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**OCHRE DEPOSITS of NUR KHWAH,  
RATA SAR and JHUGGI in the  
JHELUM VALLEY, URI TEHSIL,  
KASHMIR.**

**By**

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SUPERINTENDENT, MINERAL SURVEY OF JAMMU AND  
KASHMIR STATE.**

**(With plates I to VI.)**

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**T**HESE ochre beds are isolated surface deposits, sheeting the hillsides at the above localities. They are connected geographically and by origin with the basal ferruginous layer of an extensive and thick formation of graphitic schist, which latter in turn passes up into the remarkably developed gypsiferous limestone deposits of the neighbourhood. The vertical thickness of the ochre beds varies from a few feet to as much as 20 feet, and a conservative estimate of the total amounts of washed ochre available in the two areas is : Nur Khwah 33,000 tons, and Rata Sar 164,500 tons. Their quality is good, and they make a useful basis for oil paints and distemper. The colour scale is that common to most ochres, ranging from pale yellows through Indian yellow, Venetian red and deep brown.

**General Statement.**

**NUR KHWAH (LAT. 34° 9'—LONG. 74° 7'.)**

This place is situated on the right bank of the Jhelum river, 3 miles due west by north of Rampur and 2 miles N.N. E. of Mahura Power Station on the Rawalpindi—Srinagar cart-road. It lies at an elevation of 5,000 feet above sea level. It connects by bridle-road and suspension bridge with the cart-road 1 mile above Rampur ; but there is direct communication between Nur Khwah and the cart-road by means of a wire ropeway over the Jhelum.

**Locality: Elevation: Communications.**

The Nur Khwah deposit was first brought to notice in 1914, by Lala Joti Parshad, the then Mining Officer. It was examined, surveyed and reported on in detail with large-scale plans and sections by the Mineral Survey in 1918.

**Discovery: Detailed Survey.**

**Plan and Section.**

The reduced plan accompanying this account (Plate I.) shows the position of the ochre-bed in relation to the adjoining geological series, and the lie and conformation of the country in relation to the village of Nur Khwah and the adjoining Bagna valley. The sketched contour intervals and the horizontal section (Plate II.) will sufficiently explain the heights, distances, angles of slope and general disposition of the deposit.

**Surface area, shape and position of the deposit.**

The slope occupied by the ochres possesses a horizontal projection area of 90,000 square feet, and is roughly in the shape of a triangle, the base of which begins at a height between 100 and 150 feet above the water-channel skirting the northern edge of the cultivated fields of Nur Khwah. The blunt apex of the triangle reaches a point up the slope 350 feet above the same water-channel. The lie of the slope is generally at about an angle of  $35^\circ$  and is slightly convex outwards. Laterally the slope curves with the contours of the hill spur and so is also somewhat convex in that direction too.

**Thickness and cubic contents**

Trenches opened in the deposit show the ochre-impregnated layer to extend in vertical depth to an average of 16 feet. About one half of this must be rejected as refuse rock that would be excavated along with the ochre and thrown away at once as sand, dirt and solid pieces of barren rock. This leaves 8 feet vertical depth of material worth removing from the mine. This depth multiplied by the horizontally projected area as shown in the plan, namely, 80,000 square feet, gives  $80,000 \times 8 = 640,000$  cubic feet of ochre that would be removed in bulk for grinding, sieving and washing.

Experiments have shown that  $\frac{1}{4}$  of this amount, or 480,000 cubic feet, becomes available as washed ochre or pigment material for incorporating as paint. The average specific gravity of this material has been determined from 4 tests as 2.53. Hence the above 480,000 cubic feet would represent 33,000 tons.

The colours represented by the ochres are :—

- |   |  |
|---|--|
| <b>Ochre colours<br/>and tints re-<br/>presented.</b> | 1. Yellow—ranging from golden yellow to pale yellow ochre. |
|   | 2. Orange.   |
|   | 3. Light red.  |
|   | 4. Venetian red.   |
|   | 5. Deep purplish or pinkish red.                           |
|   | 6. Dark brown.   |

(1), (2) and (3) of the above are more generally found in the upper 5 feet of the deposit, the golden yellow variety being least developed. The lower 10 feet or so of the deposit are generally represented by (5), deep purplish or pinkish red, together with occasional bands of less deeply stained yellow tints. This variety (5), is much the most largely represented of any. The variety (6), dark brown is found generally low down in the deposit where it is merging into ordinary brown earthy limonite. All these variously tinted ochres occur in more or less distinct bands so that the material collected therefrom can at once be sorted into lots of different colour.

No brilliant reds of a tint approaching vermilion are represented, the brightest tint being that known as orange red or Venetian red. Similarly, no yellows of a brilliance approaching chrome yellow are available, the brightest being the golden yellow—and of course, there are no blues and greens. These limitations are incidental to the nature and constitution of all ochres, and must not be regarded as defects. Colours such as vermilion and chrome can only be obtained from a totally different (chemically) set of pigment materials not existing at Nur Khwah.

The question of the origin of the ochres must be briefly touched on inasmuch as it is not only of academic interest. With it is connected the problem of finding other deposits of ochre in the surrounding hills and valleys.

As is the case with all ochres, the colouring pigment is entirely derived from iron in varying states of oxidation and hydration. The mother-rock of the iron appears to consist chiefly of a band of rock, some few feet thick, generally composed of ferruginous breccia, which is mostly limonitic, but sometimes hæmatitic. This band (as will be seen in the plan) occurs separating the ordinary phyllite series from the graphitic phyllite above, and, not only is found here at Nur

Khwah, but is practically continuous all along the junction boundary line between these two formations.

From the ferruginous breccia or mother-rock the iron content is continuously being leached out and carried away by surface and underground waters. This is frequently evidenced by the presence of ferruginous springs issuing from along the line of the breccia and staining the shingle, soil and vegetation along their course a bright golden yellow. Such springs are well seen in the stream-bed a few hundred yards N. E. of the Nur Khwah ochre locality (marked on the plan), in the Bagna valley at two places, and also at Braripura village, situated in a tributary valley of the Lachhipura valley—to mention only a few.

Owing to the peculiar structure, with low dipping inclination of the divisional planes, in the phyllite beds at the locality of the ochre beds, it seems that the iron leached out from the breccia has been re-collected by those phyllite beds—soaked up as by a sponge—and so retained in the form of the ochre beds of Nur Khwah. The latter therefore, as regards origin, represent a conveniently disposed surface layer of phyllite rock that, in addition to the ordinary changes incidental to weathering that have altered it into a spongy earthy mass, has also suffered intensive impregnation by the leached out iron content of the ferruginous breccia.

It may be well to indicate the position of some other ochre "pockets" in the vicinity. As would be expected from the theory of their origin, all lie along the line of division between the phyllite and the graphitic phyllite. The nearest one to Nur Khwah lies  $\frac{1}{2}$  mile away to the W.N. W. in the stream bed. It forms a little cake of rock on the hill-spur close to the ferruginous breccia and does not promise a large supply.

Another deposit of apparently limited size occurs on the right bank of the Lachhipura nala opposite Nalusa and  $\frac{1}{4}$  mile N. N. W. of Reshwari. The colour of this is a particularly brilliant golden yellow. It would probably be well worth opening up.

In the descriptive portion that has gone before, it will be observed that I am assuming that ochre, or paint made from it, is, or may be, a commodity in Kashmir and other neighbouring parts of India, not too far

**Leached out by surface and underground waters.**

**Collected again by decomposed phyllite.**

**Other ochre "pockets" near Nur Khwah.**

**Utility of ochres as paints.**

away : that there is, or may be, in fact a market for it. It is true that paint is not much in evidence in Kashmir as typified by the capital town Srinagar ; but when we consider the extent to which wood is used in construction, it may well be that paint as a preservative and beautifier is only absent, because of (1) habit, (2) lack of initiative, (3) high cost. I conclude that cheap paints mixed in attractive tints will have a ready sale, especially, if something is done in the first instance to push them, popularize and advertise them. The P. W. D., and other Government departments could well set an example in this respect which would soon be followed. Apart from external uses there is also the question of the use of paint for internal decoration for walls, ceilings and floors. Used either as oil paints over wood or as distemper over plaster or stucco it might rapidly gain in favour with a little encouragement.

For oil paints the only vehicle necessary with ochres is linseed oil, and a small proportion of turpentine and "driers." The usual base, namely, white lead or zinc oxide used with many other forms of pigments is quite unnecessary in the case of ochres. Linseed oil is available fairly cheaply in Kashmir. Its present retail price in Srinagar bazar is Rs. 4 a tarak or 1 gallon =  $5\frac{1}{2}$  seers.

In the Trade Report of the Jammu and Kashmir State, Customs and Excise Department, for Sambat 1971, the following figures are given for the export of linseed :—

1969.	1970.	1971.
102,694 maunds valued at Rs. 492,104	47,971 maunds valued at Rs. 288,752	90,306 maunds valued at Rs. 432,255

These amounts and valuations show that linseed oil is available in large quantities for export and, therefore, would be equally available for paint-making on the spot.

With abundant opportunities for a market, either locally in Kashmir or outside in the nearer large towns on the railway, with a large supply of the crude ochre material and with linseed oil able to be expressed on the spot in equally large quantities, we seem to have every requisite for the successful manufacture of paints. It is now

necessary to describe experiments undertaken by this department in the actual processes of paint-manufacture with the object of seeing whether, from a practical point of view, such processes present any unforeseen obstacles.

The most essential processes that it was incumbent on us to experiment with, were, first the purification of the crude ochre, and secondly the mixing of it into a paint of good colour, body and covering power. There being no machinery available at the time owing to the war, all the experiments had to be carried out with simple improvised hand-labour.

The crude ochre as it comes from the deposit varies from a soft, powdery material to a moderately hard and tough, lumpy, material. In all cases it was readily reduced to a powder by crushing and grinding in large iron mortars ; the powder being reduced in the fineness of its grain until it all passed through a 90-mesh sieve.

**Purification of the crude ochre: Crushing and Grinding.**

The powder was then thrown into water for the next process of elutriation. After well stirring and mixing in pans and buckets the whole was allowed to stand for two minutes and the suspended colouring material poured off. The residue was again and again treated in the same way (with more grinding) until no further appreciable colour was obtained. The following percentages of colouring material, as compared with the crude ochre taken for grinding, were realised :—

			per cent.
Sample	(1)	Golden yellow ..	.. 80.66
Do.	(2)	Orange red and Venetian red ..	.. 84.50
Do.	(3)	Do ..	.. 67.36
Do.	(4)	Pale pink ..	.. 70.20
Do.	(5)	Deep pink ..	.. 67.82

from which an average percentage of 74 per cent. or nearly three-quarters, results, as already stated.

In our practical tests of the ochre pigments as material for oil paints, both refined imported linseed oil and local linseed oil, crude and boiled, were experimented with. The levigated ochre, after being thoroughly dried, was powder-

**Mixing with oil.**

ed again and mixed with about its own weight of linseed oil and the whole ground for 6—12 hours by hand in porcelain mortars.

It was then strained and applied with a paint-brush as a coating on a set of wood panels, whilst other samples were first mixed with turpentine and copal and shellac varnish. The results appeared as a series of painted panels that as regards brilliance of hue, smoothness, fineness, body and covering power were quite satisfactory.

Various blends and effects were obtained by mixture of the pigments in various proportions and by using the linseed oil in its raw and boiled-states. Other shades were obtained by mixture with the graphite of the neighbourhood.<sup>1</sup> Many of the latter give greys, browns and warm khaki effects that are very attractive. On the other hand the use of gypsum<sup>2</sup> to get paler tints of the ochres was not very successful owing to the lack of body in this form of mineral-white when used with oil as medium.

It is hardly necessary to remark that all these ochre pigments, alone or with admixture of gypsum, make excellent water colours for distemper work for walls and other inside decorations. Along with finely ground plaster-of-Paris, made from gypsum, they can also be moulded into coloured "chalks" for black-board use.

It remains to remark that the mining of the deposit will present no difficulties, provided that ordinary care is taken to excavate the rock according to some system, and to dispose of the waste without detriment to the rest of the deposit and without causing damage to the fields and water-channels of the village below. Pick and spade work will probably suffice to win the whole deposit without the use of explosive, unless the operations undertaken are on a large scale.

For grinding and elutriation purposes the water-power, which exists in abundance on the spot all the year round, can be used, or it may be supplemented by electric power from Mahura.

<sup>1</sup> See separate printed report on "The Graphite of Braripura, Uri Tehsil, Kashmir."

<sup>2</sup> Abundant in the neighbourhood, see separate printed report.



## RATA SAR (LAT. 34° 10'—LONG. 73° 59' 30").

The deposit at this place was discovered as a sequel following on that at Nur Khwah in 1920, by Pandit Labhu  
**Discovery: Locality.** Ram Badyal of the Mineral Survey, who surveyed and reported on it in detail with large-scale plans and sections, and from whose description the following account is taken. The locality is a rough, moderately steep slope of forest-covered hill-side lying between the villages of Maidan and Tragan as marked on the 1 inch = 1 mile map of the Survey of India, No. 43 F|16.

The ochre locality is connected with the Jhelum valley cart-road  
**Communications** by the following routes :—

1. The place in question is about 7 miles N. W. by W. of Mahura and is connected with it by a good pony track as far as Gingal, but the latter place is connected with Mahura by a suspension bridge, not strong enough for pony traffic. Therefore, the above route does not appear to be suitable for transport purposes.
2. The deposit is about 5—6 miles N. W. by N. of Uri, and is connected with it by only a hill-track, where pony-traffic is not possible.

The bridge at Uri over the Jhelum river is quite strong for all sorts of traffic.

The direct path to Uri, seems to be the shortest and most convenient for the removal of the material to other places, though the transport in this case will only consist of coolies.

The deposit is dotted over with forest trees, comprising Budlu, wild walnuts, Tilpatra trees and small shrubs of  
**Forest.** not much consequence. The timber of the above trees has not much use, since the absence of big streams precludes the possibility of exporting it. Its utility is only for local demands, which do not appear to be much, as is significant from the fact that a good lot of trees are rotting at the spot.

The reduced-plan, of the deposit (Plate III.), shows the position of it in relation to the adjoining geological series.  
**Plan of the ochre deposit.** The sketched contour intervals (50 feet), and the horizontal section (Plate IV.) will explain the heights, distances, angles of slope and general structure as well as the disposition of the deposit.

The slope occupied by the ochres has been found to possess a surface area of about  $(840 \times 350)$  294,000 square feet, and is roughly in shape of an oval with a little bulge towards the S. E., having its longer axis disposed towards N. E. and S.-W.

**Surface area, shape and detailed position of the deposit.**

The south-western edge of the deposit is at the 8,900 feet contour, while the N. E. edge lies between the 8,600 and 8,550 feet contours. The deposit keeps a little away to the S. E. of the Maidan—Tragan foot-path marked in the plan, in its lower parts, while the road just touches it near the tank and the ferruginous springs in its higher parts.

The exploration trenches were generally opened at places that were nearly flat, and so the trenches were nearly perpendicular to the surface. They were made 4—5 feet wide. They exposed ochre layers varying in depth from 4 feet near the margin of the deposit, to 12 and 14 feet in trenches more centrally located.

**Thickness of the deposit as shown by trenches.**

The average thickness of the deposit thus obtained from the different trial trenches is 8 feet, which is a fair minimum representation of the thickness of the deposit. In the case of these ochres, no worthless stuff, such as grit, sand or unimpregnated layers of rock, which abound in the Nur Khwah deposit, was encountered in any of the trial trenches. All that was excavated from the top down to the bottom graphitic stuff was valuable and useful, and represented bright tints throughout. Therefore, this gives area  $\times$  thickness *i.e.*,  $294,000 \times 8 = 2,352,000$  cubic feet of ochre that would be removed in bulk for washing and grinding.

**Cubic contents of the deposit.**

Another point in favour of this deposit is that not much grinding is needed in this case, as the whole of the stuff exists in a soft and impalpable condition; only a foot or so of the bottom disintegrated ferruginous breccia requiring a little grinding.

**Grinding not necessary.**

Washing tests of the samples from three trenches proved the existence of only 2 per cent. of stuff that had to be rejected. This amount of impurities is quite imperceptible in the manufacture of paints, consequently the material from the trenches can go almost directly to the paint mixing machine without the intervening processes of grinding and washing.

**Washing process.**

The average specific gravity of the ochres has been determined (from two tests) as 2.50. Hence the above cubic content represents 164,476 tons of the ore which becomes available as pigment material for incorporating as paint.

**Quantity available for incorporating as paint.**

incorporating as paint.

Browns and yellows of different shades are the main tints represented by the ochre.

**Ochre colours and tints represented.**

A. The different shades as represented by the brown ochres are as follows :—

1. Brown (deep).
2. Hæmatitic brown.
3. Burnt umber.
4. Light brown.
5. Orange brown.
6. Deep reddish brown.
7. Dark brown.

B. The different shades of yellow are the following :—

1. Yellowish orange.
2. Deep yellow ochre.
3. Raw sienna.
4. Bright yellow.

These yellow and brown tints do not occupy any fixed horizons in the deposit. In some trenches brown occupy the top layers of the deposit, and in some yellow ochres prevail in the top layers, while in some brown tints constitute the middle and bottom layers of the deposit. Some trenches have brown tints throughout.

The question of the origin of this ochre deposit must be briefly touched upon, inasmuch as it will widen the scope of finding other deposits in the whole stretch of country occupied by the graphitic series further west of the area so far surveyed, *i.e.*, west of Traran and Gehl. It will also show that it is unnecessary to suppose that the ochre deposit has resulted from merely percolating waters carrying ferruginous matter from the iron-bearing rocks and impregnating some favourably located rocks (as is the case with the Nur Khwah ochre deposit and other numerous pockets of ochres found at various other places in the area), but that given favourable circumstances, the mother-rock itself can change directly to ochre deposit.

**Importance of the question of origin.**

The ferruginous breccia forming the base of the graphite schist series, and consisting as it does, of angular fragments of graphite schist and phyllite in a ferruginous matrix, has, in this case according to Pandit Labhu Ram given rise to the ochre deposit by the *in situ* decomposition and disintegration of the constituent fragments into a clayey stuff, which has retained the hæmatitic and limonitic stuff resulting from the oxidation and hydration of the ferruginous material of the breccia.

**Origin of the deposit.**

The carbonaceous matter of the graphitic schist fragments has, in part, been leached out, and in part, has mixed with the colouring pigments to produce various shades of brown and yellow tints as found in the deposit. In proof of this some thin black layers still remain, and represent the unleached and undigested stuff of the graphitic schist.

The mining of the deposit will be very simple and present no difficulties, inasmuch as no waste stuff exists with the deposit and consequently no sorting will be requisite in this case, and the whole of the stuff from the trenches, may be won as ochres ready for incorporating as paints. The deposit, being quite soft, can be won with mere spade and pick-work. Explosives are not needed even if the operations are undertaken on a large scale.

**Mining operations very simple.**

JHUGGI (LAT. 34° 9' 30"—LONG. 73° 57' 30").

The most important of the subsidiary pockets of ochre located by Pandit Labhu Ram was at Jhuggi, about 1 mile S.-E. of Chhitrian, which yielded at a minimum estimate about 5,866 tons of almost refined ochre, so far as it has at present been explored by surface trenching.

**Other ochre pockets further west of Rata Sar.**

The accompanying reduced plan (Plate V.) shows the position of the deposit, in relation to the adjoining geological series. The sketched contour intervals (50 feet), and the horizontal section (Plate VI.) will elucidate sufficiently the heights, distances, angles of slope, and general disposition and structure of the deposit.

**Plan of the deposit.**

● The slope occupied by the deposit possesses a horizontally projected surface area of about  $220 \times 120 = 26,400$  square feet, and is roughly in the shape of an ellipse with its longer axis running approximately north and south, and the shorter east and west.

**Surface area and the shape.**

The exploration trenches generally revealed that the impregnation had reached approximately the depth of 4—5 feet, below which is calcareous tufa, but in the case of trench No. 2, phyllites were found to constitute the base.

**Thickness.**

With an average thickness of 4 feet, the cubic contents amount to  $(26,400 \times 4) = 105,600$  cubic feet. It is assumed that about  $\frac{3}{4}$  of this amount, *i.e.*,  $105,600 \times \frac{3}{4} = 79,200$  cubic feet, will become available as washed stuff for incorporating as paint. The average specific gravity of this being 2.55, the above cubic contents would yield about 5,866 tons.

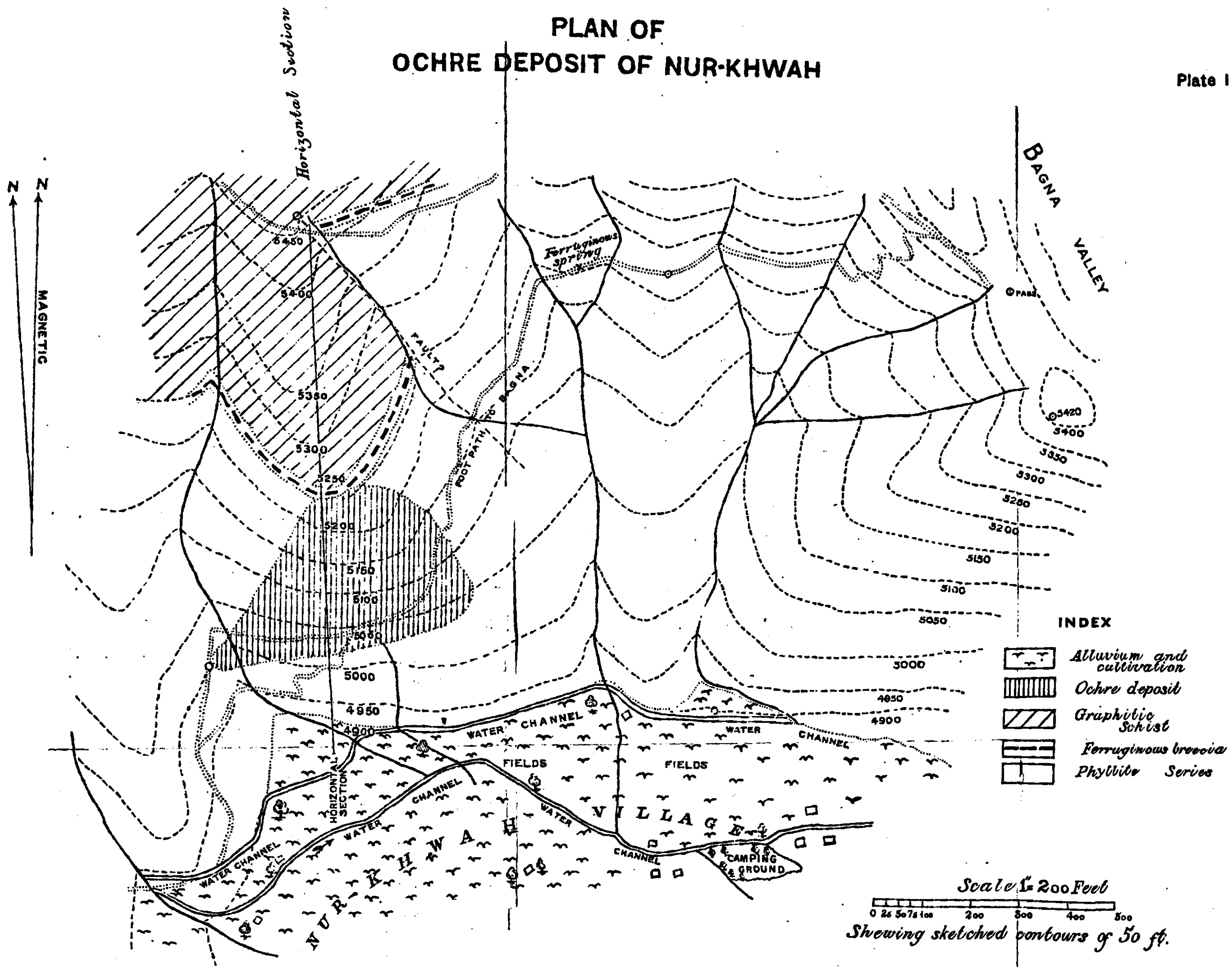
**Cubic contents of the deposit.**

The economic uses and methods of preparation of the material from Rata Sar and Jhuggi do not differ materially from those already detailed in the earlier pages devoted to the Nur Khwah ochres. The only exceptions are that the much smaller amount of sand, dirt and waste rock in these just described areas reduces the amount of washing and concentration necessary. The softer condition of the ochres also reduces the grinding necessary, which in most cases is so small as to be almost negligible.

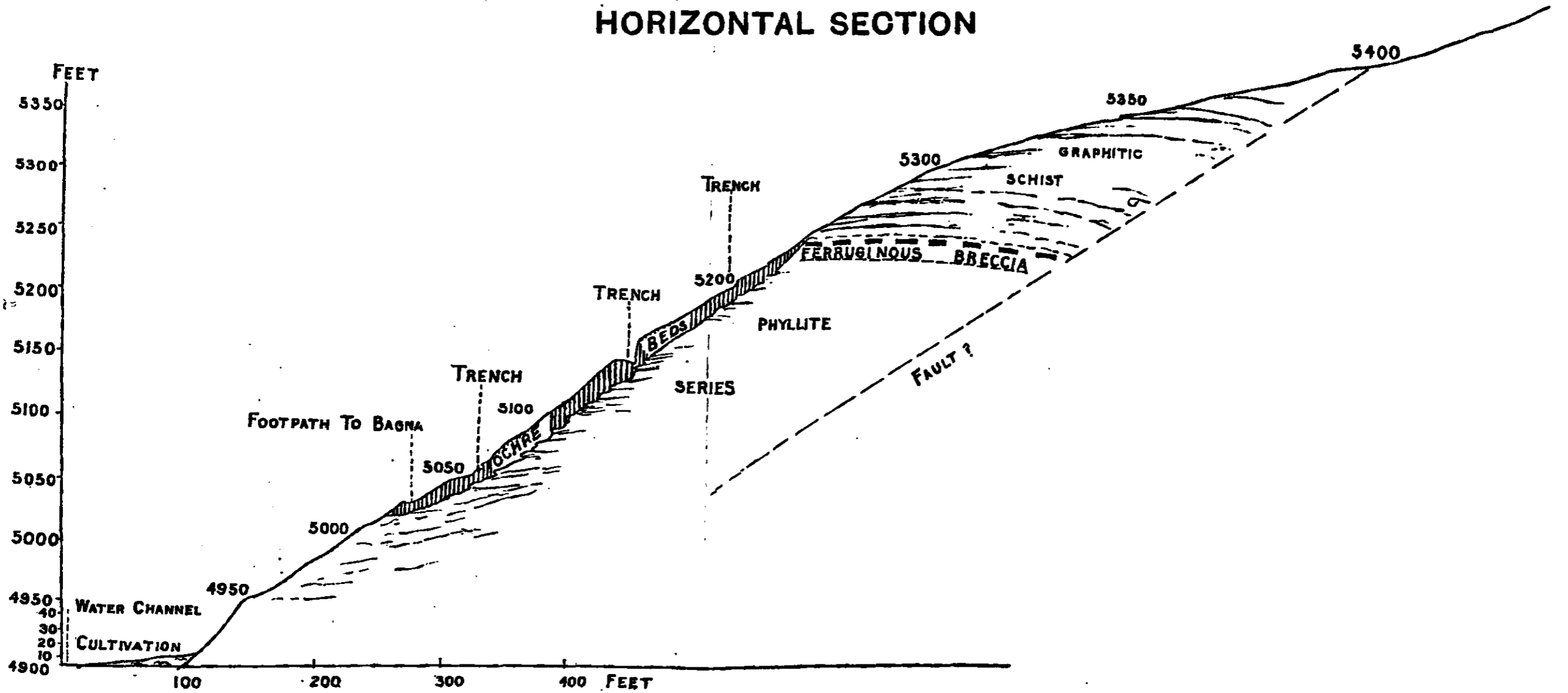
**Economic aspect of the Rata Sar and Jhuggi deposits.**

# PLAN OF OCHRE DEPOSIT OF NUR-KHWAH

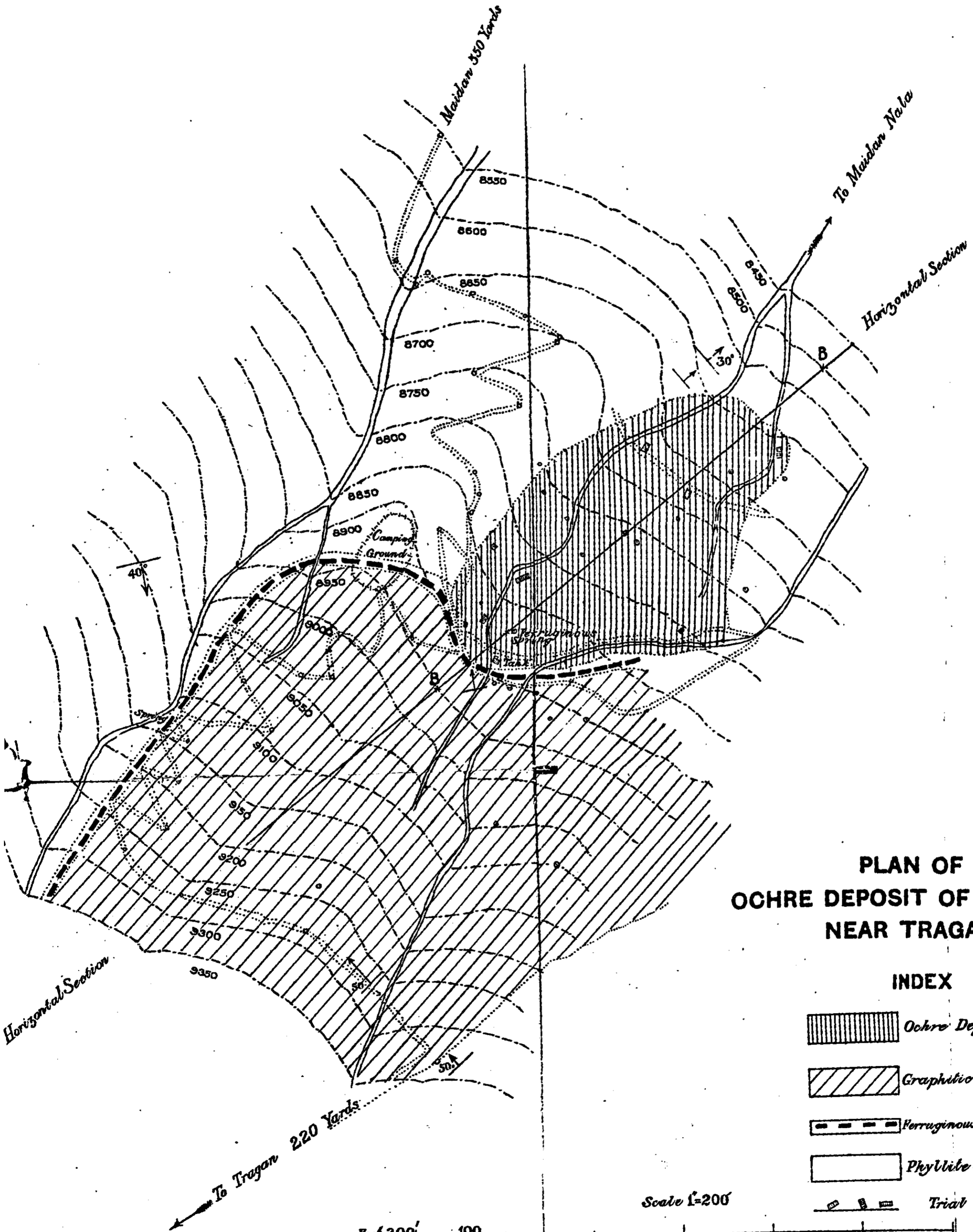
Plate I



# OCHRE DEPOSIT OF NUR-KHWAH HORIZONTAL SECTION



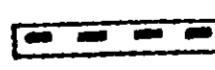




SCALE: 1 INCH = 100 FEET HORIZONTAL AND VERTICAL

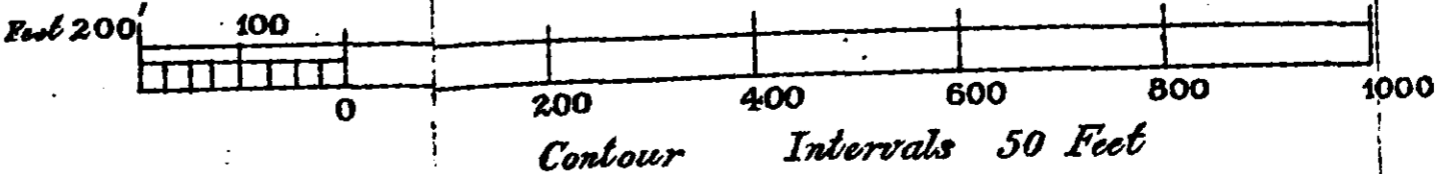


**PLAN OF  
OCHRE DEPOSIT OF RATA SAR  
NEAR TRAGAN**

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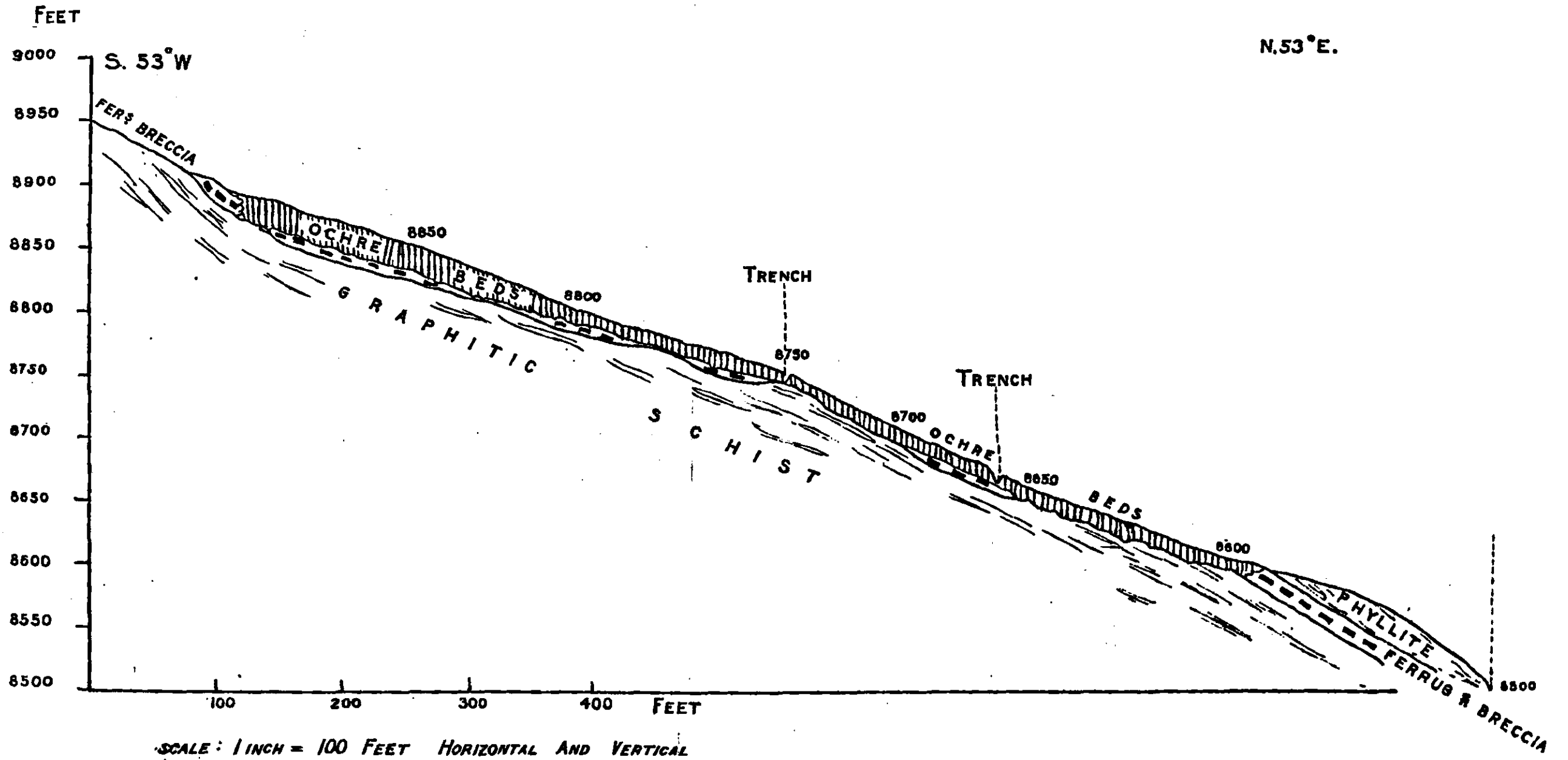
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-  Graphitic Schist
-  Ferruginous Breccia
-  Phyllite Series
-  Trial Trenches

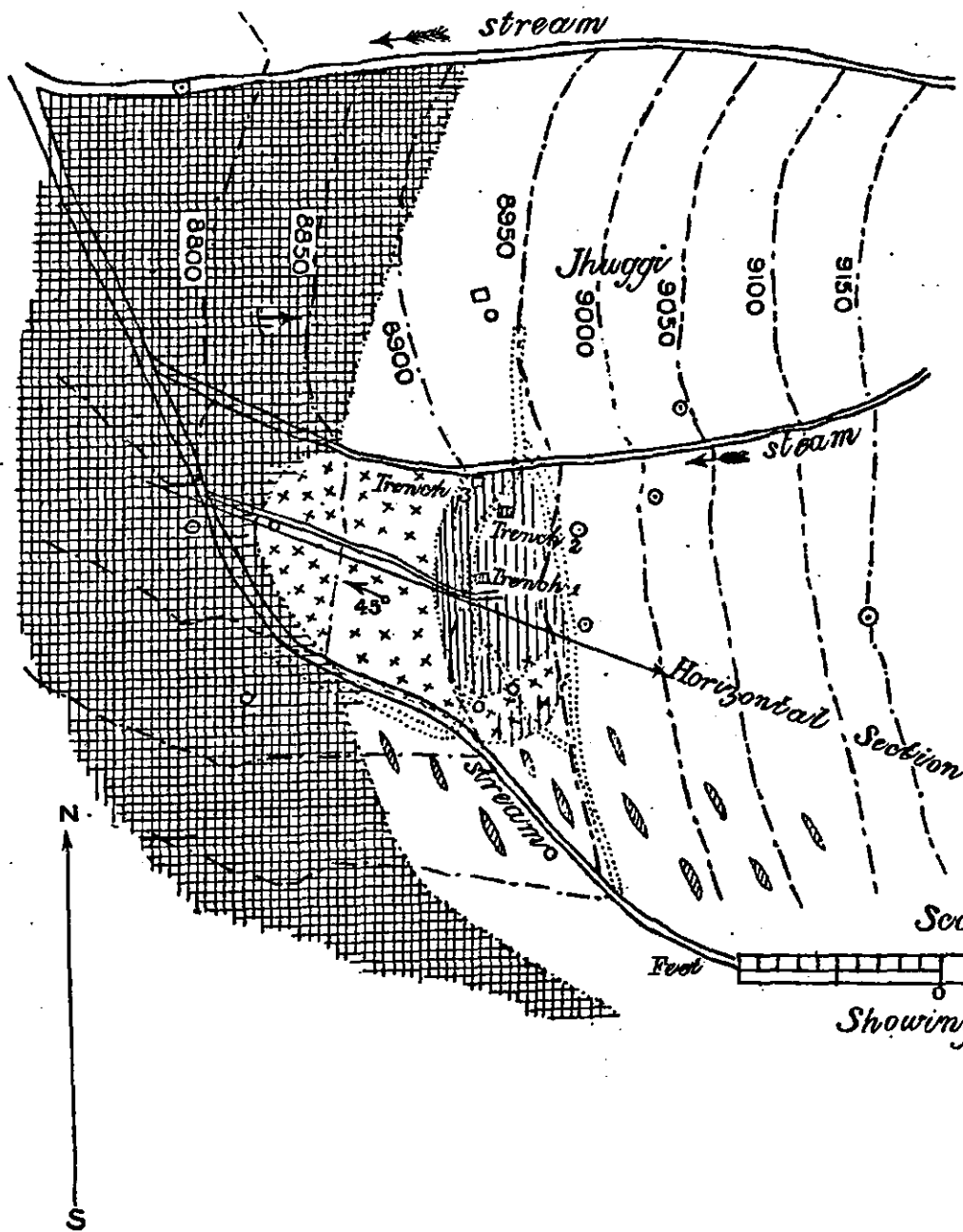
Scale 1"=200'








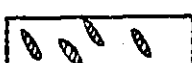

# OCHRE DEPOSIT OF RATA SAR NEAR TRAGAN SECTION ALONG "BB"



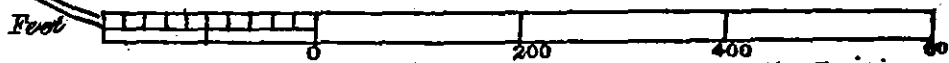


## PLAN OF OCHRE DEPOSIT OF JHUGGI

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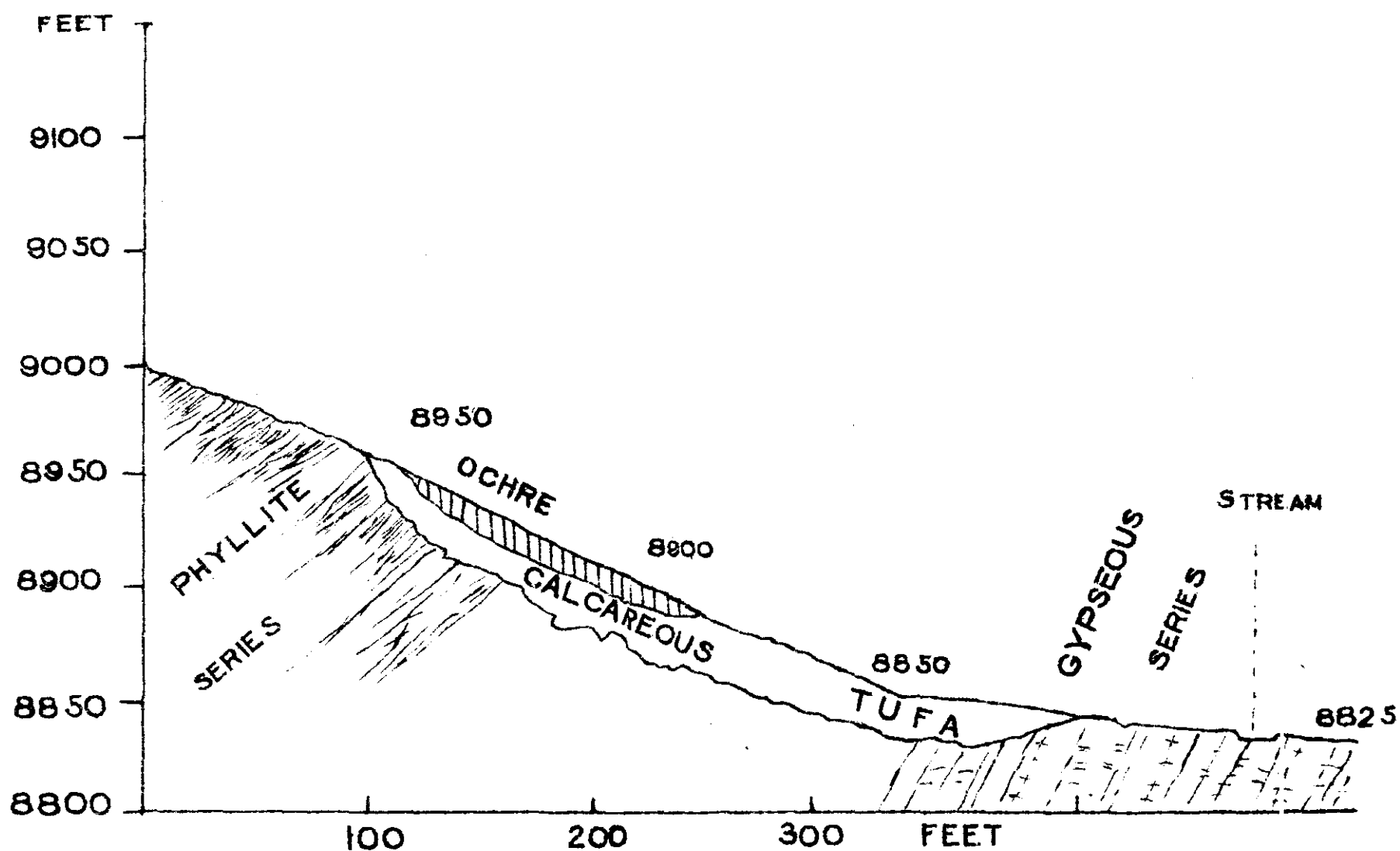
-  Ochre Deposit
-  Calcareous Tufa
-  Gypseous Series
-  Graphitic Schist Debris
-  Phyllite Series

Scale. 1 inch = 200 Feet.



Showing Sketched Contours of 50 Feet.

# OCHRE DEPOSIT OF JHUGGI HORIZONTAL SECTION



SCALE : 1 INCH = 100 FEET HORIZONTAL AND VERTICAL