RB 28-21
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Department of Mines, Adelaide

STENHOUSE BAY GYPSUM DEPOSITS

Mining of Gypsum - Marion Lake

Preliminary *

Gypsum occurs in Marion Lake in the form of both flour and rock gypsum. In the present workings a section through the beds formed in the lake would show -

Feet	
0 - 8	Flour gypsum
8 - 12	Rock gypsum
12 - 14	Black sandy ooze
14	Hard sandy travertine

The rock gypsum is a continuous undulating bed ranging from a few inches to five feet in thickness. It is overlain by flour gypsum up to 8 feet in thickness, forming for the most part the present lake surface.

Up to date only the rock gypsum has been utilized; the flour gypsum which is inferior in composition has been dumped. Marion Lake occupies an area of 800 acres, and approximately 260 acres of the 800 acres have been worked out.

It is estimated that there are 2½ million tons of rock gypsum left in the lake and 3 to 4 million tons of flour gypsum including dumped material. In addition there would be 6 to 8 million tons of possible flour gypsum reserves on Snow Lake.

Recent tests have shown that by a simple washing process the flour gypsum can be improved in quality up to the grade of the rock gypsum. There is, therefore, no longer any need to consider the flour gypsum as overburden as at present, but it can be classed a low grade material that can be treated. Consideration must be given to this point in planning future mining.

Mining Operations (see Sketch 1, S308)

Overburden removal - The overburden (flour gypsum), locally known as "caso" is in the form of a sticky sand. It is removed by stripping with a Model E Harman dragline and dumped in front of the working face, in the excavation made by the extraction of the rock gypsum.

* Information obtained from the Report on "The Stenhouse Bay Gypsum Deposits" by S.B. Dickinson, M.Sc., Director of Mines and Government Geologist, and D. King, M.Sc., Assistant Geologist.

The section being worked at present (Section F, Plan 50-211) has been well drained and the dry case does not offer any problems in handling. In a new section being proposed for the extraction of the rock gypsum, the case is very sticky. Here a grab is used on the dragline in place of the toothed bucket. The material is being dumped on the margin of the lake until a sufficient width has been stripped for the excavation of the rock gypsum to commence.

Extraction of Rock Gypsum - After the removal of the case, the gypsum is mined by blasting from auger holes and loading the broke material with a dragline.

Details are as follows:-

Holes are drilled with 1½" augers. They are spaced at 3 feet apart. For a 4 foot hole, after one bulling, 10 or 11 plug of ligdyn 7/8" diameter are used to break the rock.

The augers are driven by Multivane Turbines, compressed air for which is supplies by a Broomwade portable compressor, with a capacity of 60 cubic feet of free air per minute raised to 100 lb per square inch pressure.

The gypsum is loaded into rail trucks by means of a Bucyrus 20B, 3/4 yard dragline operating from the surface of the overburden. A light two-feet gauge rail laid on the overburden serves for the transporting of the gypsum to the washery at Stenhouse Bay. Six ton diesel locomotives are used for traction, with side-tipping trucks of 4-ton capacity.

The method of mining would seem to be orthodox, and the handling of the overburden and broken rock gypsum efficient for the type of deposit and the nature of the materials handled. A good feature of the selection of the loading equipment is the standardization on 3/4 yard draglines for handling suitable materials in all operations of the Company.

Winning of Case from unworked areas - Sketch No. 2 (S309) concerns the new area being opened up (Section E. Plan 50-211). Here the case had not had a chance to drain. An entry is being made by

material being stripped from the rock gypsum is soft and sticky. It is obvious that the draglines will not be able to operate on such a surface, and keep up large enough stripping and production rates.

Present information would indicate for this section that, if the case will not drain satisfactorily, after a wide enough strip has been taken off by the present operation, the stripping dragline is out of reach of the shore dump area, a light rail track could be laid down on the surface of the rock gypsum so that the stripped material could be taken away by train to a fresh dump or to a washing plant if the case is to be utilised. In this section it would be necessary to carry a track for rock gypsum as well as one for case on top of the rock gypsum. The tracks as well as the stripping and mining draglines would be on the same level.

If the material does drain, the present method of workin from the top of the overburden is quite efficient.

It may be necessary to provide a different type of track for the transport of the sticky material A gable-bottomed truck with side doors would be more suited to it than the present side-tipping truck. The gable-bottomed truck would lend itself more easily to cleaning, especially if water was available under pressure.

Seeing that future operations on Marion Lake are bound up to some extent with a proposal to utilize the case, which has to be cleaned in a washing plant, the use of gable-bottomed trucks with a pressure monitor at the washing plant for sluicing would fit in very well with the general layout of such a plant. A storage will be required here ahead of the washing plant. Obviously, such sticky material must be kept in the form of pulp. Water for the pulp could be supplied partly from the sluicing of the trucks.

Winning of Case - On the problem of the recovery of the case that has been stripped from the rock gypsum and dumped into the worked out areas, further investigation is required. Each worked out area is a pondage in which some of the overburden appears above the water in cones and the remainder apparently has spread out over the floor. Such a layout suggests a form of dredge, such as

a pontoon with a cutting or digging device with a pump for delivering the material to a suitable collecting point.

However, if the water were pumped out of an area into another part of Marion Lake or Snow Lake, it might be possible to operate a small shovel, a dragline, or a cable dredger on the floo or on part of the dump in the area.

Before a mining method can be selected an area should ne pumped out with a view to determining the contamination of the ove burden with ooze, and the state of the floor. There is a possibility that some sections, though not workable in themselves because of contamination, may be firm enough for machinery to operate upon them to dig other portions.

Washing Plant

Rock Gypsum - The plant at Stenhouse Bay for washing rock gypsum has a capacity of one ton per minute. The average throughput is 500 tons per day; the maximum for any one day has been 700 tons.

The gypsum is delivered to the top floor of the plant from an elevated tramway. As the train backs into the plant, the trucks are tipped singly at a time spacing depending on the rate of cleaning of the previous tipped load. All the material falls on to a 12 inch grizzly and passes to a chute loading to a set of toothed rolls, 30 inches diameter by 30 inches wide. The crushed material is fed to a brass vibrating screen, 8 feet by 4 feet, a third of which has 1/4" openings, the remainder 1/8" openings. High-pressure water sprays wash away the fine calcite particles adhering to the gypsum. Coarse material passes direct to stacker. Fines (1/2" material) pass to a 24 inch drag classifier, capacity 40 tons per hour. The overflowing slime is drained away through concrete launders to the sea.

The washed material conveyed to a dump for draining by means of stacker with a boom 64 feet long.

Power to run the washing plant is supplied by a 90 H.P. diesel engine (G.B.C.) At present, only 28-30 horse power is required for the actual operations.

Case - A report by N. Jackson, Metallurgical Engineer, on a suggested washing plant for the case forms an addendum to this report. The washed material will no longer be sticky and it can be handled satisfactorily.

Handling of Treated Material.

Rock Gypsum. From the dump the washed rock gypsum is loaded by means of a dragline into motor trucks and transported to the bin formed on the cliff face above the jetty. For ship loading this material is fed to a hopper over a belt conveyor running along the jetty. When necessary a scraper is used in the bin to rake the gypsum to the hopper.

Case The material will be delivered from the washing plant in a dry enough state to be handled on a belt conveyor. It will be necessary first to stack the case in the open so that the soluble salts may be leached from it by rain water. After this leaching and subsequent drying it is suggested that the case be taken by motor truck to an undercover storage near the jetty to await shipment.

Mr. Jackson has suggested that the dumps used for caso should be lower than those now used for the rain washing or rock gypsum. The latter are 30 feet high; probably 10 feet would be a suitable height for caso dumps.

To allow for a production of 200,000 tons per annum of rock gypsum, 100,000 tons of caso would have to be removed each year, and it is assumed that this amount will be treated. At this rate, allowing for a recovery of 70% in the washing plant and three months for leaching and drying, the dumps would cover an area of -

$$\frac{100,000}{4} \times \frac{70}{100} \times \frac{2240}{160} \times \frac{1}{10} \text{ sq. ft.} = 24,500 \text{ sq. ft.}$$

i.e. less than one acre.

It is suggested that a belt conveyor would be suitable for handling the material from the treatment plant to the dumps on the drainage floor. The distribution into dumps can be done by means of a portable stacker.

For transport to the jetty storage the material can be handled from the dumps into motor trucks by a dragline with clame shell bucket.

After drying the case should be stored under cover, firstly, to prevent losses by wind action and secondly to prevent further wetting which might create difficulty in ship loading.

It is suggested that a storage shed be erected on the top of the cliff above the jetty. The shed should supply sufficient storage for the quantity of caso likely to accumulate between shipments.

The belt conveyor system that is used for the rock gypsum could be used with modifications for loading the caso into ships. It will be necessary to enclose the belt so that material could not blow away in a high wind.

To handle the caso from the storage shed on to the ship loading conveyor, two alternatives are suggested:-

1. The caso could be scraped from the shed to a covered chute constructed on the outside of the cliff.

2. A shaft could be sunk from the storage shed, and a tunnel driven on the level of jetty conveyor to connect to it. The shaft which will constitute an ore pass through which the caso could be delivered to a short conveyor feeding the jetty conveyor.

With this suggested method, the caso will, after washing with sea water, be further washed with rain water to remove soluble salts. It will then be dried and taken to storage under cover from which it can be quickly loaded into ships. The caso will be in suitable condition at each stage for the particular handling required, and storage space can be readily adjusted to requirements.

Summary.

1. The stripping and mining operations at Marion Lake follow orthodox methods of open cut work, and the equipment used is suite to the work.

2. A dragline is used to dump the caso in the worked-out area

3. A dragline operating from above the deposit is used to load rock gypsum primarily because the black ooze underneath the deposit would not support alternate heavy equipment on the floor of the excavation.

4. The success of the joint operation by draglines depends on the bearing power of the drained flour gypsum overburden.

5. Provided the overburden on other areas will drain properly, the present methods can be used.

6. If the caso does not drain but remains wet and sticky, it may be necessary to operate from the level of the top of the rock gypsum.

7. If the caso has to be handled in a wet and sticky state to a washing plant, it is recommended that it be transported in gabled-bottomed trucks.

8. Before a method of handling the caso dumped in the old workings can be determined, it will necessary to pump out a test area to obtain information relating to -

a. the contamination that has taken place between the caso and the black ooze.

b. the state of the floor of the excavations.

9. The report of Mr. N. Jackson would indicate that a simple washing of slime particles from the caso is sufficient to give 70% of the material as a product of purity required for plaster manufacture. The washed material is no longer sticky and it can be handled satisfactorily.

10. It will be necessary to allow the treated material to be washed with rain so as to leach out the soluble salts still remaining which are deleterious in plaster making. The rain washing can be done on a drainage floor to which the caso can be transported by belt conveyor.

11. From the drainage floor it is suggested that the dry material be taken by motor truck to a storage shed, whence it can be handled through a chute or pass to the jetty conveyor for ship loading.

July, 1950 STATE MINING ENGINEER.

DEPARTMENT OF MINES.

SOUTH AUSTRALIA.

STENHOUSE BAY GYPSUM DEPOSITS.

SUGGESTED WASHING PLANT FOR OVERBURDEN FROM MARION LAKE:

General

The sand overburden of Marion Lake rock gypsum deposits is at present considered waste. Estimates of tonnage, and careful sampling followed by chemical analyses, show that this material contains a considerable reserve of gypsum. Tests carried out in the metallurgical laboratories show that simple washing of slime particles from the sand is sufficient to give 70 per cent of the material as a sand product of purity required for plaster manufacture. Equipment suitable for this operation is discussed in this report.

Suggested plant.

A plant for washing calcareous slime of minus 200 mesh particle size from sand and gravel size particles of gypsum would require the following facilities:

1. Storage for crude materials
2. Washing machinery
3. Dewatering machinery
4. Disposal of slime
5. Storage of final product.

It is assumed that sea-water would be used for washing.

Following are some considerations of these operations.

1. Sand delivered to the treatment plant would be wet and sticky. The best method of handling for storage and transport within the plant would be as pulp. Mine trucks could dump crude material direct to a screen over a vortex mixing tank. Water jets on the screen would assist the sand through slowly and the screen would safeguard the mixer from oversize pieces of rock or tramp material. Water would be added as necessary to the mixer, to keep pulp at a suitable density.

The slimes, consisting mainly of calcium carbonate, tend to stick to the grains of gypsum. It is necessary to use a vortex

mixer or turbo agitator to ensure good separation.

2. The discharge from the mixer could gravitate or be pumped to the desliming unit. Alternative types of equipment are available for this process. Simple settling tanks and launders are not favoured because of the lack of agitation. Mechanical classifiers or hydraulic classifiers could be used.

Mechanical classifiers depend on control of the pulp density to allow separation of particles with different settling speeds. The non-settling slime is overflowed. The settled sands are raked or screwed up a slope for discharge, or discharged through an orifice at the bottom of the settling tank. The raking method is suitable for handling sand separations at 100 mesh, and the bowl method for finer materials. With gypsum requiring separation at 200 mesh, but also containing sand and gravel, the best separator would be a combination of bowl superimposed on a tank containing reciprocating rakes. This is standard equipment for mineral dressing plants. This method would deliver only one sand product.

Hydraulic classifiers are similar in operation to the equipment used in the laboratory tests. The pulp is passed over columns of rising water which wash the fines upwards while allowing the sand particles to sink. If several columns were used, different water speeds in each would enable sized products to be made. This method would probably use more water than the mechanical classification, but would give more efficient elimination of the slimes. Units for handling large tonnages are available as standard equipment.

3. The washed gypsum may need dewatering before stacking. A mechanical classifier product should be dry enough to be handled directly to a conveyor belt. Sloping conveyor belts may be utilized for further drainage if necessary. The product from the hydraulic classifier may require filtration. A vibrating screen dewaterer as used for drying sand sized coal would probably be suitable.

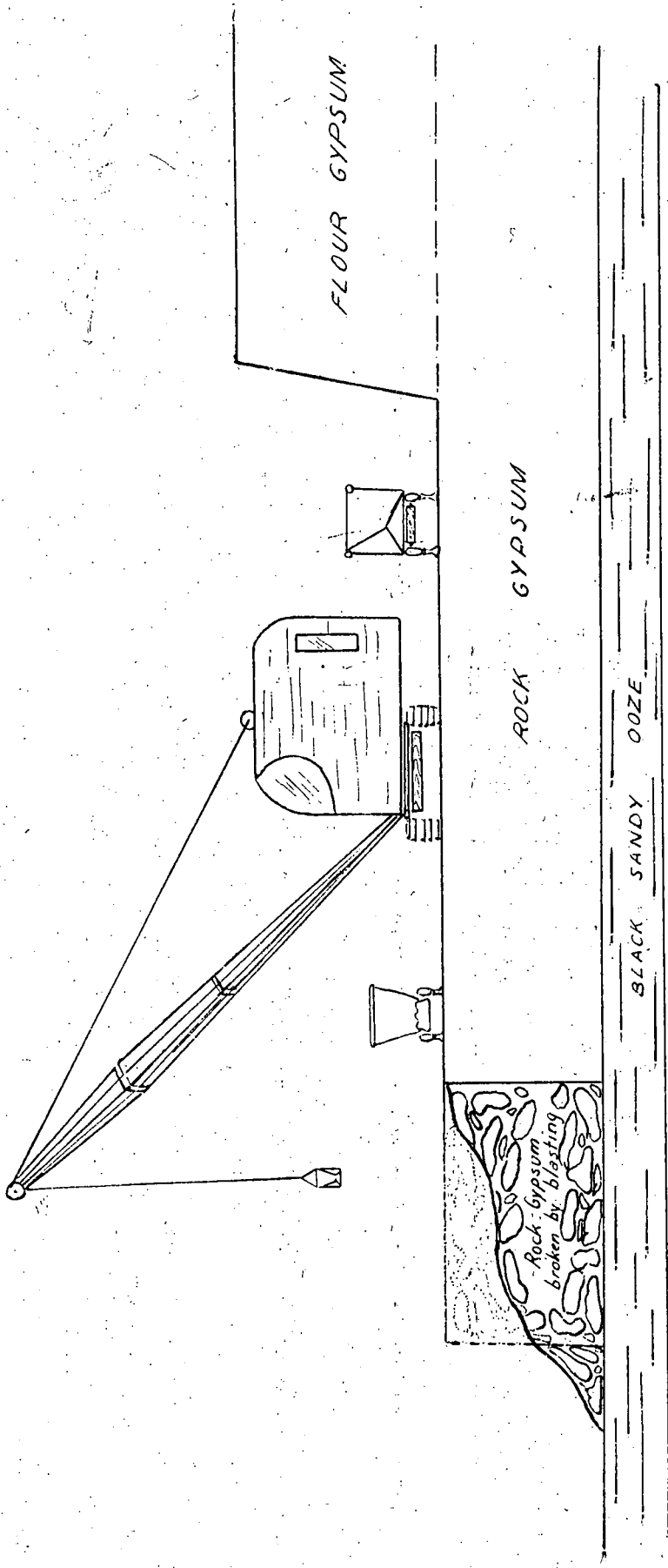
4. Disposal of the unwanted slimes would either be to settling dams, or drainage to the sea.

5. Rock gypsum washed in salt water is usually stored in stacks about 30 feet high to allow rain-water leaching of the soluble salts. This method will not be quite as efficient with the finer material. However, it is used successfully with salt stacks for removal of magnesium salts. The leaching would be more efficient if the dumps were not made so high, and if made on prepared bottoms of cocoanut matting, wooden slats and drainage launders.

Proper drainage should be supplied to enable the gypsum to dry more freely. It will usually hold more moisture than the rock, with consequent higher freight costs. In this respect, the practice of burning the gypsum on the washery site has much to recommend it.

3.7.50
NJ:EAK

Norton Jackson, B.E.
METALLURGICAL ENGINEER



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	Tcd. V.			
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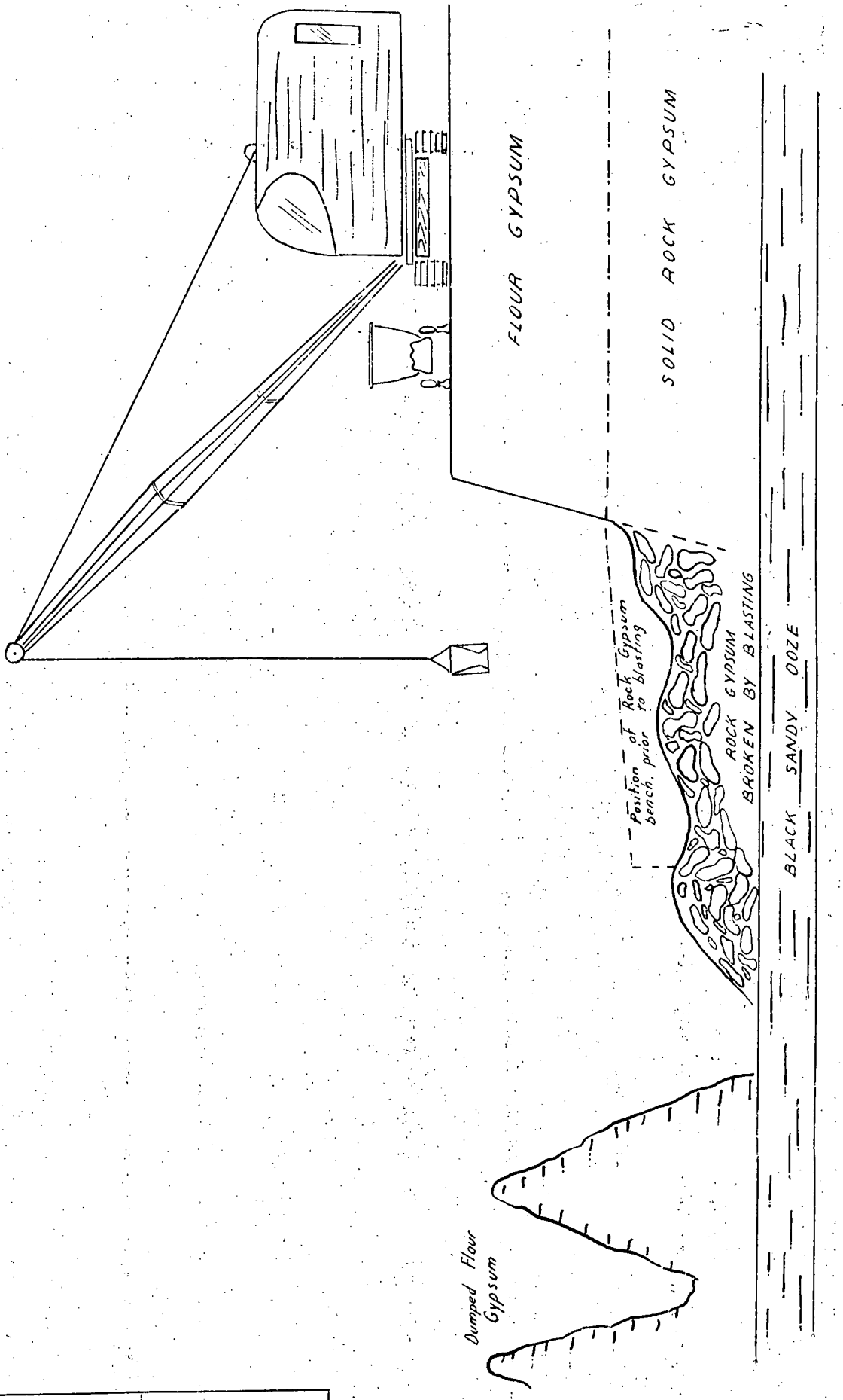

Req. No.	D.M.			
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	Tcd. L.B.			
	Ckd.			
	Exd.	C. D.		Date 30.6.50