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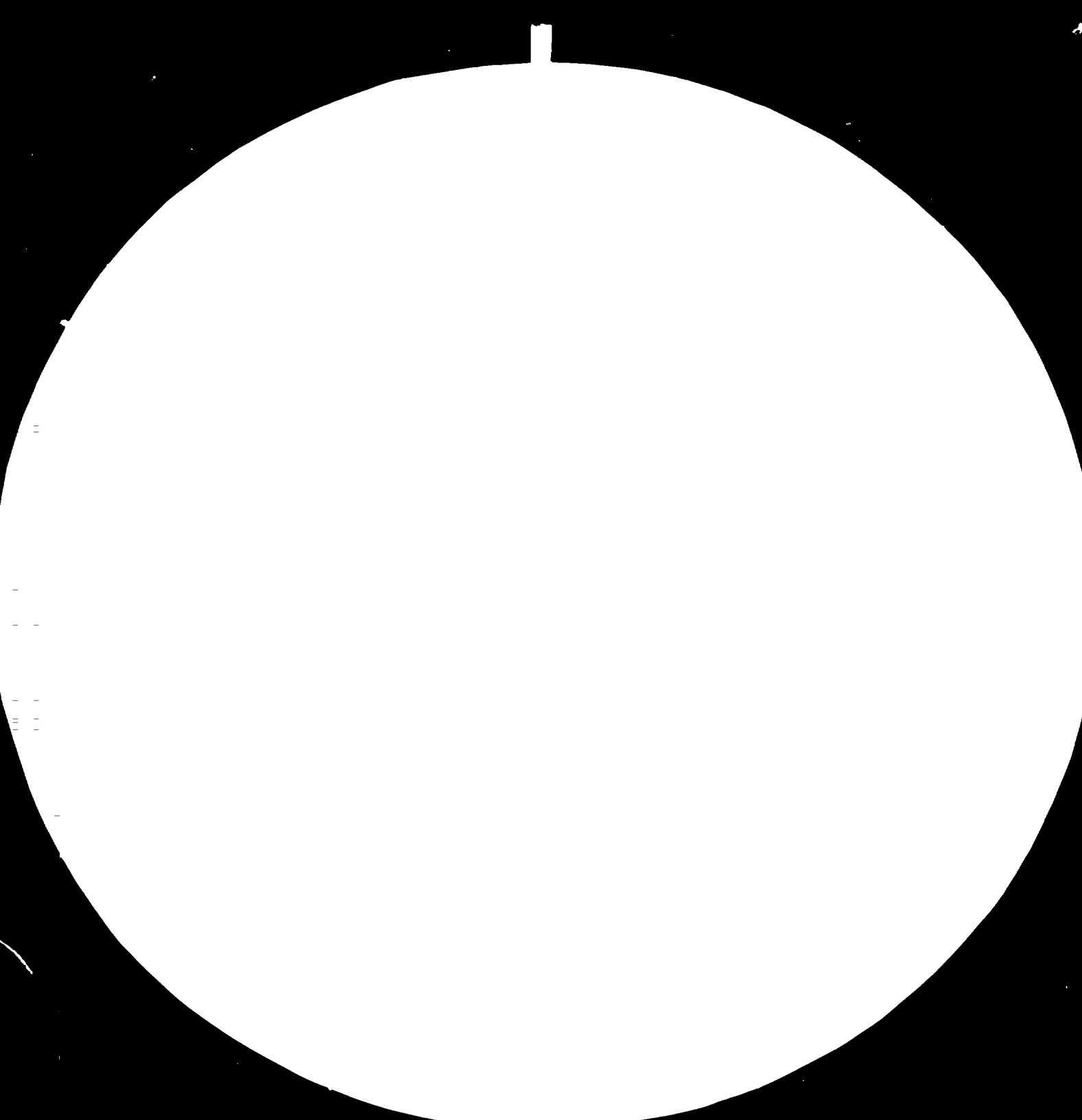

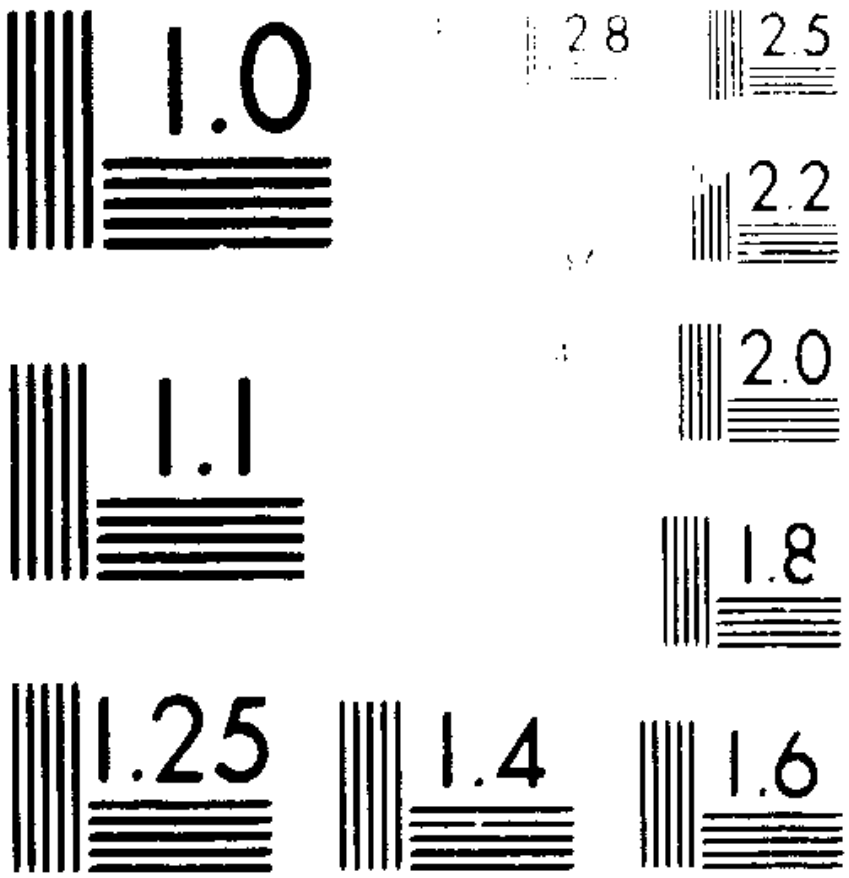
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EXPERT SERVICES AND FELLOWSHIPS FOR BUILDING MATERIALS AND NON-METALLIC MINERALS

DP/CPR/79/019

CHINA

Terminal report

Prepared for the Government of China
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of E.C. Maccari,
expert on marble and granite processing

United Nations Industrial Development Organization
Vienna

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Explanatory notes

References to dollars ($) are to United States dollars unless otherwise indicated.

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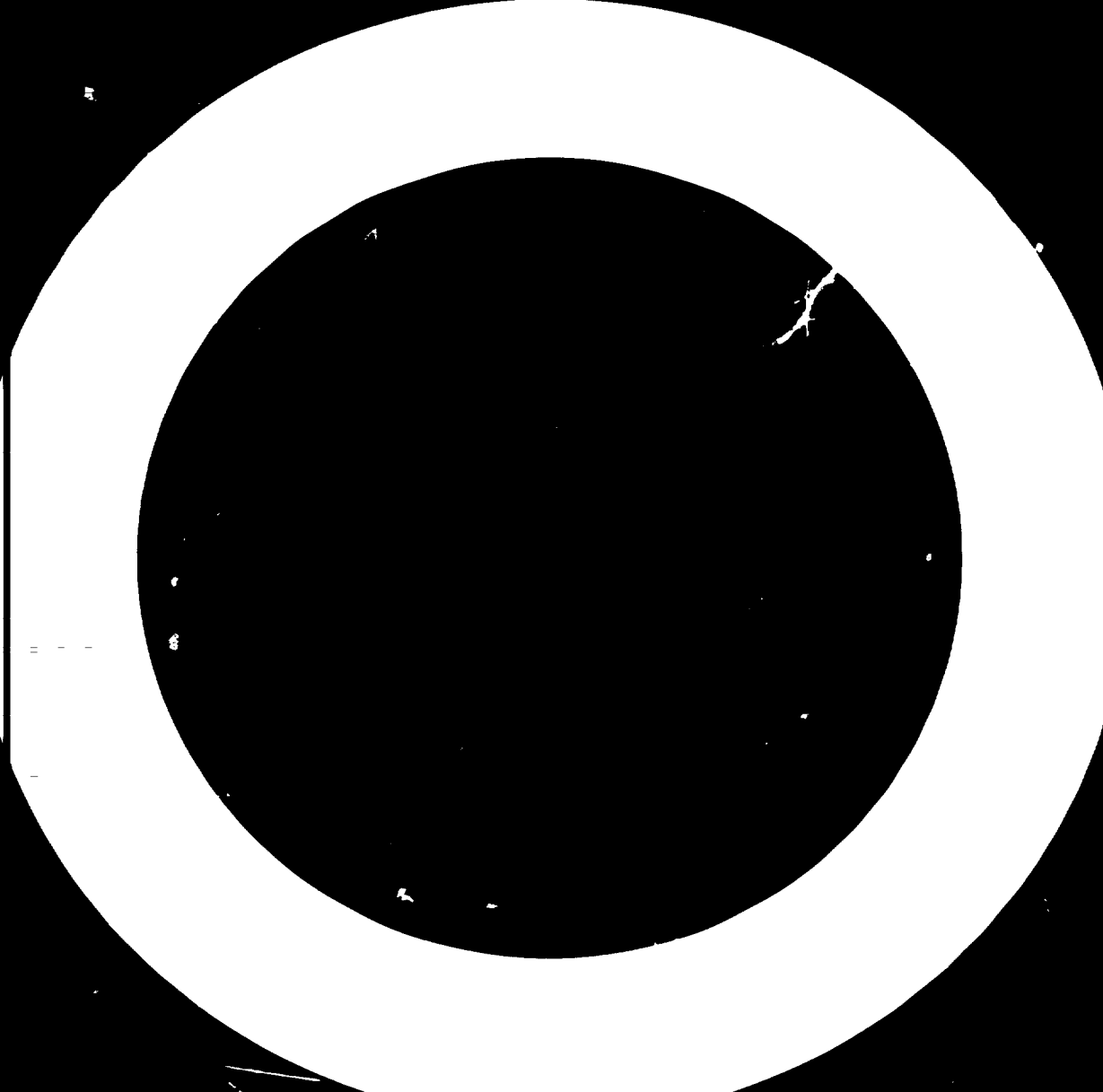
ABSTRACT

The project "Building materials and non-metallic minerals" of the United Nations Development Programme (UNDP) in China was carried out by an expert in marble and granite processing from the United Nations Industrial Development Organization (UNIDO), which was the executing agency. The project was for one month.

The main objectives were to help to increase the expertise of the Hangchow and Shanghai marble factories in the field of marble processing, to give lectures on the modern technologies used in the processing of marble and to prepare guidelines to improve the technologies being applied.

The expert's findings indicate that short- and long-term development plans for the Chinese marble industry should focus on the modernization of the technologies, improvement of quarrying and production techniques and upgrading professional skills with training programmes. Guidelines and steps to be taken during implementation of short- and long-term plans are given in detail by the expert.



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INTRODUCTION

The project "Building materials and non-metallic minerals" of the United Nations Development Programme (UNDP) in China was carried out by an expert in marble and granite processing from the United Nations Industrial Development Organization (UNIDO), which was the executing agency. The project was for one month.

The main objectives were to help to increase the expertise of the Hangchow and Shanghai marble factories in the field of marble processing, to give lectures on the modern technologies used in the processing of marble and to prepare guidelines to improve the technologies being applied.

On his arrival in China the expert stayed three days in Beijing. The Building Materials Ministry proposed a plan of work for his stay in China which caused some changes in his original programme. The first task of the expert was to visit the plants. Though the time was short, the expert formed the impression that he should try to do the following:

(a) To make it understood that the most important handicap of the industry was the lack of adequate blocks;

(b) To assist the Government authorities to organize the work by modern management techniques and to analyse production costs.

The expert's findings indicate that short- and long-term development plans for the Chinese marble industry should focus on the modernization of the technologies, improvement of quarrying and production techniques and upgrading professional skills with training programmes. Guidelines and steps to be taken during implementation of short- and long-term plans are given in detail by the expert.

I. FINDINGS

China is rich in marble and granite. Work in this field started in 1955 and was further developed in 1973. According to Government data, 350 marble and granite quarries are being worked; the State administers 40 of these and the farmers' communities administer the rest. In addition, there are 50 plants to work the marble. The annual output is as follows:

Quarries:	30,000 m^3 marble blocks, none for export
	10,000 m^3 granite blocks, almost all for export
Plants:	400,000 m^2 slabs and marble products with a basic thickness of 2 cm, of which about 10,000 m^2 are exported

In 1979, the total export value was about $9 million.

In the State industries, 10,000 workers are employed and 30,000 in the plants and quarries managed by the farmers' communities. The cost of labour increases the cost of the finished product by about 20%. (A concrete analysis of production costs cannot be done because modern techniques are lacking.)

The plants the expert visited have the following features:

(a) A strong labour force;

(b) Modern (30%) and old-fashioned (70%) machinery, which is not properly utilized (some machines are copies of foreign models);

(c) Organization of work that is different from the occidental one, partly to utilize the number of workers;

(d) A conception in the making and employment of tools different from the occidental one in that every plant produces its own tools with a consequent increase of costs and loss of quality. However some of these tools are of a good technological level;

(e) Well-kept machines, but working time is lost because repairs are made during working hours.

The quarries that the expert visited near the Hangchow plant have the following features:

(a) Considerable marble deposits, not particularly valuable but suitable for the trade, with good possibilities of exploitation;

(b) Low production rates considering the workers employed and the existing equipment that is not utilized;

(c) A lack of machinery necessary in a modern quarry such as derricks, loaders and modern hammers operated by compressed air;

(d) Production of blocks that are unsuitable for new working technology because they are too small.

The expert noted that there was quite a difference in the technological knowledge of the various units due, he believed, to differences in experience. For example, the Beijing plant produces artistic articles of a good level and prized architectural works, but its organization to produce the materials required for modern building is inadequate to demand.

On the other hand, the Shanghai plant has a rather modern organization. It has a team of engineers alert to every innovation but, because of their restricted means, it must build its own machinery. Because of the impossibility of comparing experience with other people, this machinery is unusable.

The Hangchow plant and quarry has many possibilities of expanding, but has three great handicaps:

(a) The number of workers, which hampers the introduction of advanced techniques;

(b) A lack of knowledge due to the isolation its engineers have been in until recently;

(c) A lack of means to buy modern machinery. (These could be found because a number of countries are willing to give credit to China.)

It would be a good time to support the development of the Chinese marble industry because the few industries that operate in this area are unable to meet current demand, although they are not promoting their products, and they have remarkable possibilities for increasing exports. Also the home market needs marble for public buildings and hotels.

II. PROPOSED ACTION

The expert was requested by the Government of China:

(a) To make concrete proposals on how to improve the Shanghai and Hangchow plants;

(b) To recommend new machinery and modern management techniques.

He did not have much time to analyse the plants: he spent one morning visiting the Beijing plant; two days visiting and discussing improvements to the Shanghai plant; and two days visiting and discussing the Hangchow plant.

Beijing plant

The expert's impressions were:

(a) A strong labour force and an incomplete utilization of equipment;

(b) A scarcity of blocks suitable for modern machines;

(c) A deficiency in home transport;

(d) Badly located buildings and badly adjusted machinery;

(e) An artistic division that produced sculpture and architectural works and employed artisans.

The plant, defined by the Building Materials Ministry as second class, produced all the tools it needed to work the marble and granite and also to build sawing machines and frames in its workshop. However, although the managers have very good theoretical knowledge, they lack experience, other than Chinese, and therefore have difficulty meeting the requirements of modern production.

The expert recommended that the plant should be modernized to produce the marble and granite necessary for public buildings and should develop the artistic division for restoration works. For manufactured articles, for which a large labour force is required, the marble industry has the possibility of increasing its exports because of the high level of the product and its competitive cost.

Shanghai plant

The Shanghai plant is defined by the Building Materials Ministry as first class; it is the most modern factory in China. It employs 500 workers and produces 75,000 m^2 annually of finished products for building. It also produces granite precision instruments, artistic objects and architectural products of a high quality, and exports 80% of its production. It uses about 400 m^3 of blocks annually.

The plant is self-sufficient and produces all the tools needed to work marble and granite. It builds machinery to work the marble in its machine-shop, and built its own building. The machines and frames producing the slabs are well kept and, because of the right choice of sands and tools, have a production equal in quantity and quality to the European one. Yet, here, also, there are the usual defects characterizing the Chinese stone industry: lack of suitable blocks, and lack of organization and opportunity to compare their own experience with that of others.

The plant's engineers try to build modern machinery themselves, but that machinery is not utilized except for two belt sawing machines.

The plant's managers have envisaged the following objectives and asked the expert's opinion of their realization:

(a) To reach an annual production of 200,000 m^2;

(b) To reduce production costs by increasing the output;

(c) Ways of using the marble pieces discarded during the working process.

As there was insufficient time to make a detailed plan, the expert proposed the following:

To reach an annual production of 200,000 m^2, the programme should be planned in two phases. The first phase should include the introduction of a few modern machines, one diamond disc block-cutter, one tile squaring machine and one automatic polishing machine. Such equipment would increase the annual production to 200,000 m^2 and the workers could practice modern production techniques.

The second phase should include the establishment of two plants equipped, like the first one, with breaking machines, and a diamond frame able to produce annually 40,000-50,000 m^2 of marble slabs with a thickness of 2 cm.

It was advised that suitable sized blocks be quarried to obtain better results from the modern machines currently used.

To reduce production costs by increasing the output, the expert suggested a working plan for the existing machinery, which should be divided into four sections, as follows:

(a) A section to saw the blocks. In this section, the working of marble should be separated from that of granite and the best available frames, among which is a large Italian frame, should be used to saw the granite;

(b) . section to saw and polish. This section should establish the machinery correctly so that a proper working cycle can be obtained, avoiding time losses;

(c) A section for the finished products. Production should be rationalized according to the measures recommended and the most suitable marble provided;

(d) An administrative section. Production costs are as follows:

	%
Manpower	8
Raw material, tools and upkeep	50
Administration	37
Energy	5

The expert believes that, with the changing of the plant structures, the percentage of cost for manpower should be increased and that for administration should be reduced. Moreover, the latter percentage should cover the cost of advertising.

The expert suggested two ways of using discarded pieces of marble. The first was based on the manufacture of tiles from marble pieces. (This method had been already considered by the plant managers.) The second was teams of workmen supplied with portable polishing machines setting and polishing floors in the building yards made of pieces of marble and cement (Palladiana).

All the proposals made by the expert were fully discussed with the plant managers and Ministry officials.

Hangchow quarry and plant

It had been intended to study the Hangchow plant for several days but only one day was spent at the plant and the following afternoon the quarry was visited together with geologists from the Ministry.

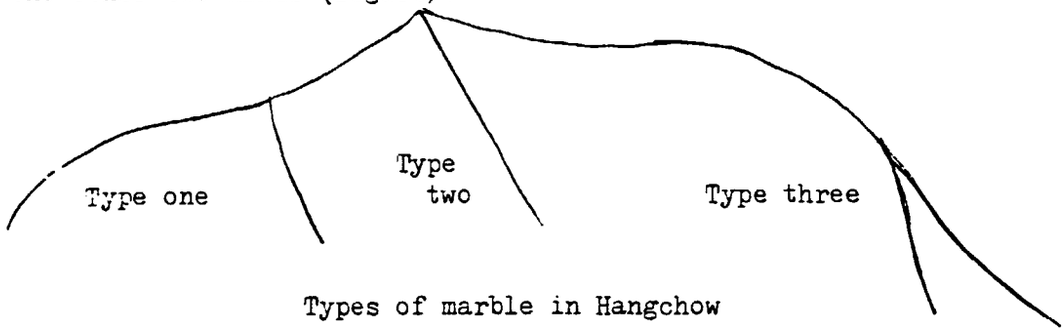
The quarry and plant are about 20 km to the south of Hangchow and the marble deposit on small hills, oriented from east to west, is about 40-60 m high and about 1,000 m long.

The quarry

The marble is stratified with a slope changing from 24 to 60 degrees in three superimposed layers that change colour. According to a very precise geological study done by the Ministry, the deposit is estimated at about 10 million cubic metres. This kind of marble is not very prized and it has on its stratification plane some open veins. Even so, it can be used for many purposes.

The type of marble most prized has a basic colour with some red veins; other types have a base that is less grey and have very large calcite veins.

The problem is to mine marble of the darkest kind, without removing the bed of the other two kinds (figure).



Types of marble in Hangchow

The features of the first type (which is similar to the other two types) are:

		%
Chemical composition:	CaO	54.12
	MgO	0.12
	SiO_2	2.33
	Al_2O_3	0.09
	Fe_2O_3	0.10
	CO_2	42.30
	Other	0.85
Relative density:	2.7	
Resistance against compression:	800-4,000 kgf/cm^2	
Hardness:	about 2.5 Moh scale	

There are three open quarries and in two of them a helicoidal wire is used with a horizontal and vertical cut of 150 m. The bench obtained is cut into blocks 160-180 m long using compressed air. The quarries have three modern Japanese compressors of 10,000 l/min.

The quarry produces 700-800 m^3 annually. There are 70 workers in the quarry and an undefined number of agricultural workers who are assigned to produce scabblings to make lime. The admittance road to the quarry is good and there are no obstacles to opening other quarries. At many points of the deposit there are vertical fractures that can facilitate excavation. The plant is placed at the bottom of the hill and it is supplied with frames, sawing-machines and polishing machines like those of the Beijing and Shanghai plants. The plant has a division that produces artistic articles, however, the quality of products is lower than those produced in Beijing. It produces

the tools and abrasives that it needs in its workshop.

There are about 200 workers in the plant; annual production is about 20,000-25,000 m^2, the percentage of the finished product is very low. The blocks made by the frames are very small and have deep scratches from abrasive (iron fillings) that is too large. Also they are badly cut. The product is carefully selected and the packing is good. About 70% of production is exported.

The objectives of the Hangchow managers are:

(a) To increase the annual quarry production from 700 to 5,000 m^3;

(b) To increase the annual factory production to 100,000 m^2;

(c) To obtain a marble production with thin thicknesses;

(d) To establish a division to work the granite.

The proposals to increase and improve the Hangchow quarry and plant are as follows:

Quarry

(a) The helicoidal wire righter, which makes much deeper cuts than the present ones, should be used,and a perforator should be used to obtain proper cuts in the channels;

(b) Modern pneumatic hammers and compressed air drills, able to make horizontal and vertical holes at superior depths than those reached now, should be obtained;

(c) Chisels for the drills should be chosen with wide tips so that they can reach the necessary depth;

(d) A derrick with an arm .30 m long should be put in the main quarry to facilitate the moving of the blocks, which will be larger than the present ones;

(e) A loader with a power of 100-150 hp should be bought to open new roads and load the scabblings.

The introduction of these new machines will facilitate attainment of the following objectives:

(a) To increase production and diminish costs;

(b) To open a new quarry to exploit the darker marble, which is abundant. This would take a lot of work as the lighter marble layer has to be removed first. It would be possible and profitable if a part of the lighter materials were utilized for the production of blocks and to produce lime. First, a careful study should be done to work out how to cut the blocks parallel to the layers because the deposit has a slant of from 24 to 60 degrees;

(c) To exploit the presence of a big natural fracture on the right side of the main quarry to increase the height of the mining wall and facilitate the cutting of the blocks;

(d) To consider the utilization of scabblings, after granulation, in the manufacture of terrazzo tiles, from those quarries where the darkest marble is processed. This will be a more profitable approach than the present way of using scabblings in the manufacture of lime.

Using new machinery, it should be possible to produce annually 3,000-5,000 m^3 of blocks. Blocks could also be made of the lighter marble which, in the expert's opinion, because it is particularly sound, may be sold in low-priced markets.

The plant

A new way of working should be introduced based on the use of a block-cutting machine and ancillary machines that will increase the annual production from 20,000 to 25,000 m^2. This equipment, which is the same as that recommended for the Shanghai plant, will have to be mounted with the collaboration of the city's engineers.

When the quarry can supply suitable blocks, it is suggested that a frame with diamond blades, able to produce annually 25,000-30,000 m^2 of slabs, be used together with the best frames presently available to saw the granite.

The Hangchow plant should be first on the development programme so that the sale of the blocks that it will mine will finance the purchase of machinery for the factory.

III. RECOMMENDATIONS

1. A plan giving short-term and medium-term aims should be drawn up.

2. The first short-term aim should be to modernize the quarries, equipping the best ones with modern machinery to enable them to produce suitable blocks.

3. Machinery for the quarries and plants should be chosen with great care in order to avoid mistakes made previously. It should be based on simplicity and compactness to allow amortization at low cost.

4. If it is possible, the machines should be selected by seeing them working, not from pictures.

5. The blocks produced in the quarries equipped with modern machinery should be exported to finance the purchase of new machinery for the factories.

6. Representatives of the stone industry should take part in foreign fairs so that Chinese marble and granite will become known.

7. Some modern equipment should be purchased abroad, such as diamond frames, block-cutting machines with diamond discs, and ancillary machines so that the workers can be taught new techniques.

8. Some engineers should be sent abroad to study new equipment for the quarries and plants.

9. A trade organization should be created with the aim of orienting production towards the products most in demand and to ensure a constant flow of orders. It should also increase the sale of the artistic articles that are already competitive in the international market.

10. A research group should be created to analyse production costs and programme development in accordance with Government plans.

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