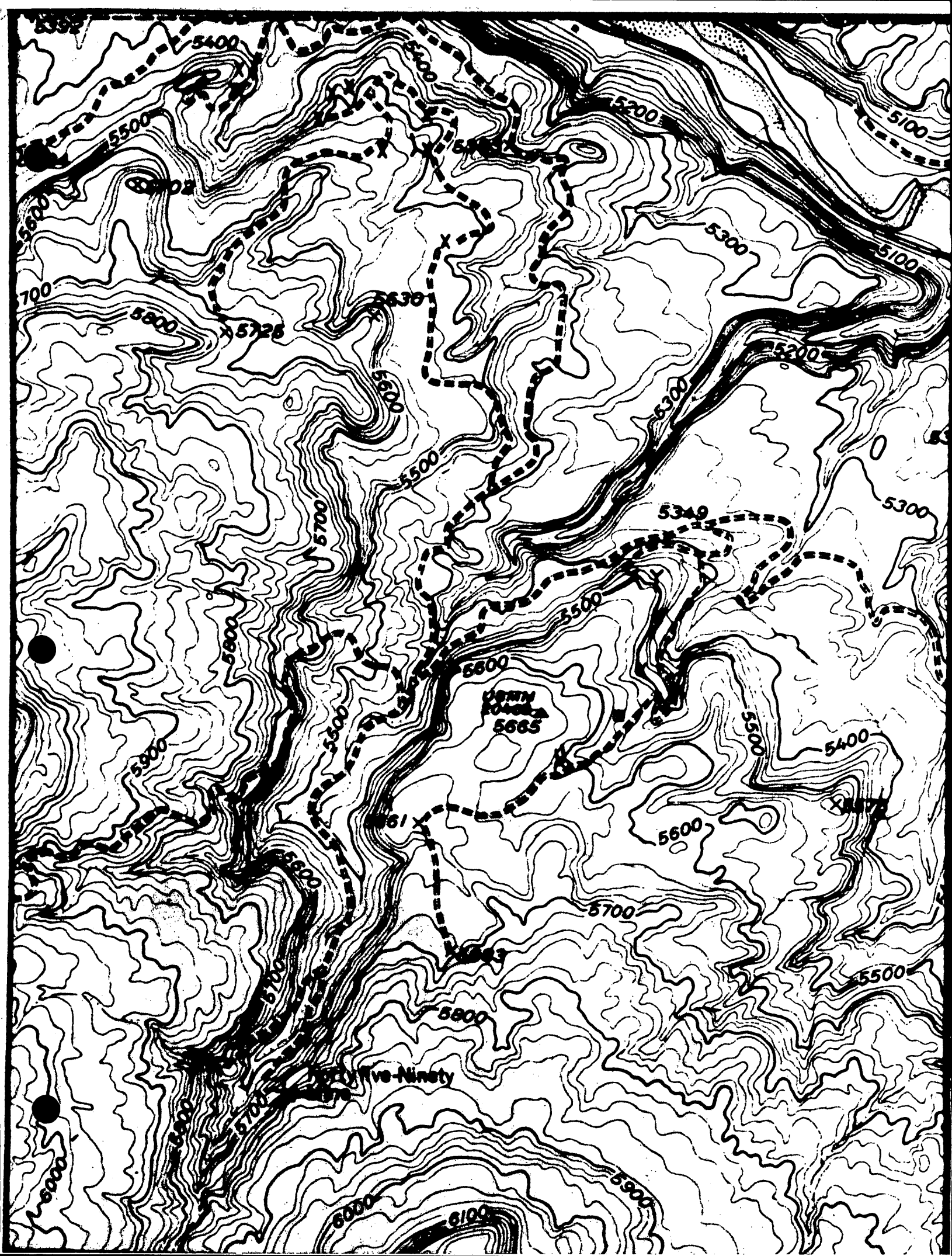
On the following page is a photostatic enlargement of a portion of the United States Geological Survey Topographic map of the "Uravan Quadrangle". This photostat-map includes all of the claim area owned by the Corporation in the Vixen Mining District, Montrose County, Colorado.

THE SCALE IS VERY CLOSE TO 1" ON THE MAP EQUALS 1000' ON THE GROUND. Minor distortions are unavoidable around the edges of the picture, but they have no significance for the purposes of this report.

The wandering lines on this map are "contour lines". They are, in effect, "THE SHAPE OF THE SHORE LINE, IF THE SEA SHOULD RISE TO ANY GIVEN POINT". If, for example, the sea should invade this area to what we now consider as 5600 ft. elevation, the "shore line" would have a certain outline, or "contour". If the sea then increased its invasion to 5700 ft. elevation, the shore-line of that day would have another "contour", or outline. The lines on the map are at 20-ft. intervals, and each line represents a "shore-line".

When these "wandering lines", referred to above, are close together, --- this indicates that the ground is steep. When they are widely spaced, it indicates that the slope is gentle. When they are irregularly spaced along any given direction, it indicates that there are irregular slopes in the area.

THE OCCURENCE OF CARNOTITE IS VITALLY TIED IN WITH THE QUESTION OF "HOW DEEP", for any given deposit. The "wandering lines" on this map are vital information or "control data". They outline areas that are "possible-to-probable" uranium-producing zones, according to the mechanical limits of exploration equipment now available.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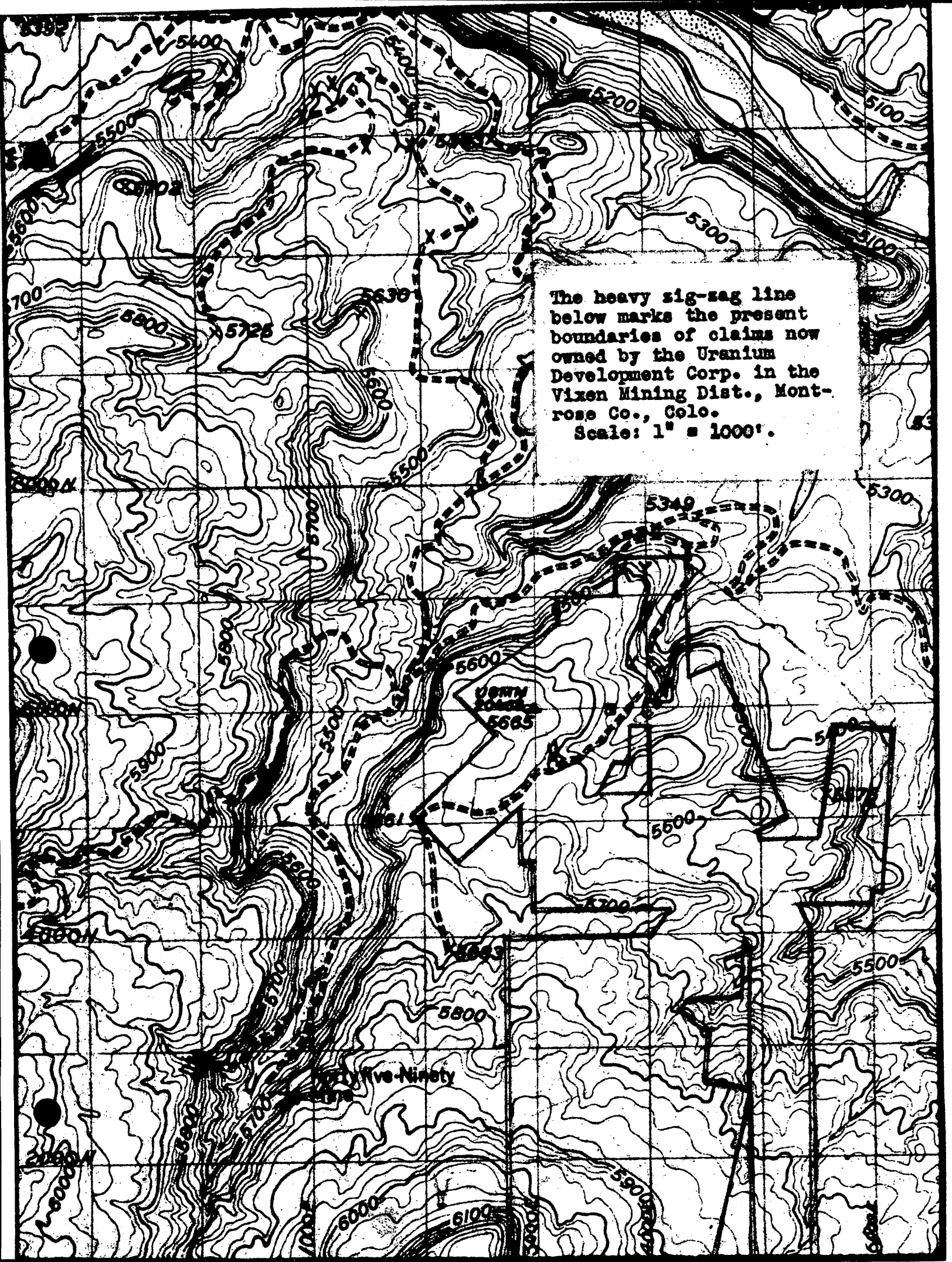
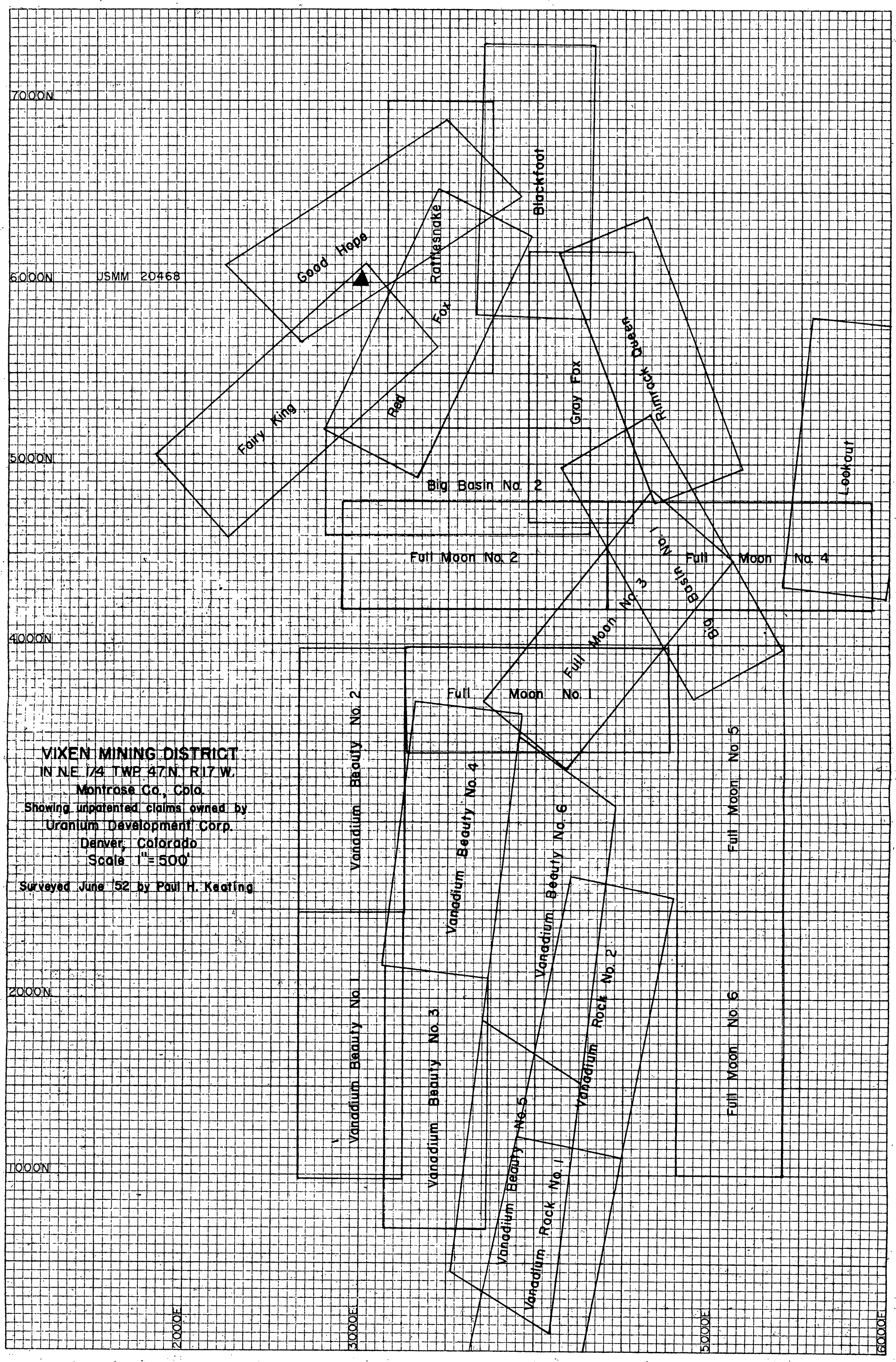

The heavy zig-zag line below marks the present boundaries of claims now owned by the Uranium Development Corp. in the Vixen Mining Dist., Montrose Co., Colo.
Scale: 1" = 1000'.
5400
5500
5200
5100
5300
5630
5726
5600
5700
5349
5665
5900
5800
6000
6100
Forty Five-Ninety

UNPATENTED MINING CLAIMS OWNED BY THE URANIUM DEVELOPMENT CORPORATION, IN THE VIXEM MINING DISTRICT, MONTROSE COUNTY, COLORADO, AS OF JUNE, 1952

Name of Claim	Filed in Montrose County Court House Book	Page	Date
Gray Fox	201	287	7/4/29
Rattlesnake	201	289	7/4/29
Big Basin No. 1	201	571	3/15/40
Big Basin No. 2	201	572	3/15/40
Fairy King	213	206	10/ 8/40
Red Fox	213	210	10/ 8/40
Rim Rock Queen	213	211	10/ 8/40
Blackfoot	213	212	10/ 8/40
Good Hope	213	213	10/10/40
Lookout	213	314	10/ 8/40
Vanadium Beauty No. 1	335	539	12/13/49
" " No. 2	335	540	12/13/49
" " No. 3	335	541	12/13/49
" " No. 4	335	542	12/13/49
" " No. 5	335	543	12/13/49
" " No. 6	335	544	12/13/49
Vanadium Rock No. 1	335	549	12/13/49
Vanadium Rock No. 2	335	550	12/13/49
Full Moon No. 1	343	357	2/17/51
" " No. 2	343	358	2/17/51
" " No. 3	343	359	2/17/51
" " No. 4	343	360	2/17/51
" " No. 5	343	361	2/17/51
" " No. 6	343	362	2/17/51

All of the above 24 claims are shown on the map included in this report. Except for a very narrow sideline conflict between the Fairy King (fifth from the top in the above list), and a patented claim No. 20468, these claims are without conflict with other previous filings and/or discoveries, except with themselves.

KEUFFEL & ESSER CO., N. Y. NO. 359-5L
10 X 10 to the inch.
MADE IN U.S.A.



Sept. 15, 1952

From:

URANIUM DEVELOPMENT CORPORATION, 620 E&C Bldg., Denver, Colo.

To:

Defense Minerals Exploration Administration, New Customs House, Denver, Colorado.

Re:

Application for assistance in exploring the Blackfoot Group of carnotite mining claims in the Vixen Mining District, Sections 10 and 11, Twp. 47N, Range 17 W, in Montrose County, Colo.

CONTENTS

A. Letter of transmittal, with minor alterations of estimates submitted on original application in July, 1952.

B. (In pocket of this cover) The Following maps:

i. Map of the Underground workings on the Blackfoot mining claim, at 1" = 20'; This map shows, in color, the areas that have produced or are producing commercial grade carnotite. It also shows the direction and inclination of the "rolls" in these productive areas

ii. Map of the most physically-accessible portions of the Blackfoot Group for wagon-drill prospecting. On this map is outlined the various "rims" or stratigraphic horizons where they are evident in field examination.

iii.) iiia.) This map (iii), and a tabulation (iiia) are stapled together. Map iii shows the co-ordinates at which a drill hole is proposed for exploration. Most of these drill holes have an estimated figure beside them to indicate the effective depth necessary for thorough exploration. These depths were estimated from a series of isopach sections made across the topography, which reconciled stratigraphic occurence for with topographic variations.
Map iiia is a tabulation based on co-ordinates of Map iii. In the top and left margins of this tabulation are the co-ordinates of the Blackfoot Group. If the co-ordinates of any point on this tabulation are selected, and transferred to the "Map iii", the drilling depth is indicated on either or both of these maps.

C. Two or three blank pages for notes and comments by the professional staffs of the Federal Agencies concerned.

URANIUM DEVELOPMENT CORP.
620 E&C Bldg., Denver, Colo.

Defense Minerals Exploration Administration,
New Customs House, Denver, Colo.

Re: Application for assistance in exploring for Uranium ores on the Blackfoot group of claims, Vixen Mining District, Montrose County, Colorado.

Gentlemen:

Herewith is submitted such additional data and maps as have been requested, or indicated as pertinent to the above application.

In the field work incidental to assembling these data, minor changes in our original application should be made. This is in order to better adjust available equipment, labor policy, and production continuance with the requirements of your Administration and other agencies whose approval is necessary. To wit:

1. We would prefer to convert our entire drilling exploration program to "wagon drill" methods. There is now available in the district new and superior equipment that can explore to 120 ft. or more, any area accessible to a truck, with the aid of a bull-dozer now and then. This more modern equipment renders our own "wagon drill" obsolete. Furthermore the new equipment can explore these greater depths cheaper, faster, and with more technical skill in the matter of taking samples than our own machine.

2. You may discount from our original application, various items of buildings, spring-conditioning, machinery-repair, and diamond drilling.

3. It is our desire to enter a "short-form" contract, in such a manner that the assistance obtained will NOT involve any salvage problems of materiel upon completion of the contract.

4. We wish, and are able to, furnish the use of a bull-dozer in order to make accessible the areas outlined on the accompanying map of proposed exploration. This item we should like to retain in our estimate.

5. A "resident engineer" is an absolute "must" in this program. On our application this man's services must be numerous, varied, accurate, and highly skilled, both technically and in personnel management problems. A revised estimate of the services of such a man is $400 to $450 per month for the duration of the exploration period.

6. The revised estimate herewith is on a basis of 16,100 ft., of wagon drilling, at 80¢ per ft. $ 12,880.00
(Estimated time, 6 months, allowing for weather, maintenance, and contingencies).

Resident engineer, (par. 5 above)	2,700.00
Sample sacks (est. at 13.50/100)	135.00
Sampler's wages ($60/wk. - [redacted] 25 weeks	[redacted] /1.500.00
Bulldozer & operator; 3 hrs./day, 150 days, $10/hr (including operator's wages)	4,500.00
Accounting, reports to pertinent agencies, $50/mo.	300.00
Wooden plugs and metal tags for holes drilled for permanent record in the field,	250.00
Contingencies, (subject to review as vital to the operation and on-the-ground-decisions)	1000.00
	$23,265.00
	(23,265.00)

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7. The Corporation (applicant) is prepared to furnish its required share of this project in any acceptable terms required by the Defense Minerals Exploration Administration and/or other agencies competent to specify such terms.

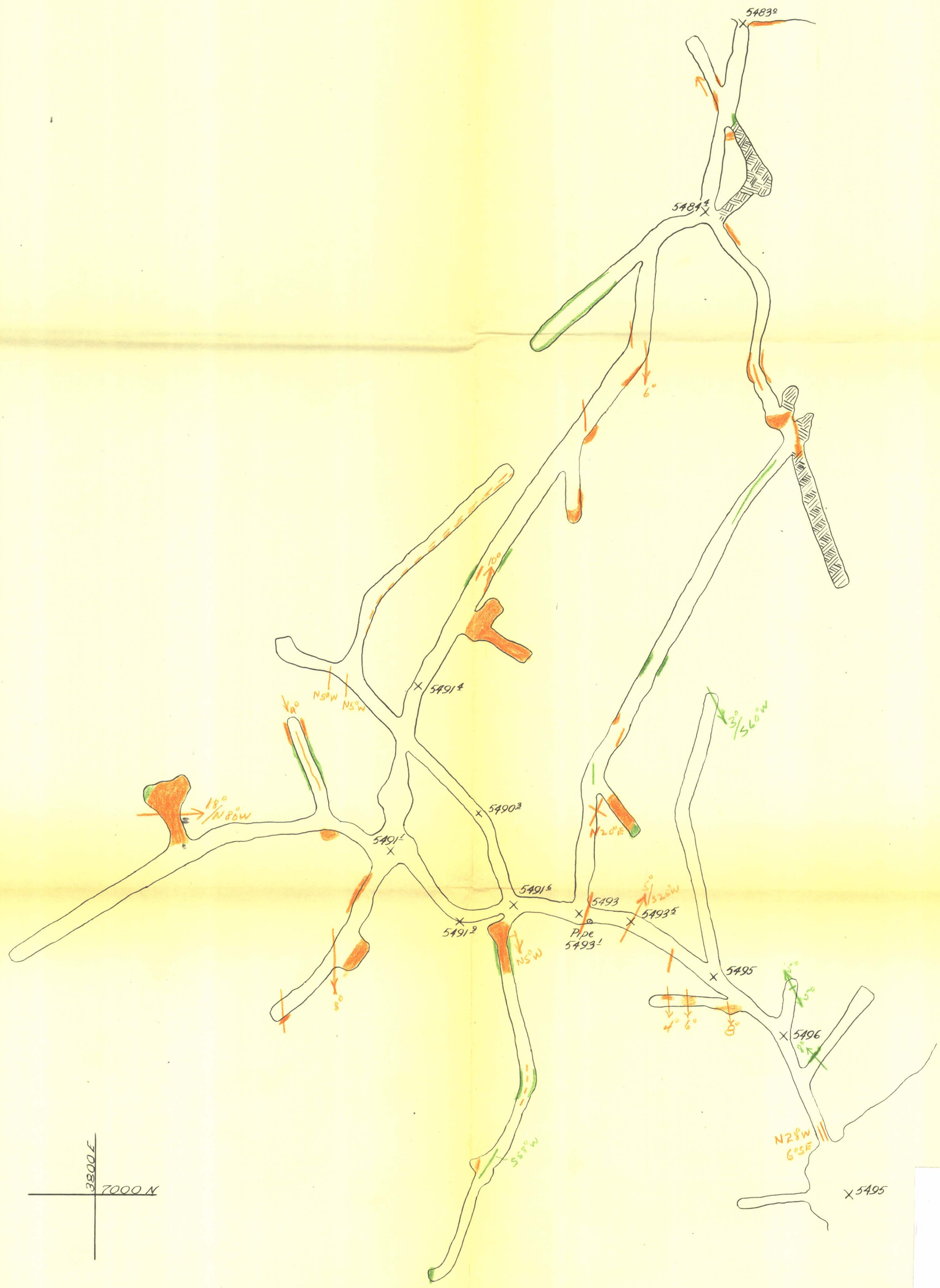
URANIUM DEVELOPMENT CORPORATION

By Paul H. Keating 9/15/52
Paul H. Keating
(Managing Director,
Uranium Development Corp.)
Denver, Colo.).

NORTH \ EAST	2000E	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950	4000	4050	4100	4150	4200	4250	4300	4350	4400	4500
7200																																																		
7100																																																		
7000																																																		
6900																													65		67		58			48														
6800																										48		60			74			55		43		35												
6700																										68			75		78		62			39			31										
6600																								74		78		77			76			51		34		28											
6500																					66		75			87			78		72		64			30			30										
6400																					84			90		95		85			70			45		22		38											
6300																					115		108			100			86		77		58			30			35										20
6200																		121			117			110		103		95			83			60		44		48											19
6100																			120		115		112			108			92		81		65			40			40										19
6000																		120			X			107		117		101			77			49		30		20										21
5900																			115		106		107			110			88		72		50			18			x										38
5800																		120			102			100		97		81			58			28		x		x							28			38	55
5700																			106		94		85			73			57		45		29			x			x		40		56			79		69		63
5600														120		120		110			82			70		60		53			42			34		x		x			70			80		87			72	62
5500											119		114			106			89		72		66			58			51		45		x			x			x		77		80			83		73		60
5400								103			100			94		88		76			68			63		60		55			47			x		x		x			70			70		76			53	41
5300							95			94		93		85		74			70		67		68			70			56		x		x			x			x		52		40			21		20		x
5200				105			92		92			90			79		68		67			66			73		79		74			x			x		x		x			32			31		30			18	x
5100		105			92		88			87		87		80		65			66		66		74			83			73		66		61			53			35		23		29			37		27		26
5000		100		92			86		85			84			74			82			90			94		99		85			63			57		52		42			28			34		38			29	40
4900					84		83			84		87																													33					45				28
4800				80			79		83																																38									33
4700							80																																		44									
4600																																																		
4500																																																		
TOTALS	205		277	176		603		363	265		660		279	367		321		696	566		1310		695	781		1593		766	721		1193		447	379		483		211	171		507		205	215		518		189	210	535

GRAND TOTAL 16,107 ft.

398-SL KEUFFEL & ESSER CO.



BLACKFOOT MINE,

Vixen Mining District

Montrose County Colo.

Scale: 1" = 20'.

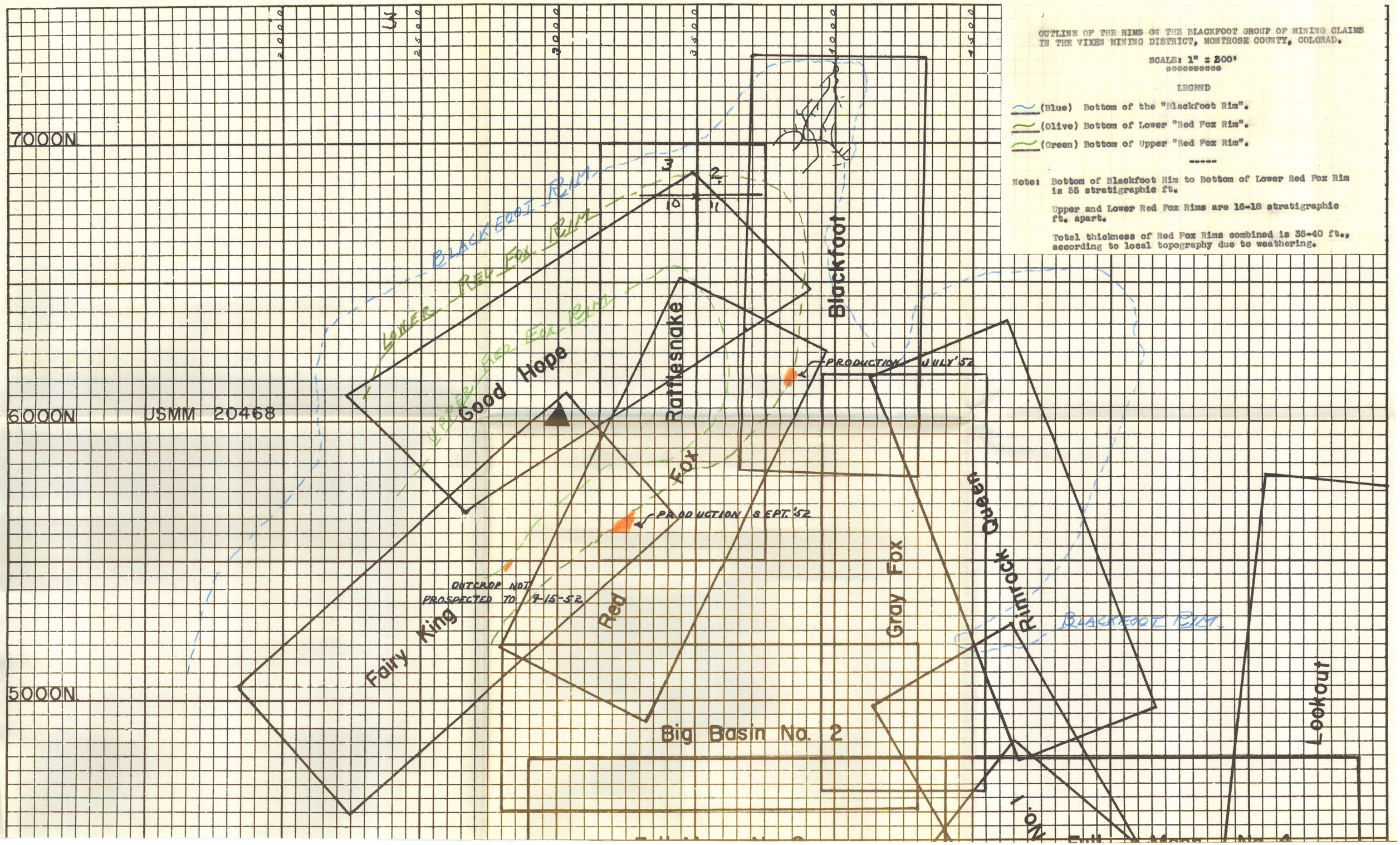
LEGEND

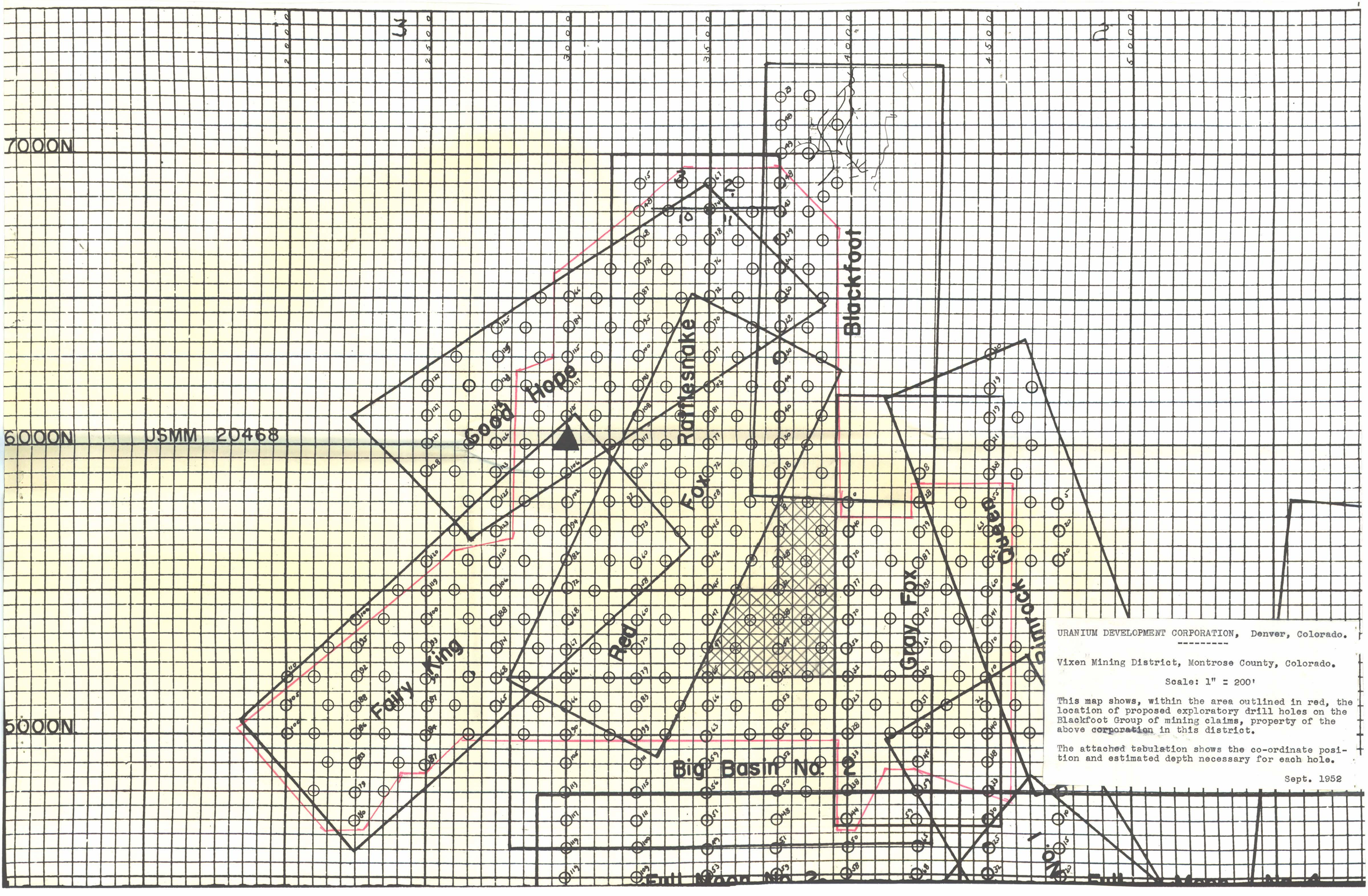
Co-ordinates refer to
USMM 20468 @ 6000N-3000E

Commercial grade carnotite

Low grade carnotite

6° Direction and inclination of the axis of a "roll".


OUTLINE OF THE RIMS ON THE BLACKFOOT GROUP OF MINING CLAIMS IN THE VIXEN MINING DISTRICT, MONTROSE COUNTY, COLORAD.
SCALE: 1" = 200'
LEGEND
(Blue) Bottom of the "Blackfoot Rim".
(Olive) Bottom of Lower "Red Fox Rim".
(Green) Bottom of Upper "Red Fox Rim".
Note: Bottom of Blackfoot Rim to Bottom of Lower Red Fox Rim is 55 stratigraphic ft.
Upper and Lower Red Fox Rims are 16-18 stratigraphic ft. apart.
Total thickness of Red Fox Rims combined is 35-40 ft., according to local topography due to weathering.
7000N
6000N
5000N
USMM 20468
2000
2500
3000
3500
4000
4500
BLACKFOOT RIM
LOWER RED FOX RIM
UPPER RED FOX RIM
BLACKFOOT RIM
Blackfoot
Rattlesnake
Good Hope
Red Fox
Fairy King
Gray Fox
Queen
Rimrock
Lookout
Big Basin No. 2
No. 1
PRODUCTION JULY '52
PRODUCTION SEPT. '52
OUTCROP NOT PROSPECTED TO 9-15-52



URANIUM DEVELOPMENT CORPORATION, Denver, Colorado.

Vixen Mining District, Montrose County, Colorado.

Scale: 1" = 200'

This map shows, within the area outlined in red, the location of proposed exploratory drill holes on the Blackfoot Group of mining claims, property of the above corporation in this district.

The attached tabulation shows the co-ordinate position and estimated depth necessary for each hole.

Sept. 1952