CONSIDERATIONS ON ECONOMIC POSSIBILITIES AND DEVELOPMENT OF TURKISH MARBLES

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I. INTRODUCTION

In many countries, besides Turkey, marbles (dimension stone) and cut stones in general are not yet protected by an adequate mining law defending and assisting them in developing and industrialization.

Turkey, from a general viewpoint, can offer an enormous potential reserve of materials, such as marble, stone, onyx (onyx marble), travertine, granite, etc., often of excellent quality, that could prevail on the world-wide market.

At the present time the quarry mining conditions are in most cases primitive and in an artisanal stage. When mechanization exists, it consists of pneumatic hammers solely, obtaining only about 30-35 % block production of the whole material exploited. Many areas prospected in detail (maybe covered by private industry permissions) are not exploited for lack of budget allocations or are subjected to a sporadic exploitation for road paving blocks, tombstones and mosaic work, whereas modern engineering can offer excellent equipment for obtaining quarry's maximum production with minimum material waste.

As concerns marble factories, few of those visited are well equipped. In many factories there are inadequate systems of working or inadequate materials. For instance, looms operating with coarse calcareous sand instead of fine-grained siliceous sand for obtaining homogeneous cuts.

All this leads to a high cost of production even if the workmanship cost appears, on the whole, comparatively low. Collateral industry of marble is represented by the mosaic working in different sizes of grain. Actually, in the areas examined application of mosaic in building represents 80-90 % of the total use of material for pavement, lining, covering, stairs, etc.

Although better in quality and appearance, compared with mosaic, the «Palladiana» —formed by fragments of marble, different in kind and maybe color, and cemented to form an artificial breccia— is not yet taken into consideration by building draftsmen. Moreover the price of «Palladiana» at present is five times higher per square meter than that of the mosaic.

Now let us take into consideration the different branches of marble industry in order to examine the development possibilities.

II. ACTUAL PRODUCTION AND EXPORT ACTIVITY OF THE TURKISH MARBLE INDUSTRY

Among countries producers of dimension stone in the world, Italy occupies the first place, with yearly production of 1,740,000 tons, U.S.A. is at the second place, with 500,000 tons, then follow Spain, Balkan Countries, Belgium, France, Germany and—as concerns granites—Scandinavian Countries and Brazil. Data are related to 1964-1965 (1).

Turkish marble production from 1960 to 1964, reported in the «İstanbul Ticaret Odası Yayınlarından Türkiye'nin Toprakaltı Servetleri, 1965» publication, is the following:

Year	*Production (m^3)*
1960	14,000
1961	15,000
1962	16,000
1963	15,000
1964	20,000

In the above-mentioned publication neither peculiarities of marble nor its quality are reported.

As known, there are qualities peculiar to every kind of marble, relative to its color, grain size, impurities, presence or absence of fracturing or «peli» (piles).

From a general point of view, in the world marble market exists a commercial gradation of three qualities. From what could be observed in the area of Afyon Vilayet, 60-70 % of production are given by blocks of third quality, 30-40 % by blocks of second quality and 10 % by blocks of first quality liable to be exported.

Such low percentage of the first-quality block production is due mainly to inadequate mining equipment. As concerns the marble production of the Marmara Island (in the neighborhood of Saraylar Köy), the percentage of the first-quality block production increases, at times, to 30-35 % of all the blocks worked.

This increase of first-quality block production is due primarily to the lithological and structural peculiarities of marble layers and to the experience of the quarry workers. In Italy, for instance, first-quality dimension stone production can be estimated at 60-65 % of the whole production. Thus in 1964, the entire marble production of Marmara Island has been 10,000 m^3, corresponding to the 50 % of the whole national production in the same year.

The Turkish marble export activity, taking into consideration data related from Devlet İstatistik Enstitüsü reports from 1958 to 1964, is the following:

Year	Export (m^3)
1958	28.3
1959	264.0
1960	285.7
1961	785.0
1962	1115.6
1963	1475.5
1964	1781.3

Observing 1964 marble export activity and considering potential reserve of country and possibility of world market absorption, actual export movement can be considered still insignificant. In percentage it represents only 8.9 % of the whole national marble production of 1964.

Considering economical advantages of the marble industry and export activity, we can examine the biggest producer countries in the world : Italy and U.S.A.

In 1965 Italy exported more than 750,000 tons of dimension stone and worked material (2), corresponding to 44.4 % of national production with an amount of sales of 50 million dollars. In 1963, U.S.A. sold 2.5 million dollars worth of short tons of dimension stones and worked material as well as basalt and sandstone worth 96 million dollars. Imports in the States have been estimated at about 20 million dollars, mainly from Italy, Spain, France, Greece, Portugal, Belgium, Luxemburg and Mexico. Dimension stone export activity of the United States concerns mainly Canada, with 1.6 million dollars (3).

III. RESERVE ESTIMATION AND LABORATORY TESTS

The reserve estimation must be made with a detailed survey mapping on 1 :25,000 scale, with the utmost attention given to boundaries, lithological facies and color changing. The direction, orientation and frequency of the fracture system must be considered and studied in detail. Thickness and volume of overburden must be investigated and calculated. It is obvious that the economic value of the marble beds depends on the possibility of producing blocks of commercial size as well as on their homogeneity in color.

Secondly, a statistical sampling, advanced to a certain depth, must be made over the entire area under investigation, where outcrops have been previously surveyed in detail. Locations for opening quarries must be determined after a detailed survey in 1 : 1000, 1 : 5000 and 1 : 10,000 scales, and particularly sampled with trenches or exploration holes, arriving, if necessary, at a mining marble pilot production of about 20 m^3. Samples must be taken with greatest possible caution, avoiding shocks or work system that could invalidate in future mechanical, chemical and petrographical test laboratory results.

Laboratory tests are of the greatest importance both from technical and commercial point of view. Foreign countries are reluctant to buy marble not provided with mechanical, chemical and petrographical tests. Later on, in architecture, the mechanical, chemical and petrographical properties of a stone, and naturally its color, will be

the factors in determining the employment of marble for different purposes, such as pavements, lining, covering, stairs, etc.

Influence of particular minerals, pigmentation or structure in a stone can result in variations both of color and intrinsic physical properties of material, if subject to determinant atmospheric conditions, environments, mechanical stress and wear.

IV. DEVELOPMENT OF QUARRIES

Observations made on present quarry mining indicated that :

1. Work system inadequate, still in an artisanal stage,
2. Mechanization scanty or lacking,
3. Equipment, when existing, consists only of pneumatic hammers.

At present, in Turkey there are only four helicoidal wire equipments for cutting marble. One is working in the white black-veined crystalline limestone, outcropping in the vicinity of Sapanca in Sakarya Vilayet. The exploitation belongs to a Turkish-French firm. Others are in Belevi Köy (Selçuk-İzmir) (not yet operating); in Süpüren (Eskişehir); and in Akhisar (Manisa) (Turkish-made equipment).

The problem of mining mechanization and industrialization of the quarries is very large and naturally involves not only economical factors, but also planning and technics. The modern technics of the marble-mining industry offers a large scale of equipments.

The selection of equipment must be made considering manifold factors, of which the principal are:

a. required production,
b. lithological kind of material,
c. structure of material,
d. structure and disposition of outcrops,
e. demand and cost of foreign markets,
f. peculiarities and cost of similar material produced by other countries.

From a general point of view, we cannot trust equipment that does not resolve in a positive way the above-mentioned problems. Such problems can change from outcrop to outcrop, from environment to environment, and sometimes even in the same outcrop from quarry to quarry.

Because of these facts, it is not economically feasible to work with inadequate or outmoded equipment in a country such as Turkey, where the marble industry is still in the embryonic stage of development. Modern and adequate equipment must be considered in future programs, absorbing quarry planning, not only with regard to national production, but also observing foreign producer and exporter countries equipment, so as to know better possibilities of opening markets in foreign import countries. Only in this way Turkey can enter in competition with other producer and exporter countries. These countries have already finished the planning stages and nowadays are in full production and exportation activity.

V. WORKMANSHIP QUALIFICATION STANDARDS

Workmanship qualification problem in the quarries must be approached substantially in the sense of training workmen in handling mechanical equipments.

Observations made in the quarries examined proved that there are able quarry foremen and they know marble working. From a general point of view, there is a need of management and adequate equipments. There is, in other words, the stope organization problem, or better, the mining program problem.

Thus, like any other mining activity, marble quarrying needs a mining project, in order to plan work within a definite period of time. Quarrying must be followed in its development up to the production of blocks and also with constant investigation on the spot made by a marble specialist. A work and production project must be compiled. New production points and choice of suitable cutting places must be advised. All this on a monthly or yearly plan, taking into consideration the problems of economical and practical factors.

As concerns the use of equipment, the M.T.A. Institute must compile an experimental table, showing equipments, working peculiarities and output. Such tables must also indicate what kind of material equipments can be used more successfully. Naturally, in compiling the above experimental data, the M.T.A. Institute can benefit from the experience and specialization acquired by foreign countries in this branch.

On the whole, we think that with a stage of training varying from two to six months any quarry foreman will be able to operate even the most modern equipment, if supervized by specialized industry technicians.

VI. FACTORIES

From a general point of view, the industrial concerns that use materials coming from marble quarries — for instance those in Ankara, Afyon and Marmara Island — are sufficiently well-equipped for actual production. If we can speak of defects or lack of equipment, these can be related to the same working technics. It could be observed, for instance, that the «charge» on the loom is made often with material of different hardness, in detriment, naturally, to the output of the loom, thus shortening the lifetime of the equipment. Most of the factories employ inadequate sand (often of coarse calcareous grains) for cutting the marble. The result is a high discard percentage of the whole material cut. This discard percentage is naturally influenced by cheap quality of blocks.

Presently there is only a factory in the vicinity of Gemlik (Bursa Vil.) for materials such as granite, gneiss, diabase, and similar rocks.

More factories could be installed — especially for interior market — in the neighborhood of areas presenting potential marble reserve and equipped with modern equipment. These factories should work full time (24 hours per day), as is customary in European and American countries.

In particular, the industrial exploitation of hard materials, such as granite and effusive rocks, should be developed. Presently the only effusive rock mined by the marble industry is the Gemlik diabase. Granite is not mined and other intrusive rocks are employed in general only for paving blocks.

VII. COLLATERAL INDUSTRY

Possibility of employment of overburden and discard material should be considered. Discard material and overburden coming from quarries arc presently employed, as said above, mainly in mosaic industry (90-93 %), while «Palladiana» finds very few applications. In this matter, a marketing analysis was conducted in Afyon and Denizli Vilayets, sounding public and private opinion -among draftsmen architects.

A large scale of mosaic employment in its different granulometrical size is due above all to the low product price (about 15TL. per m^2), while the cost of Palladiana is actually five times higher. Reasons of high cost of Palladiana can be found in the following motives :

1. Palladiana is manufactured with discard material coming from factories and not from quarries; that means that apart from the raw price the cost is influenced by the working cost in the factory.

2. As manufacture is handmade, requiring placing fragments in cement and consequent smoothing and polishing, it naturally increases once more the cost.

Actually on the European market there are equipments with full-time working cycle producing about 10 m^2 per hour of Palladiana slabs binded with normal cement or with synthetic resins.

With such equipment, and employing directly discard materials from quarries, it is possible to lower considerably the final product cost. Palladiana manufactured in this way, besides national market, could be object of export in countries such as Lebanon, Syria, Pakistan, Africa, etc.

Moreover discard materials and overburden can find very large employment in modern industry like calcium carbonate. Often marble presents a very high percentage of this mineral and in this way can be used with more profit. Employment of $CaCO_3$ powder finds large applications in caoutchouc industry and mixed with mica powder is used in paint industry. Turkey employs in these two industries about 10,000 tons of calcium carbonate powder per year. Other industry branches employing calcium carbonate powder on large scale are those of metallurgy, cellulose, rubber, soda-ash, caustic soda, paper, glass, sugar, etc.

In cases when quarries are not very far from center of working and employment, discard material coming from quarrying can offer a large and profitable employment.

VIII. MINING POSSIBILITIES OF ROCKS

Crystalline limestone, variously colored, limestone, travertine, onyx marble and many other rocks abundantly outcropping in Turkey can be mined and employed as cut materials and used for modern architecture.

There is the whole range of intrusive rocks, such as granite, syenite, diorite, peridotite, gabbro, that if subjected to particular working systems, especially as regards sawing and polishing, can give very good results and a very nice appearance. Likewise, serpentine — if treated with special polishing technics with paints — can also give excellent results. Effusive rocks, such as porphyry, andesite, trachyte, tuff, showing

particular grain and typical minerals, may be cut, polished and employed like ornamental materials in buildings.

Naturally, what is exposed above applies to inalterable rocks that can offer economical possibility of giving blocks. A large scale of the rocks mentioned above is already widely and successfully employed and required by foreign countries.

IX. MINING LAW PROBLEMS

There are numerous problems related to marble mining laws, which involve private mining permission, industry mining permission and those of actual legalization. Today the Turkish mining marble law presents two possibilities :

1) A quarry permission can be taken. Permission area is varying and depending on different factors. Permission duration is of 25 years, but generally is granted for five years only. Upon expiration of this permission, it is given to the highest bidder. Governmental tax is fixed in proportion to an estimated yearly production.

2) If dimension stone is exportable and used by industry, quarry permission can be changed into a mining permission. Mining permission has a 2,000 hectares maximum per permission. Permission holder is compelled to pay a 2 % tax on quarry FOB price per m^3 in a year. The permission duration is of 99 years.

The second possibility is more expensive but offers a larger duration security. On the other hand, the first possibility even though of shorter duration, seems more convenient when the quality and reserve of the material are not economically satisfactory.

For afore-mentioned reasons, in both permission possibilities a detailed previous survey is necessary, with exploration trenches, sampling and laboratory tests.

It was often observed, in the Denizli and Afyon Vilayets, that although permissions were taken by private enterprises for areas showing sometimes excellent material, either the exploration was badly conducted or the area was not exploited at all. This is due mainly to lack of adequate budget allocations and the absence of proper organization. In future permissions could be given to large, adequately-equipped firms and in this way assure a maximum of production within determined time, varying with stone value, potential reserve, interior and foreign market requirements, etc.

In the field of export activity, the fiscal facilities could be established, without bureaucratic and fiscal burdening, in the way to tempt the marble industry producers, to introduce into foreign markets a greater quantity of material with a competitive price, and tempt foreign firms in buying raw and worked materials from the Turkish marble industry. In order to be competitive, dimension stone's price must be between 100 and 150 dollars per m^3 at the quarry.

X. INTERIOR AND FOREIGN MARKETING ANALYSIS

1. Interior market

Relating to 1964 national marble production, described above, we can observe that 91.1 % of marble blocks are worked and absorbed by interior market. Naturally, this data does not report the discard material employed by mosaic industry and small dimension blocks used in manufacture of sinks, basins, fountains, fireplaces, etc.

Taking into consideration prices given for 1965 by the «Bayındırlık Bakanlığı Yapı ve İmar İşleri Reisliği» publication, we can observe that the lowest price is referred to the «Marmara beyaz» marble (90 TL per m^2 for a 2-cm thick slab), while the highest price of 160 TL per m^2, 2-cm thick slab, is for the «siyah» marble (Adapazarı, Hatay, Afyon, Haymana). The same prices, are given for Söğüt «açık yeşil» marble, and the Hacıbektaş «yeşil beyaz» onyx marble. Price of travertine is established as 70 TL per m^2, 2-cm thick slab.

All prices above are naturally related to factory, without transport charges. As concerns 1966, an increase of prices varying from 0.15 to 25 % has been observed in the same publication of 1966.

Prices compared with those existing on foreign markets for marble products, are higher, if compared with the purchasing power of other materials in Turkey. Such high product costs are partly due to the existing working system in quarries, with a high percentage of low-quality blocks which give high discard percentage at sawing.

From 1 m^3 first-quality dimension stone ideally 40 m^2 of slabs, 2-cm thick, could be obtained. If dimension stone is of second and third quality, square meters slab production decreases rapidly.

In the second place, the high product costs are due to the scarcity of factories and to the faults of organization and technics in the existing factories, as mentioned above.

In order to sell in the interior market the blocks and worked marble of such a quality, at a relatively low price, an industrial working concern—proceeding at the same rate with industrial quarry production—should exist.

As regards collateral industry development, such as employment of «Palladiana» and increasing its consumption, it was referred to previously. For interior market development in general, programs preceded by marketing analyses must be made, in order to know demand and absoption possibilities of Turkey. All these factors should be taken into consideration and a program planned so as to obtain product prices accessible to a larger number of customers.

2. Foreign market

Marble mainly required by foreign markets is the pure first-quality white marble, then follow colored marbles and intrusive rocks atractive in color.

In 1964, Turkey exported 8.9 % of national marble production. There are many problems concerning the possibilities of meeting the requirements of foreign markets. Substantially they can be divided in two main groups :

a) In the first place, there are general problems concerning marketing possibilities. Enquiries should be made in order to evaluate the actual absorption by foreign countries of export marble (dimension stone), quality and quantity required, as well as market prices of the country in which such exportation is possible.

It would be uneconomical for the arising Turkish marble industry to establish costly isolated enterprises that may sometimes lead to unsatisfactory results.

Presently the M.T.A. Institute has launched a pilot marble enquiry in order to know from a general point of view the possibility of the world market absorption.

For instance, it is useless to sound the export possibilities in countries such as Greece, Spain, Brazil, etc., because these countries are already endeavoring to establish planning, producing and exporting particular kinds of their marble. Owing to this, market analysis must be directed in evaluating price, quality and quantity of marble actually required by certain countries.

b) In the second place, marketing enquiry must be addressed in considering the exporter countries systems, working equipments and production, naturally taking into consideration the quality and the amount of marbles exported.

Only after having carried out such investigations, in all importer countries of the world, sometimes by direct contact made by participating in symposiums or European fairs, the possibility of introducing the Turkish marble into the world market can be considered.

c) As concerns contacting foreign marble industry, negotiations must be made directly, without mediation of selling agents, which sometimes can compromise or negatively influence export possibilities in a country such as Turkey where marble industry is newly arising.

XI. TRANSPORT PROBLEMS

Connected with industry development, interior market and possibilities of exportation, there is the transportation problem.

With regard to roads in general and access roads to quarries, we can agree that actually the high cost of marble is partly due to lack of these roads. Besides this problem, there is also, lack of accessory equipments, such as decauvilles, «lizze», and winches able to transport blocks from quarries to more easily accessible places for trucks.

Other problems involving quarries located along the sea coast : Wharves with adequate equipment must be built in such a way that cargoes of certain tonnage (about 3000 tons) can moor at loading docks, so that marble may be shipped directly to foreign ports, with no intermediate stops. The above problem is particularly felt, for instance, in Saraylar Köy on Marmara Island. Today, as already mentioned, Marmara Island produces about 50 % of the national marble production. At the Saraylar Koy landing place can moor only 400-ton cargoes. Consequently, marble is shipped from Saraylar to Istanbul, where it is unloaded and then reloaded in bigger cargoes that reach foreign ports.

Transport charges from Saraylar to Istanbul increase by 22 % the base price per m^3 of marble sold FOB on the Saraylar landing place, while base price increasing from İstanbul to Italian ports, for instance, is only 10 %, without considering time lost in different loading and unloading operations.

XII. CONCLUSIONS

After considering the problems discussed in this short report, it is obvious that the Turkish marble industry is in need of organization and plans for its interior development and status in foreign markets. Especially now —in the phase of detailed surveys, reserve evaluations, laboratory tests and analyses— the necessity of such measures is

apparent. Otherwise, other countries with minor potential reserves of marble —from the point of view both of quality and quantity— could contribute to their development and prosperity by introducing their marble into the world market and thus deprive Turkey of this considerable source of profits.

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