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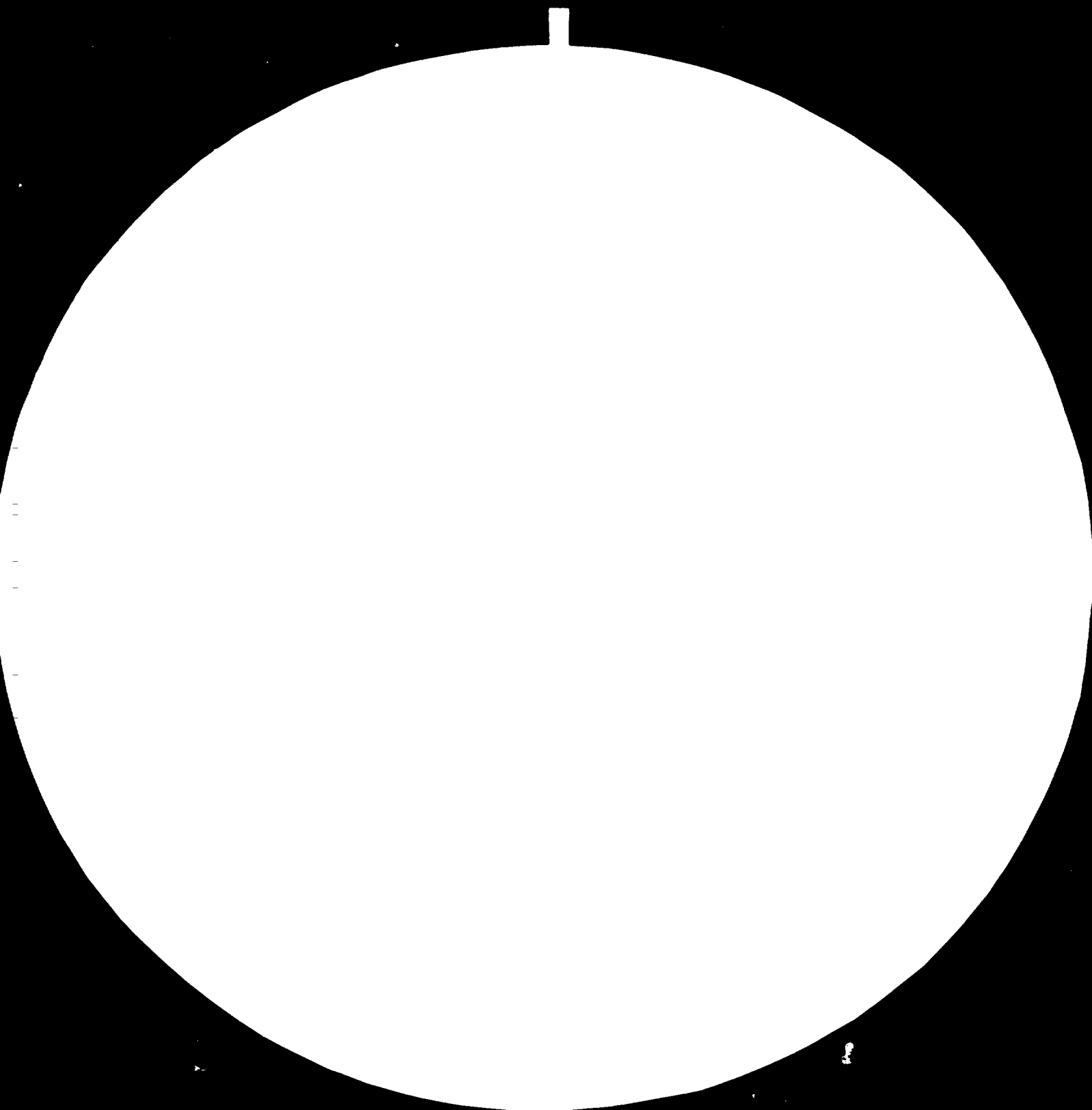

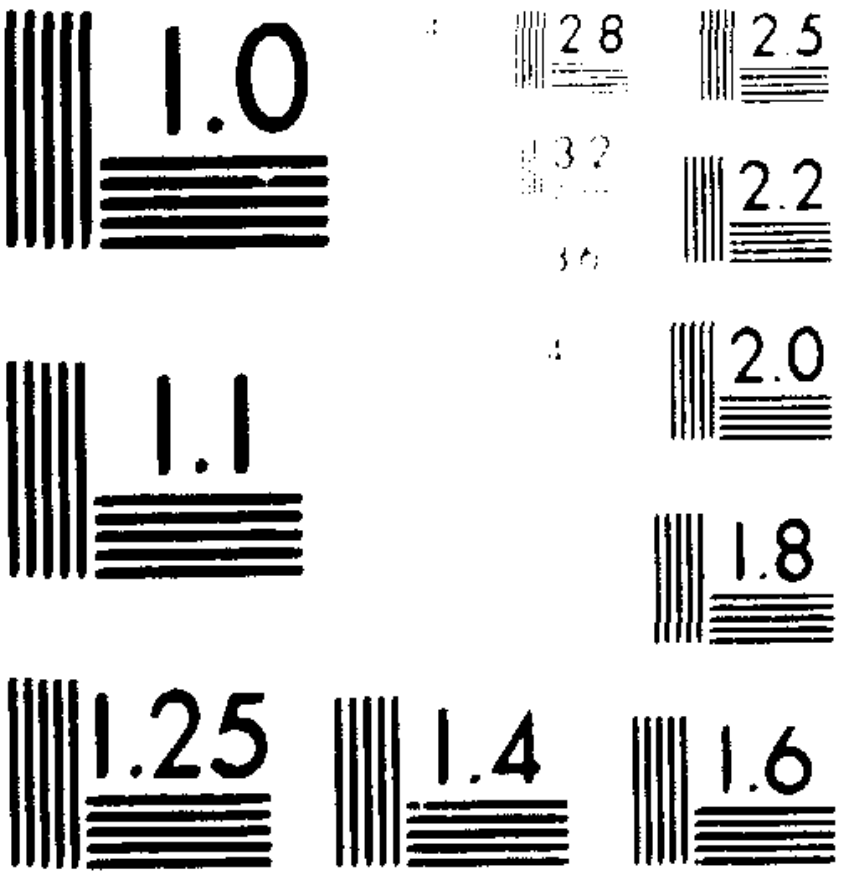
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DP/ID/SER.B/313
27 June 1981
English

10718

PROCESSING OF PRECIOUS STONES IN THE REPUBLIC OF KOREA */

DP/ROK/72/023

Terminal report

Prepared for the Government of the Republic of Korea by the
United Nations Industrial Development Organization,
executing agency for the United Nations
Development Programme

Based on the work of R. Boese, expert in
precious stone processing

United Nations Industrial Development Organization
Vienna

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ABSTRACT

The Republic of Korea requested UNIDO to supply the services of two experts in the processing of precious stones. Mr. H. Meder and Mr. R. Boese were sent by UNIDO for two months each to the Republic of Korea from 15 February to 20 May 1981 to study the existing products and production processes, suggest improvements in them, and participate in seminars. The experts were attached to the Korean Trade Promotion Corporation (KOTRA) and the duty station was the Iri Industrial Estate.

The gem-cutting industry was found to be, with the exception of one diamond company, an almost mono-structure cutting mostly temporarily fashionable Cubic Zirconia (CZ); the remainder was devoted to executing orders or to making unattractive items from a few coloured stones.

The technical outfit of the lapidaries was simple and, though not organized for maximum efficiency, it was just adequate for the limited work carried out. In some cases the lapidaries could be supported with technical assistance.

The raw material supply of rough gemstones is, except for the grey Korean nephrite-jade, fully dependent on import, burdened with institutional restrictions and putting the Korean industry at a disadvantage in the international market. Korean andalusite has been proven to be of gem quality but, unfortunately, it could not be introduced as an additional gemstone within the duration of the assignment.

In conclusion the main recommendations are:

1. Diversification from CZ to a broader range of gemstones;
2. Exemption of rough gemstones from import duties;
3. Development of supply of domestic stones, especially gem-andalusite, amethyst and others which, according to indications, exist in Korea.

CONTENTS

INTRODUCTION

The Iri Jewellery Association (IJA), assisted by the Korean Jewellery Industry Cooperative, was founded as part of the Iri Industrial Estate in the year 1976. All export-oriented jewellery manufacturers and gemstone cutters are, since then, obliged to establish themselves in a custom-controlled common compound within the Iri Jewellery Export Zone. Iri lies about 250 km south of Seoul in the Jeon Ra Bug Do province. There are now about 50 companies in the IJA with two to three thousand employees. The total export volume in 1980 reached approximately US$ 18 million. To improve the quality of processed precious stones, the Korean Government requested from UNIDO the assistance of two experts for two months to solve such specific problems as identification, faceting, cutting and polishing. Mr. H. Meder arrived first in Korea, with duty station at Iri, and served from 15 February to 15 April 1981; Mr. R. Boese followed from 15 March to 20 May 1981. The latter was expected to study existing products and production processes, suggest improvements and participate in seminars on processing of precious stones, held for the benefit of Korean precious stone processors.

Both experts were attached to the Korean Trade Promotion Corporation (KOTRA). Its staff members accompanied the experts, and provided different kinds of services such as introduction and interpretation services, organizing transportation and accommodation, arranging official contacts and even taking care of the experts' personal well-being. The collaboration with KOTRA was very close and in every way agreeable and pleasing.

Contrary to the expert's original intention, only some 20 companies of the IJA could be visited due to shortage of time. Some were served for a short time, others more intensively depending on the problems faced (annex I).

During the expert's assignment, seven lectures were given on selected topics in gemmology at the Art and Crafts Department of the Wonkwang University in Iri (annex II).

Towards the end of the duty in Iri, a seminar was held on gem-processing and marketing (annex IV).

To get further information about the potential of the Korean raw material supply for gem cutting, consultations took place with the KOREAN MINING PROMOTION CORPORATION in Seoul and Prof. Dr. Soo Jin KIM of Seoul National University (annex III).

During Mr. Meder's round of duty, in addition to advice on gem processing, assistance in metal working and jewellery designing was given; Mr. R. Boese, as a gemmologist and mineralogist, exclusively was concerned with questions and problems related to gemstones.

I. ANALYSIS OF PRESENT STATUS

A. Survey of the Jewellery Industry at Iri

1. Production range

Out of a total of about 50 companies belonging to the IJA, more than 40 are engaged in cutting stones, mainly Cubic Zirconia (CZ), [1/] and only about a dozen are processing coloured stones [2/] as well. It could be said that approximately 80 per cent of all stone cutting is CZ cutting, while the remainder consists mainly of the quartz group as rock crystal (in Iri called "white crystal"), irradiated smoky quartz (in Korea generally still called "smoky topaz"), further low grade amethyst, tiger's eye, various kinds of agates, some artificially dyed, and obsidian. From the wide range of other coloured stones, only some are or had been occasionally cut, or are just in preparation to be cut, such as: opal, peridot, garnet, malachite, nephrite-jade, synthetic emerald (Chattam) and synthetic ruby (Kashan), and one firm intends to cut American turquoise.

All synthetics are cut as faceted stones; moreover, some rock crystals and smoky quartz, and even the really cabochon-grade amethyst, is exclusively cut to low quality faceted stones in Iri. The few peridots and occasionally garnets are preferably also cut faceted, while very few cabochons are processed.

The coloured stone cutting in Iri can be described as poor and underdeveloped, cutting of cabochon is fully neglected. There are a few stone necklaces made, mainly from rock crystal and smoky quartz in faceted shapes, but the widespread bead cutting of all types of stones for bead chains is, apart from a few cases of poor uncommercially hand-cut exceptions, not practised at all.

Most of the coloured stone cutting is anyhow done on consignment orders from Japan and the USA, and only a few lapidaries take the risk to process coloured stones on their own account.

1/ CZ is a synthetic product of zirconium-yttrium-oxide and used as a diamond substitute on account of its high refractive index of n = 2.2 close to diamond of n = 2.4.

2/ All gemstones which are not CZ or diamond are called at Iri "coloured stones".

2. Labour force

The majority of the employees are engaged in stone cutting and most of them are under 20 years of age, still in training or with just brief experience. Therefore, the shortage of skilled workers will be only temporary. These young workers are paid comparatively low wages because of their lower productivity. Skilled workers with some years experience are paid $250 monthly and more according to workmanship. There would be, in future, a substantially increased capacity in stone cutting.

3. Diamond cutters

The only diamond-cutting firm in Korea is the KOREAN DIAMOND CORPORATION (KDC) which has had a factory at Iri for nearly five years. It has 80 workers and 40 apprentices of whom only a part can be absorbed later on, as the lapidary is working at a third of its capacity now. Diamonds are mainly cut from 1 to 35 points in size (hundred points come to 1 carat), and the cut is reported to be of higher quality (Belgian standard) which accounts for the relatively high export prices. Three of the staff members had been for one year at Antwerp for training (awarded diplomas), and one Belgian expert had been in Iri for three months. Though contact with Belgium is still strong, the output of finished brilliants in relation to the raw material used (diamonds rough) was in the last few years nearly 50 per cent less compared to that in traditional diamond-cutting centres (Antwerp; Israel), so that the company incurred a loss of several million dollars. The young diamond cutters, after being trained for some years, have to serve in the army for three years, and by the time they return to their jobs, they lose their skills; this is what makes training a very costly and material-consuming task.

The rough diamonds are now bought from the DIAMOND TRADING CO. in London. From next year on, they hope to get on the "buyers' list" and then be able to buy whole "sights" directly and on better terms from the Syndicate.

On account of the small amount of capital available, not enough raw material can be bought to ensure permanent employment for all workers. Through exports only competitive prices could be obtained. Therefore the financial situation is unsatisfactory. To improve the situation, the KDC applied to the Government for a permit to be allowed to supply the domestic market, which up to now is provided for with smuggled diamonds (mainly from Hong Kong); 20 per cent of their production would be for the domestic market while the remaining 80 per cent would be left for export.

Another application is for opening up a showroom in Seoul (not allowed now because of customs' control), rather than in Iri to which potential diamond buyers can hardly be invited.

B. CZ Prospects

The synthetic product CZ was introduced in the market in the mid-seventies. Prior to that there were other diamond imitations as YAG, YIG, GGG, forerunning those synthetic rutile and fabulite (strontiumtitanate), and in the beginning synthetic corundum and spinel were used instead of genuine diamonds, if we exclude the simple strass and simily (glasses).

All these synthetics were fashionable only for a few years; at the start and subsequently, comparatively high prices collapsed and they became very cheap machine-cut mass products, as most of the synthetics in use nowadays are marketed.

The Iri gem-cutting industry participated considerably in the boom of CZ and a lot of money was made in the last years. But there is reason to believe that CZ will go the very same way as its forerunners. Moreover, CZ's are fashionable in the USA and Japan only where by far most of the CZ cut at Iri are absorbed.

In Europe CZ is not and was never in great fashion. People there are fed up with all these synthetics and valueless imitations, and very probably developments in the USA and Japan will take the same direction.

Furthermore, the CZ prospects are already predetermined by the constantly falling prices of rough CZ and accordingly cut CZ too. Two years ago, the export price of CZ cut was around $3, but now it has dropped already to approximately $1.50 for a standard brilliant cut stone of 1 carat. Preceding this development was the collapse of the price of rough CZ. A short while ago, rough CZ on a wholesale basis cost $2.50 a carat. Nowadays the price is 9 cents per carat for transparent white CZ, and the latest US quotations in May 1981 were 6.75 cents for A grade and only 2.75 cents for B grade rough CZ.

The CZ raw material has now reached a price level where machine-cutting becomes very lucrative, despite the greater use of raw material, and it will not be very long before machine-cut stones will be thrown onto the market, causing further price drops until it reaches a level which covers the production costs plus a reasonable profit margin.

The machine-cut synthetics cost less than half of what hand-cut stones cost. The prime cost of hand-cut CZ in Iri is above $1 and there is no way in which this cost can be reduced.

As a consequence, the CZ cutting in Iri will soon not be competitive and today's market will be lost. Even if machines for CZ cutting are introduced in Iri - which looks unrealistic for short-term - only a small portion of the large labour force could be further employed.

C. Technical conditions

The technical outfit and equipment is simple, and though not organized for maximum efficiency, just adequate for the limited work carried out. Practically all the CZ cutting and faceting of coloured stones is carried through on simple, light type hobby machines which are mostly copies made by a local manufacturer.

Preforming and grinding are done with diamond discs, and polishing on scored tin discs with a strange mixture of differently graded diamond powders, Linde A and a so-called "crystal powder". Grinding and polishing are done by each worker on one and the same machine, a fact which professional cutters elsewhere would find unbelievable. Contamination problems on the rotary discs are inevitable and some polishes (even on gems sold in Seoul) were terrible to look at.

Regarding this polishing procedure, the expert was told that working on separate machines was tried before without success; the mechanics of the same types of machines lined up one after another vary too much and the gears which are easily and quickly worn out are uncontrollably different from one machine to the other, one angle adjusted in one machine would not fit with the same angle on another machine.

Despite such conditions marketable gems are still produced and can only be attributed to the painstaking, time-consuming efforts of the workers. The expert saw only one lapidary equipment for cabochon cutting. Most of the cabochon-cutting in Iri, which is indeed neglected compared to faceting, is done fussily on discs which are professionally used for faceting only.

Semi-automatic cutting machines are nowhere in operation, though one company keeps three of them in a store room (each one for preforming, cabochoning and faceting).

It was argued that nobody had been trained to use them, but that somebody should be sent abroad for training in their use.

As to bead-cutting machines, the expert saw several old ones out of order. Maintenance problems forced some manufacturers of bead chains to revive the complicated, uneconomic and unequal bead cutting by hand. Hole drilling is done with most primitive ultrasonic devices, holding the stone to be drilled in one hand while the other is feeding, by means of a simple spoon, the drill-hole with abrasive suspension, with the effect that actually the borings are hardly centred and regular.

In some of the better organized lapidaries there are only early starts of a rationalized production flow.

As a final conclusion, it has to be stated that there is no technical standard with optimum efficiency established anywhere.

D. Raw material supply

Except for the Korean nephrite jade, all raw materials for gemstone processing have to be imported. Much of the material is bought from Japanese dealers, often customers of the companies which buy back finished commodities or place consignment orders for gem cutting.

The largest quantity of rough material is quartz in the kind of transparent white rock-crystal which is to a great part irradiated to smoky quartz. There is a cobalt 60 radiation bomb as a joint set-up of the IJA and serviced by the Cooperative. Some of this artifically coloured smoky quartz is again transformed to yellowish citrin varieties by heating.

There are hardly any direct supply sources from the countries of origin such as Brazil or some African countries, and thus by buying through middle men prices paid are comparatively higher. Practically nobody on the companies' staff has sufficient knowledge about supply sources, market conditions, customary prices and quality ranges.

Furthermore, there are a number of institutional restrictions hampering import, and levy of heavy duties, which puts the Korean gem-cutting industry at a disadvantage against international competition.

There is the customs' security amounting to 400 per cent of import duty on rough gemstones which will be paid back if the cut stones are re-exported within one year. This requirement restrains larger individual enterprises from developing the coloured stone business.

Not only the lost interest rate, but also bureaucratic procedures (application for prolongation of the customs' security tax, export within one year which in many cases is not possible), the bargaining with officials about the loss-percentage of raw material in relation to output and to have to apply even for a recommendation paper from the Cooperative and not to be allowed to export directly but only through a licensed tradi' company, all of this discourages foreign trade considerably. Even to get some sample boxes there is a troublesome and time-consuming procedure to be followed.

II. TECHNICAL ASSISTANCE

A. General advice

Usually after a general survey of each company visited, they were questioned on their particular problems. Hereby typical lapidary questions were raised which were often repeated from one company to the other, for instance: for certain applications what are the most suitable grinding and polishing powders and their specifications, proper dopping cements for special purposes, grinding discs and wheels, types and compositions of lapping plates, etc.

Before setting out on mission, KOTRA had suggested that the expert should buy necessary materials. So all the range of professionally used grinding and polishing powders and dopping cements of one kilogram each, some grinding and polishing pastes and immersion liquids were bought in Germany and reached Iri during the first part of the assignment. These ingredients were made available to each interested company in small quantities for testing and experimental purposes and were highly appreciated; addresses of suppliers and price-lists were distributed.

Furthermore, questions arose regarding gem cutting machines and the possibility of introducing them in the lapidaries (manufacturers' addresses and machine prospectuses were often copied), questions on production flow and rationalization were discussed and economic calculations were made. Some companies had questions of a gemmological kind, e.g. how to identify certain gems

as, for instance, genuine topaz from the misnoming similarities of the quartz-citrin group. Some had material unknown to them and wanted it to be identified (such as dark green Canadian nephrite and blue topaz), some were shown how to use gemmological instruments which existed only in a few companies (I carried the handy ones of my own private instruments and colour filters with me), questions on staining agates were made, also concerning gems in general and specifically, because none of the staff had been given the chance of attending a course in gemmology.

B. Cutting techniques

1. CZ cutting

The CZ cutters complain about high consumption of grinding and polishing material. More than 10 per cent of all prime costs of CZ consist of diamond-coated discs, tin-plates, diamond and other powders.

Therefore, experimental tests were made to substitute diamond material with the principal grinding agent, the silicon carbide (SiC; or another trade name for it is "carborundum"), which is in professional gem cutting nearly exclusively used for gemstones up to the hardness of 8.5 which CZ just reaches.

In SHIN JIN CO. a series of tests with varying grain sizes of carborundum powders were undertaken and lapping of CZ proved to be - although it was said that it takes a bit longer - working fine and satisfactorily. The finish of the cutting process in polishing exclusively with Linde A (after an interposed fine-grinding process) was tried, too, but failed on account of contamination problems which was obvious from the technical conditions mentioned earlier.

It was suggested to try further the polishing process in other companies, but a final result on this could not be obtained during the project.

To avoid contamination and to simplify and economize grinding, it was suggested to use instead of powders the more convenient carborundum discs of equivalent grain sizes. Although the expert advised them to buy these discs ready-made - there is even a supplier of carborundum-discs in Seoul - SHIN JIN intends to produce these themselves. Additionally an inquiry letter to an American supplier was sent, advertising in "Lapidary Journal" a special lap for polishing CZ, where no scoring is needed and more than an extremely fast polishing cuts time by half, as advertized.

Advice was given to do all preforming of CZ, which is still exclusively done on diamond-coated discs, on vertical running carborundum wheels which do the job equally well and save costly diamond abrasives.

2. Coloured stone-cutting

It was suggested to carry out coloured stone cutting exclusively with carborundum discs and wheels. Polishing in Iri is still widely done with the bad staining chromiumoxide, although, for the past couple of years, ceriumoxide has been on the market at a reasonable price, and has proved to be the best polishing agent for many types of stones, especially all the members of the quartz group, for beryls, topazes and others.

Advice was given on: how to cut gems with a predominant cleavage plain like topaz, how to handle stones with a strong pleochroism like tourmaline to get the best colour out, how to get a bright polish with dull material like malachite with admixturing a drop of vinegar or other ingredients when treating it and so on.

The expert had carried some 30 kgs of rock specimens for teaching and practising purposes, and distributed it to companies expressing interest therein. There were: malachite, sodalite, rhodochrosite, rhodonite, apatite, tiger's eye, Canadian nephrite, black spinel (pleonast), citrins, amethysts, lapislazuli, turquoise, chrysoprase, dendritic opals, green opalite, rutilated quartz, black and greenish tourmaline, tourmalin-quartz, jaspers, amazonite, garnets, corundums and topazes, most of the material for the easy cabochon cutting.

Unfortunately, only very few of these stones were cut; many of them, despite detailed advice, in an unfavourable way or without any success. Turquoise, e.g. has to be soaked before cutting in hot paraffin which was apparently not done despite advice. Though in several cases sincere interest in processing these new stones unknown to them was affirmed, hardly any really serious approach was undertaken to cut the material according to instructions. Much of the material just went into drawers and some of it had to be collected back unprocessed. Thus these efforts did not yield positive results.

The expedient cabochon polishing in tumblers was not known at all in Iri. The same applies to the phenomena of undercutting by means of grinding and sanding belts. All this wide-spread ignorance of coloured stone cutting can only be explained from the fact that this kind of gem cutting is completely under-developed and neglected in Iri.

C. Marketing advice

Some of the companies in Iri are aware that the future looks uncertain, if they depend exclusively on one fashionable product like CZ. Some of them had experienced a temporary boom with rock crystal and smoky quartz in the seventies, which is now out of fashion and much less in demand. Just in time the CZ came up and started a boom in Iri with considerable enlargement of the cutting capacities.

Sometimes the expert was asked what will come after CZ, or more concretely what other gemstones could be profitably cut in addition to CZ?

The latter question has to be considered carefully. Several factors are important such as the possible supply of raw material (some rough gem varieties such as faceting tourmaline, aquamarine and others are hardly available on account of export restrictions by countries of origin such as Brazil, which has developed its own gem industry); the capital cost of buying raw material (high valued stones such as emeralds, rubies, sapphires, etc., require high capital investment and are financially a greater risk); international competition with countries of higher technology, experience and better market connections (Israel, Hong Kong); or lower wage levels (India, Sri Lanka, Thailand); and finally there has to be taken into consideration the equipment and the workers' skill in the lapidaries.

Taking into account all this, there will be few gem items left on the faceting side, but many of the sort to be cut en cabochon, as mentioned above. Cabochon cutting is easy, not much technical equipment is needed, and workers can quickly be trained for this process. The raw material price is less than $100 a kilogram, some of them can even be bought for less than $10, supply is still not difficult, and the profit margin of the finished gems in relation to the raw material price is about 50 to 90 per cent. The largest part of the end price is on account of the value added by processing which is ideally what Iri needs.

Moreover, there are still some kinds of stones which are not abundantly on the market, but are still sought after such as cabochon and pendants made out of rutilated quartz, tourmaline-quartz, dendritic quartz and cheap green and dendritic opal and others.

Skill and imagination of workers can provide a wide variety of different shapes and individual designs with many kinds of reasonably priced gemstones.

Bead cutting on a larger scale for necklaces, after introducing appropriate machines to get a better quality of fully round-shaped balls, would be another alternative for Iri. Large thin cut and polished stone slabs could be used for dial plates for clocks, stone carvings and other articles made from so-called "semi-precious" stones could be further objects for future activities.

On the faceting side, white transparent rough genuine topaz is still available on the market at reasonable prices, and if appropriate radiation facilities could be offered in Korea, blue irradiated topaz is still a profitable item.

III. RECOMMENDATIONS

A. Recommendations for government action

1. Exemption from import duties

To give the Korean gem-cutting industry a real chance to compete in the international gem market, the import duty on rough gems should be abolished.

In Hong Kong, for instance, gem cutters enjoy the status of a free port. Korea is completely dependent on imported raw material, and follows a liberal policy regarding the import and export of gemstones.

It is recommended to eliminate the institution of customs' security and bureaucracy, and in its place introduce a simple, reasonable taxation procedure as practised in other countries, for instance in Germany: certain favoured raw materials, including rough gemstones, are in principle duty free. They are taxed like domestic material with the normal, usual turnover tax when imported. That means in the case of rough gemstones a taxation of 6.5 per cent on the cif price paid, half of the normal turnover tax of 13 per cent.

2. Location of gem industry

The concentration of all export orientated jewellery and gem-cutting industry at Iri cannot, indeed, be regarded as a great advantage. Therefore, the government should consider changes in that policy.

Most of the companies anyhow came with great uneasiness to Iri, because they were previously established in Seoul, Pusan or somewhere else in Korea.

Iri as a remote country town with bad, time-consuming communications for foreign businessmen, with no acceptable hotel for customers, is certainly not a convenient place for such an industry which needs the stimulations of a real commercial, technical and cultural life of a busy city with all its facilities, as could be found in Seoul, for instance.

Iri, indeed, does the opposite of attracting potential customers. There is no reason why Iri should be the only place for this industry, there are no old established firms with well-skilled labour force. Therefore, the decision should be left to each individual company to stay at Iri or to move back to Seoul or to other places of their former establishment.

The places which would become vacant in the already overcrowded IJA-compound, could serve the remaining companies for eventual expansion.

3. Relevant education

In connection with the location, the question of relevant education arises. Vocational schools for gem cutters and gold/silversmiths must be in a place where such enterprises exist, whether it is in Iri, Seoul or somewhere else.

To the specialized four year course at Wonkwang University, within the Arts and Crafts Department, not too much importance should be attached. From all the 160 graduate students pursuing professional study for jewellery and gem processing, there may be - as the expert was told by professors - only some 10 per cent find a job at the Iri industry. The larger part of the students are girls.

There is no equivalent of such exclusively specialized university graduates in countries with a large advanced gem industry, and occasionally special courses in gemmology or jewellery design are and might be offered in addition, but not as separate full-time courses at some universities and academies of art. 3/

In USA, UK and Germany, gemmologists and diamond experts terminate their training with a graduate examination by the Gemmological Societies, as independent corporate institutions.

4. Mechanical engineering service

The Korean gem industry faces, due to the growing mechanization and automatization, problems of maintenance and the lack of proper operational instructions which could hardly be solved by each individual company.

2/ At the Department of Geology of the Seoul National University Prof. Dr. Kim intends to offer as from the next semester lectures in applied minerology with gemmology (annex III).

The government may give assistance by means of a mechanical engineering advisory board or by helping to establish a centralized mechanical workshop as a joint venture of all the lapidaries (like the cobalt 60 facility) supervised by a mechanical engineer trained in gem-processing machines.

An individual company cannot afford such a full-time engineer, and such a course would neither be recommendable nor necessary. However, occasional service and initial training instructions given by a specialized expert, would be of substantial advantage.

5. Trade name regulations

As there are still incorrect names used for certain gemstones (as "white-smoky or golden-topaz" for plain and much less valuable rock crystal, smoky quartz and citrines respectively), there should be a regulation requiring the use of the correct trade names.

The expert was shown at Iri cut rock crystals, heat treated, and thus cracked with smallest tiny fissures, soaked with green ink and this poor make-up was proudly presented and called "oriental emerald"! Such falsifications would spoil the reputation of the Korean jewellery and gem industry. It should at least be strictly forbidden to trade such items under a false designation. Other industrial countries have introduced trade-name regulations for gems, which may be followed or modified for the special Korean situation.

6. Raw material survey

As no systematic survey on the occurrence of mineral deposits for the gem-cutting industry has been carried out so far in Korea (annex III), considerations and efforts should be given to this phase, to reduce at least to some extent the dependency on imports.

Nephrite-jade is already mined in Korea, amethysts since old days and is still exploited occasionally on a small scale at several locations (mainly near ONYOUNG), and chiastolite-andalusite could be, to a large extent, used as a gem material (see also III.C. p. 20).

There are further indications of fossilized wood, obsidian, demantoid-garnet, hematite, rhodochrosite, jaspers, landscape-agates, multi-coloured rocks and others (annex III).

B. Recommendations to the industry

1. Diversification

The current dependence on CZ should be reduced immediately, as the future outlook for this product is not encouraging, probably the market for it may disappear soon completely.

Therefore, intensive efforts should be made to produce other stones and introduce additional new gem items.

There is a large variety of coloured stones for Iri marketable in larger quantities, which could even be used for the jewellery manufacture preferably with a larger number of pieces in the silver jewellery, for instance: malachite, sodalite, rhodochrosite, rhodonite, apatite, tiger's eye, all the quartz group, lapislazuli, amazonite, the beautiful but not very common varieties of cut rutile and tourmaline quartz and many others.

The argument at Iri that there was no market for coloured stones is baseless, if an assortment is presented. Buyers will find things of interest, if they were shown an attractive collection.

There are furthermore a wide range of varying items which could be made at Iri, such as: really good bead necklaces from all kinds of stones, pendants in the various shapes of drop form, ovals, rounds, baguettes, marquises, briolettes, navettes, balls, triangles, baroques, etc. There is no limit to the designs of good workmanship. Even the simple slab cutting for dial plates for clocks, window plates and pendants as well as all sorts of stone carvings offer additional possibilities.

To employ skilled labour force trained in faceting stones, only few gem items are available where the raw material supply and price are not so uncertain such as: garnets, amethysts and citrines, white topaz for irradiation treatment, and occasionally some lower grade beryls and tourmalines.

2. Technical recommendations

On the technical side, the lapidaries should show more flexibility. Old working methods cannot be forever an optimum solution. Thus, at Iri the present practice of cutting CZ could be improved. Diamond as a grinding and polishing agent could be substituted fully or, at least, to a greater

extent by siliconcarbide (carborundum). There are carborundum wheels and discs available, for cabochon cutting even wheels with concave grooves of different diameters, according to the normal standard sizes.

Preforming should be exclusively done with vertical running carborundum wheels. Preforming on diamond-coated discs, as generally practised in Iri, is a waste of money.

A lapidary should be equipped with a set of at least three different grits of carborundum wheels (vertical) and discs or plates (horizontal):

coarse grit (optional 60, 80, 100, 120, 180 or 220 grit)
medium " (" 320, 400, 500, 600 ")
fine " (" 800, 1000, 1200 ")

Lapidaries going to cabochon cutting on a large-scale have to be outfitted differently as compared to the present set up.

Of course, for each stone type a separate system has to be worked out, but experimenting and testing is one of the major principles of success.

Concerning polishing powders, the still widely used chromium oxide should be replaced by a little more expensive but much more effective and not staining cerium oxide. The expensive Linde A can be, in appropriate cases, substituted by the lower graded and therefore cheaper aluminium oxides.

Ordering of semi-automatic cutting machines, which seems to be unavoidable in future if a competitive position has to be maintained, should be considered thoroughly and planned carefully.

C. Targets for the promotion of andalusite

North of Jeon Ju is a large andalusite deposit which is under development for high refractory purposes.

Occasionally some of this material was brought to Mr. Meder in Iri and he once showed it to the expert. It was recognized that some of the column-like crystals showed a black cross when looking at the top of the

small cross-section. This phenomena is well-known in the andalusite variety of "chiastolite" and cut en cabochon to gemstones. The black cross is due to graphite demixed orientated in the crystal structure.

To get some larger and better crystals suitable for a cutting test and to inspect the deposit - which was unfortunately not possible - the experts went one Saturday afternoon in April 1981 to the factory site, and from the boulders lying around, they could select a few larger crystals. There were crystal columns finger-thick and longer than 10 centimeters. But getting them out from the rock unbroken was not possible as there were no tools other than a pick.

Anyhow, a few pieces were collected and distributed to three lapidaries at Iri for cutting. From six stones totally cut, just two came out fine while the others were cut in the wrong direction. The stone showed to be translucent to semi-transparent with a grey-brown background, the black cross coming out clear and sharp, and achieving a fine smooth polish.

These stones were shown to a gem dealer from Idar-Oberstein who happened at that time to be on business at Iri, and were considered by him as marketable. The dealer declared his readiness to promote this stone, and place orders from late August to October this year (Xmas season), if he could get a binding price offer in time and about 200 pieces for distribution to potential customers. He said that the stone had to be cut in standard sizes, calibrated, and the lots should cover one thousand or ten thousand pieces. The price was suggested to be about equivalent to that of tiger's eye which is cut the same way and in similar large lots. The potential of this year's orders was estimated to be about half a million pieces. In the following years, after introduction in the market, demand would be higher with some millions alone in Europe. For later on, bead cutting for necklaces was suggested as a further production item.

One of the bigger lapidaries in Iri, which is one of the few already outfitted to a certain extent for cabochon cutting, expressed serious interest in cutting this material on a large scale.

Though I advised to follow-up this opportunity with gem-andalusite [4/] and made proposals for further investigations and the supervision for the initial stage of introduction, however, due to some unfavourable circumstances all intended and planned efforts were stopped, and the project ceased.

Targets for further promotion of andalusite-gem would be:

1. Visiting the outcrops at the supposed mining site, and looking for convenient places of material occurrence and exploitation possibilities. The material may be first hand-picked or broken out from the surface rock.

2. Finding a method to separate the unbroken crystal columns, which have grown cross-cut through the black dense graphite schists, from the hard tough mother rock. At first, the troublesome work with hammer and chisel can only be suggested. But later on, a better method may be found. People would acquire skill on this with practice.

3. Instruct workers in the lapidaries for the proper cut, advise modification in the outfit which will be necessary and supervise the cutting process until working on such material has become a routine.

4. Making calculations on the expenditure and cost price of the raw material, cutting process and output from the amount of raw material processed.

5. Establish a binding price list and distributing specimens to potential customers.

4/ Chiastolite is the andalusite variety with the black cross and occasionally cut and already known to gem dealers, but because of limited material supply from a few small occurrences, has not been widely introduced in the gem market.

Transparent red-green andalusite from Brazil is more commonly marketed.

There may be a chance too, to find transparent andalusite in the Korean deposits, as pieces of this chiastolite already show spots and edges translucent to an unclean transparency.

IV. FACT FINDING

The prevailing mono-structure of CZ cutting in Iri makes this industry liable to collapse, if a sudden loss of the market and the non-appearance of continuous further consignment orders should take place, and large unemployment would result.

There are practically no alternative products worthwhile mentioning, only a very few coloured stones and hardly one attractive commodity offered by the Iri gem industry which could replace the CZ essentially one day.

Unawareness of this state of affairs and unconcern prevented the lapidaries from diversifying their production line, and even after pointing this out, many of them showed no seriousness of approach and willingness to make efforts for a real change.

On the technical side, indifference is again predominant. Nice polite affirmations, rarely, and if so, very slowly followed by actions. The technical standard is certainly not at the highest level, and the ability to compete on the international market will decrease with the quick rising wage level. Semi-automatic cutting machines, even though some exist, are nowhere in operation due to maintenance problems.

The present labour force of two to three thousand workers seems according to the unused potential of rationalization possibilities, too big.

The future for the IJA-industry looks - as at present constituted - rather dim, if this challenge is not accepted.

The duration of the mission turned out to be too short to result in substantial improvements or changes.

V. ANNEXES

Annex I

Companies visited:

1. Korea Diamond Corporation (KDC)
2. Orient Handicraft Co.
3. Jemyeong Co. (Yangheng Co.)
4. Dae-Kwang Industry Co.
5. Shin Jin Jewelry Co.
6. BO WOO Industry Co.
7. SANG-MI (SA) Co.
8. MYUNG SHIN GEM Corp.
9. GEMKOR Co.
10. Skyver Mfg Co.
11. Ilshin Trading Co.
12. Far East Gem Corp.
13. KOMEX COMPANY
14. SAM JIN JEWELRY Co.
15. KINGSTONE
16. KIMMAN Co.
17. SE JIN STONE Co.
18. STONE HOUSE OF TAE YANG, INC.
19. KWANG SHIN TRADING CO.
20. WOORIM INTERNATIONAL, INC.
21. DAE YOUNG Manufacturing Co.

Annex II

Lectures in gemmology held at Wonkwang University/Iri
Art and Craft Dept. on April 29 and 30, 1981
(interpreter: Prof. YANG, Pyong Sok, gemmologist)

- first day:

1. The gem-groups according to the mineralogical system.
2. Pearls and other organic gem material.
3. Synthetics and synthesis.
4. Gemmological instruments with demonstrations.

- second day:

5. World market and supply of gemstones and gem raw material.
6. Treatment of gems.
7. Gem identification with demonstrations, especially on discrimination of genuine topaz and the citrin-group.

Annex III

Institutions consulted in Seoul regarding potential gemstone resources in Korea (with Notes):

1. 18 May 1981

KOREA MINING PROMOTION CORP.

meeting with:

Mr. Sung Soo, KIM, Chief geologist, director

Mr. Won-Hi, NAM, geologist

Mr. Jae Yuhl, YANG, Chief of mineral laboratory

Mr. Choon Gil, YOON, geologist

Note: General prospects of raw material for gem-cutting in Korea were discussed. It was confirmed that the ore-body of the andalusite deposit in the JeonJu area is very large, and so the possible raw material supply for gem-andalusite may be vast, too. Several multi-coloured specimens of Korean rocks were shown by the gentlemen, which might also be suitable for gem-cutting.

2. 19 May 1981

Prof. Dr. Soo Jin KIM
Department of Geology
College of Natural Science
Seoul National University

Note: Prof. Kim considers as favourable the prospects of finding raw materials for gem-cutting in Korea, though no investigations had been carried out on this line so far. Some indications about its occurrences were pointed out, another deposit of andalusite in the country mentioned, and the collection of Korean minerals shown, of which some might as well be suitable for gem-cutting.

Annex IV

Seminar Report on Gem Processing

held by

R. Boese
UNIDO expert

at Wonkwang University - Iri/Korea
on 9 May 1981

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This report was subsequently also translated into Korean language and distributed to all of the companies of the Iri-Jewellery Association.

1. Introduction

On behalf of the UNIDO project for the benefit of the Iri-Jewellery-Association (in the following abbreviated as IJA), my colleague and predecessor, Mr. H. Meder, held a seminar for you on 13 April, and suggested already the most obvious recommendations to you and the Government which I hereafter should not repeat again, but which I, in principle, would strongly support and only to a few points I may return again.

As a gemmologist, my knowledge is only limited to that field, and I shall in the following not deal with problems of metalworking, since this field was covered by Mr. Meder in detail, but point out the main topics related to gemstones.

2. Analysis of present status

2.1 General considerations

A healthy economy where business is based on competition and individual enterprises, and the ability is governed by the principles of Darwinism, which means that the weak, unfit, incapable and inefficient will be defeated by the stronger, cleverer, more flexible and more advanced ones. And to my regret, I have to say after two months of local experience that I did not get the impression that the Iri gem-processing industry definitely belonged to the latter group, if it comes to a relentless struggle for existence in your branch.

And this will be, I am afraid, pretty soon. As you know approximately 80 per cent of all Iri gem-cutting depends on Cubic Zirconia (CZ). Only about 20 per cent is due to coloured stones, if we exclude diamonds which are not of concern in these considerations. And even this small 20 per cent is represented by a rather poor assortment. The range is nearly limited to rock crystal and smoky quartz, a few agates, mostly dyed, and some very low quality amethysts of really cabochon material which is cut in faceted stones resulting in a very poor looking and in Western Europe, for instance, unsaleable product.

I must admit that I found almost nothing attractive enough which I would consider as saleable in Germany. A foreign gem dealer, who had been already 16 times in Korea, assured me after having visited Iri that he would make his purchases in Seoul where he can find everything that he is looking for and could not find at all in Iri on concentrated display. He also told me that in his home town gem dealers say that Iri is no longer worthwhile visiting.

The Iri lapidary industry has practically nothing to show, at least not in the better quality range of gemstones of ambitious commodities. I do not mean the high-priced valuable stones, but just attractive goods at a reasonable price, as you can find in Seoul. During my few short stays there, I saw in jewellery shops and department stores beautiful things such as nice necklace chains in rock crystal (I bought one there myself, which I certainly would not have done, if I would have seen this in Iri), then also smoky quartz, amethyst, jade and others.

The Iri gem-cutting is practically solely, apart from CZ, limited to consignment orders and has hardly anything to offer of its own. This is a most unsound situation which has to be challenged immediately. All the objections I heard that there is no market for coloured stones are nonsense; there is a vast market for coloured stones, but you must be in a position to present an assortment which the market requires. The market will not follow you, but you have to watch the market.

2.2 CZ prospects

In the last years Iri was participating in the boom of CZ and still now enjoys, luckily, satisfying orders. As long as this situation is on-going, it is fine and we all are happy. But be aware that this will not necessarily be the case for ever, it will change very soon - this is my and Mr. Meder's opinion. All detached insiders of the gem business would predict the same and I am going to explain this as follows. A German gem dealer, briefly visiting Iri, and who is doing business in CZ, asked me reproachfully, if we are the ones who are spreading the news that CZ belongs already to the past. This is nonsense, and that dealer by praising and advertising CZ as the history's best diamond imitation, is just following his very own business interest.

To spur as many CZ cutters for more and more production will help buyers to push the price down if the market is flooded, a situation which has already started.

Some of you may remember what happened to the forerunner of the present CZ. If we disregard the first diamond imitations as strass, synthetic white sapphire, and spinel before the Second World War, there were fabulite, synthetic rutile, YAG, YIG, GGG which are all long forgotten.

Some of you have experienced in the mid-1970s the fashionable boom in rock crystal - or as you call it here white crystal - in which Iri was participating quite a lot. But this fashion has gone, too, if we exclude the necklaces.

The fashion for CZ may go sooner or later. In most of the European countries CZ was never a great fashion - in Germany at no time at all. People there are fed up with all these synthetic imitations and substitutes. They demonstrate antipathy against anything synthetic, because their clothes, food, air and the total environment is too much spoiled by chemical products. So at least for their private aesthetic enjoyment, like jewellery articles, they just do not want to be confronted with synthetic substitutes again. There is a strong, and rapidly growing desire for everything that is true nature. So, if people cannot afford a real diamond, they prefer a reasonably priced natural stone, because that is true reality and not an imitation to delude people.

The Americans, where CZ was and still is in fashion, have in the majority a somewhat more simple taste. But they surely will develop further, too. The Japanese, have still, despite their fast development of technology, a great backlog demand in all higher consumer articles and luxury goods, and are coping with a state long past in Europe.

I can observe this situation also in another line: if I make blue topaz by an irradiation process, I can sell virtually none of it in Germany or in Europe. The only substantial markets for these products are again the USA and Japan.

A gem and jewellery manufacturer has always to think also about psychological reasons, because these play an important role in the market.

But there is still a more dangerous fact which gives a warning to the CZ prospects.

Two years ago, the price for rough CZ material was above $2 a carat. but since then it has fallen to under 10 cents a carat. The latest quotation in USA, I heard last week, was less than 7 cents for A-grade and less than 2 cents for B-grade.

The CZ-rough, has now reached a level where automatic machine cutters throughout the world may think over turning on their machines for CZ-cutting.

And there is no reason any more why they should not do so. As long as the price for rough CZ was above $1 or in that range, it was not economic for them, because of the loss in relation to output, around 90 per cent by machine-cutting, while yours with hand-cutting is much less. Thus by a high price of CZ-rough, you get the advantage, while on a low price level, the machine gets the advantage.

This will happen very soon as it happened before with synthetic corundum and spinel. Raw material is now about equivalent for both of them, CZ and the Verneuille-synthetics, and so the end-products will be the same, too.

Thus you may just compare a price list of the latter ones to get to know what your CZ-prices will be in future. According to such a calculation, the price of a standard size 5-6 mm round brilliant cut would be less than 50 cents a piece, while the machine-cutters would still make a profit on that price.

I don't know if you can still compete then; already now with $1.50 you complain about the severe decline in price. The coming price drop will be sudden and abrupt, beginning when the first machine cutter places his product on the market. Everybody will then want to participate on a buyer's market which is getting smaller, because potential customers would also lose their interest as soon as a product devaluates. It will happen just the same as it already happened with CZ-rough, only with more delay.

2.3 Alternatives to CZ

The Iri lapidaries must look for alternatives to CZ. Any prudent industrialist has some projects filed away which he can make use of and realize as soon as his old product is no longer marketable.

But I doubt, if all of the Iri-CZ-cutters are prepared for such a change. You should consider this seriously and take precautions along this line. You should make yourself acquainted with alternative gem material, study and experience its process of cutting. Some of you have started already on this line, but, I am afraid, with the wrong materials, opal for instance, and turquoise, which I saw and was told about. I have no objection against opal or turquoise. I find both of them wonderful natural stones - but just realize that both are very recently produced as synthetic products on a relatively large scale which even professionals are able only with sophisticated methods to discriminate from natural stones. This may be unknown in Iri, so let me point this out.

Another reason why I would not recommend opal anymore is, that the great fashion of opal has also passed. The market is still flooded with hardly saleable opal, thus prices are down and opal dealers consider their situation as hopeless. A gem dealer told me recently that in Hong Kong, where mainly opal cutters and dealers are concentrated, they try excessively to sell from their vast stocks of first class opals at very reasonable prices. Low-grade or even medium-grade quality are considered not saleable anymore.

Cutting of opal is a delicate job, and beginners cutting that material would surely pay a high price for one's wisdom.

Turquoise likewise is an unsuitable material which I definitely cannot recommend. You would not get the good Persian or Chinese-Tibetian turquoise as raw material on the world market. Only the pale-coloured, brittle and soft American type is available in large quantities. But only few gem-cutters have the "know-how" to handle this material, for without staining and hardening it cannot be worked to saleable gems.

I gave to some of you a few rough specimens of medium, but not American quality of turquoise for processing and told how to use it. But the result was not very encouraging, so I suggest, it may not be your line. It is a too difficult material to work and you had better forget it, as well as opal. At least for the latter, the so-called "precious opal" which comes practically exclusively from Australia. You may work the cheaper and uncomplicated green opal, in which case you would not take such a great financial risk.

I distributed to you a number of cheap, but suitable specimens of various kinds of stones for you to gain processing experience and to see what may come out of sometimes insignificant looking material many of you had not seen before. I wanted to show you new kinds of gem material, I wanted originally to cut together with you and learn about the object. But due to organizational circumstances that was hardly possible, unfortunately, except for a few cases. Thus I was restricted to just explaining to you theoretically.

In spite of your affirmations that the new materials you were shown are of great interest to you, I saw that most of you have not a sincere approach to work with these materials. It just went into your drawers, and too often I had to ask what is your experience, did you have success or not. I sometimes felt like a petitioner who wanted just something to cut from you, by asking again and again but nothing happened.

2.4 International competition

Your competitors in Hong Kong, Bangkok, India, Brazil, Israel, and nowadays also in a number of African countries, are not sleeping and have some important advantages, you do not have, such as: higher technology, own raw material resources, lower wage level or the advantages of a real free port as Hong Kong.

Thus, there is every reason to be aware of what is confronting you, and to change your attitude of unconcern.

3. Recommendations to the Government

3.1 Liberation from bureaucratic restrictions

Some of the presidents complained about too much bureaucracy on the side of governmental regulations, with the effect that the IJA-industry will in the end not be promoted as originally intended by the Government by establishing the Iri Estate; on the contrary it will be hampered. To get an export permit, there are about six steps to be taken and agencies to be visited, for instance: the Jewellery Cooperative in Iri to get a recommendation paper, a bank for opening up a LC or likewise, the Ministry of Commerce and Industry in order to get the "loss-percentage" according to the cutting

process of the imported material, and the Customs House has to be contacted to take back the 400 per cent of customs security. A trading company which holds an export licence has to be visited, for only they are allowed to export. Even to get some sample boxes you have to follow this long procedure.

The 400 per cent of customs security, representing a heavy burden due to the lost interest rate, will be automatically paid back, if the material is exported again within one year. But this is in many cases, especially in gem-cutting, not possible because orders have to be received and customers found.

Practically in all cases it will not be possible when you process material at your own risk and on your own account, and often, or most of the time, you get only reasonable prices by buying raw material, if you take larger quantities which you have to keep in stock for years.

If you cannot export the imported material within one year, you have to apply again for a prolongation.

So all these bureaucratic procedures for exporting as well as for importing should be drastically simplified. The import tax for raw material should be completely suspended; then you would have an equivalent competitive basis with gem-centres in Hong Kong.

The Government may take the same turnover tax on imported rough gems which is to be paid for products not due to foreign trade.

For instance in Germany, we have to pay for imported raw material, including uncut gemstones, an import-turnover-tax of 6.5 per cent, which is half of the normal turnover tax of 13 per cent. The 50 per cent reduced rate concerns all raw materials such as ores, foodstuff, scientific, art and collection articles.

3.2 Question of location

I heard that serious consideration has been taken to remove the jewellery industry from Iri back to Seoul. I find this a very useful and worthwhile reflection. At least industrialists should not anymore be practically forced to establish in Iri, if they mainly want to export. If they want, they should be allowed to move back to Seoul and still produce for export.

From the beginning I found it not a good idea to establish a jewellery and gemstone industry depending very much on new ideas and stimulations of real commercial life, in a remote backward country-town like Iri, where not even an acceptable hotel can be found and which is most inconvenient for customers to reach. This branch needs the fluidity of a place where it has a tradition. The city of Seoul with all its facilities of communication, accommodation of international standards, educational and cultural life would just be right.

There is no need to concentrate all such export production only in one place like Iri, just because of the 400 per cent custom's security.

The Korea Diamond Corp. applied for a showroom in Seoul, because Iri is definitely not a place to attract buyers. The compound itself is not, indeed, impressive looking.

So I would suggest that everybody who wants to move away from Iri should be allowed to do so, while those who are going to stay, would have more space for enlarging. The compound area is anyhow over-crowded.

3.3 Relevant education

There is also the question of relevant education for this industry. A vocational school for jewellery and gem-cutting must be in every place where such enterprises exist, if it is in Iri, Seoul or somewhere else.

What concerns the university in Iri with its special department, I have to admit that nothing of that kind is existent in Germany where this branch is much larger and has a long tradition. We have no university graduates in this branch only a kind of medium or at most college level as "Goldschmiedefachschule", "Zeichenakademie", and more than a dozen academies of art exist at a number of places spread over the whole country. There is no reason why it should be different in Korea.

Cutting techniques are solely limited to vocational schools in the cutting centres, whereas gemmology, also a basic subject here, in Germany as well as in the USA and the UK, is the concern of an independent non-profit corporate body, a gemmological society, which holds courses in gemmology up to their own graduated gemmologists and diamond-experts.

Specialized lectures in gemmology are in addition available in the mineralogical departments of larger universities which offer also the facility for guest-auditors, mainly jewellers and goldsmiths, to join.

3.4 Mechanical engineering service

As some of the IJA-factories already have unused machines for semi-automatic cutting, and others may buy some in future, there is the problem of maintenance and repair service.

It is obvious that an ordinary mechanic will be technically over-taxed in servicing such sophisticated machines. But those machines are at least partly necessary if the Korean gem-cutting industry is to meet international standards.

Wages in Korea are already too high to do just simple time-consuming handwork. Korea is not anymore considered a low-wage country.

It has already in some branches a highly developed industry. Fundamental processes should be done by machines; handwork should be limited to more sophisticated processes.

In the Iri gem-cutting industry there are many opportunities to economize production by introducing semi-automatic machines, especially for pre-forming and cabochon-cutting, which for many kinds of stones is carried out on a mass-production basis, and in bead-cutting.

But, if machines are used on a wider range, then the question arises, who will care for the maintenance and repair service?

I don't know, if in Korea there is a Mechnical Engineering Advisory Board, as exists in some other countries where a newly developed industry would be assisted by graduated mechanical engineers trained in special fields. Not every factory can afford a full-time position for an engineer, but it is most necessary to have at least for first training or arising problems the help of an engineering expert.

3.5 Trade regulations for naming

There is also the necessity of having an obligatory regulation scheme concerning the proper and correct naming in the trade of gemstones.

Smoky quartz should not anymore be called "Smoky Topaz", citrin not "Golden Topaz", and at least it should be by law forbidden to sell such stones under the name of topaz which is of a far higher value.

I found in Iri heat-treated rock crystals, thus getting cracks and then stained in green ink called "Oriental Emerald". Such falsifications should be forbidden as these spoil the reputation of the Korean gem and jewellery industry. In Europe and America the trade usage of gems and jewelleries is regulated and obligatory by special regulations as RAL or CIBJO, respectively.

3.6 Raw material survey

Apart from amethyst, which can be seen in the shops of Seoul, and nephrite-jade, there is so far hardly any gem material known or used which has its source in Korea.

For a gem industry this is a very unsatisfactory situation, namely to be entirely dependent on imported raw material. This could be changed to some extent, as there are indications of occurrence of cuttable stones in Korea such as: andalusite in the variety of chiastolite (specimens demonstrated), fossilized wood and landscape agates. Occurrence of snow-flake obsidian was reported to me on Mt. Sogni. On Cheju Island, which is of volcanic origin, there is probably also obsidian, and perhaps agates and jaspers.

Steps should be taken to investigate the country for cuttable material.

Further amethyst-deposits worthwhile exploiting may be found after prospection.

4. Recommendation to the industry

4.1 Technical recommendation

4.1.1 CZ-techniques

It may be worthwhile considering, if the cutting process of CZ with the costly diamond-discs and powders could be substituted partly or even wholly by other materials such as siliconcarbide and polishing powders which are not based on diamond.

Gem material up to the hardness of 9, with the exception of some high-valued emeralds and chrysoberyls, is generally ground on siliconcarbide (SiC or also called carborundum) discs and wheels. To my surprise, SiC was only known to a few of you, although it has been the abrasive most used for many years. It is a synthetic product, the next hardest after diamond, and on the Moh's scale of hardness between 9 and 10, but closer to 10.

In one of your factories we tried grinding CZ by lapping with SiC of various grades on steel discs. It worked fine, only the contamination is still a problem, as you all grind and polish with one and the same machine.

This problem will be solved, if you use later on carborundum-discs instead of powders.

Polishing with Linde A alone - we tried this, too - was not successful, but I suppose this is only due to contamination problems. If you finally get a smooth lapped surface, with SiC 1200, there should not be any reason why you should not get a fine polish just with Linde A. Most professional cutters in the world work successfully according to these procedures.

Your polishing with diamond-powder 14,000 and 50,000 mesh in a mixture with Linde A and Crystal powder (a brand-name not rock crystal = quartz powder) is really a combined fine-grinding and polishing process. A mixture of fine grain with coarse grain makes no sense. Only the coarser will act, and therefore it is better to take ungraded powder of a certain range of grain-size; thereby you save a lot of money.

4.1.2 Techniques for coloured stones

Carborundum is the most widely used grinding agent. Nearly all stones, except a few high valued ones, are worked first with this on lapping discs or better on horizontal discs for faceting stones and on vertical running wheels in pre-forming and in all kinds of cabochon cutting.

For the latter, there are special wheels available which have small concave grooves of various diameters, where you could produce calibrated stones.

I saw such practical, cheap and easy equipment in very few of your factories.

Carborundum is available from 60 up to 1200 micron-mesh; I distributed to some of you a list for copying where all the principal grinding and polishing powders used in professional cutting are mentioned as well as their approximate prices.

Linde A is the finest levigated aluminium oxide and very expensive. But there are other Al-oxides which may be for some of your purposes just as good and less expensive. Chromium-oxide which is still, in spite of bad staining, widely used in Iri, has long been replaced by the far better cerium-oxide which is the best polishing agent for all minerals of the quartz-group, but can also be used for beryls and topaz.

Cabochons are generally polished in tumblers with the appropriate agent. In some cases, you may need two working operations with the tumbler to get the best polish.

Grinding and polishing powders as well as cements of various kinds for dopping are made available in small quantities for testing experiments by KOTRA and you could take them from SIN JIN Co.

4.2 Marketing

4.2.1 Diversification

To be dependent on one product only is always unfavourable. A larger variety in one's assortment has the advantage that potential buyers may find something more easily in a well-assorted than in a poor collection.

I cannot give you a guarantee on what could be sold on the market, but I would like to give you some advice.

All kinds of Cabochons and pendants can be made from inexpensive material and you can further process it within your jewellery commodities, especially with silver. Furthermore, cabochons and pendants are suitable for export because in many cases they are mass-products and sold in thousands and ten thousands of pieces according to standard sizes. Also such products - and I find this very important - guarantee you in many cases a high proportional appreciation of raw material to finished product.

Such a stone is, for instance, RUTILATED QUARTZ, obtainable in its rough plain form for 5 or maximum $10 a kilogram. You may cut it nicely en cabochon as oval or pear-shaped pendant, beads, etc.

A cutter with imagination could create wonderful things out of it. The cutting may cost you a maximum of $1, but you could easily get $2 or $3 on a wholesale basis. To find enthusiastic buyers would not be difficult, even in Germany.

A similar material for a skilled workmanship is TOURMALINE-QUARTZ which has about the same price as rutile-quartz.

Another very similar material to handle would be dendritic opal or dendritic quartz, moss-agate, polyhedrite agate and, generally, agates of all kinds.

Even rainbow agate could be sawed and polished in slabs for making dial plates for clocks, as they are exported in thousands from Brazil to many countries. In addition to those, there is a wide range of coloured stones which could also be worked to cabochon, pendants and beads, e.g. MALACHITE, RHODOCHROSITE, RHONDONITE, AMAZONITE, SODALITE, blue APATITE, TIGER'S EYE, various coloured types of JASPERS, CHRYSOKOLLA or EILATSTONE, black TOURMALINE and black SPINEL (PLEONAST), AVENTURINE and many more. (Rutile and tourmaline-quartz and all of the latter mentioned stones were demonstrated in specimens of rough material and cut products.)

If you could get cheap chrysoprase, garnets, cabochon-grade tourmalines and aquamarines, lapislazuli, this would be likewise a fine material and easy to sell. The same for faceted stones as garnets, tourmalines, aqua-beryl and the amethyst-citrin grades, if you can get such material at reasonable prices you may work it, because they are all much liked gems and are not subject to fashionable trends.

White topaz is still available and you may cut it, if you have the possibility and know-how to irradiate it.

I would not recommend to you to start gem-cutting with high-priced materials such as emeralds, rubies, sapphires; except for the latter, abundantly available in inferior quality in Australia, you may not get a chance to buy the raw material.

Concerning rubies and sapphires you could probably anyhow not compete with those from Bangkok, Ceylon or India, the reasons being that they have been familiar with this material for centuries and have cheap labour costs and domestic raw material at the most reasonable prices possible.

Don't touch at all such synthetic stones as the Verneuille-processed corondums and spinels in their wide range of colours with all the funny misleading names. They can be and are at cheapest prices machine-cut and you never would be able to compete with them.

Nice cut bead-necklaces of various coloured stone materials are always a good saleable product.

4.2.2 <u>pply of raw material</u>

I was often asked: "where can we get raw material for coloured stone cutting?"

I must admit that I was not really prepared for such a question. I had practically only two or three addresses which I could recommend with a good conscience. The majority of raw material you get through your customers in Japan; in some cases, at rather high prices as I could see. This is obvious, since Japan, in most of the cases except for their obsidian which you can get directly from them, has to import all material from overseas.

Try to avoid middlemen where possible, at least buy directly from the countries of origin.

I have already promised to write to some of you and give you some reliable addresses of exporters in Brazil. Write to me, if you have any questions on this. I shall try to get some direct contacts.

Brazil is still the most important source for coloured stones. These inexpensive stones are the ones I essentially recommend to you as they are most likely not subject to the new export restrictions on gemstones issued last year.

Other sources are rather limited. I gave you a suggestion for cabochon-grade amethyst, mine-run, directly from Zambia at a most reasonable price.

Mozambique, Tanzania and Madagascar, formerly also important sources, have nearly completely ceased production.

Afghanistan, likewise up to recently a substantial source for fine tourmalines, kunzites, rubies, turquoise and especially lapislazuli, ceased as well due to political reasons.

From old stocks of well-established traditional gem dealers you may still get one or another material; but watch and compare prices, you will find great differences.

It is in many cases (e.g. faceted amethyst material) almost impossible to tell you what the adequate price is because the various grades range from about $80 a kilogram up to $5,000 and more.

The difference is less marked in cabochon material, especially with the opaque coloured stones. You may get nearly all of them for less than $100, many of them for $10 to $30; even for $5 you can get already workable stone material.

It is quite normal that when starting to buy raw material one has to pay dear for one's wisdom. But keep it as little as possible by exchanging your experience with others.

I hardly can tell you more about these delicate opportunities, because you may blame me later, that I may have been wrong. The market changes quickly and I am not so much liable in this field that I could give you exhaustive information regarding all these questions.

5. Summary

Concluding my statements, I wanted to point out to you the danger which is ahead of you, and urgent steps are required on your part as a challenge, if not it would be too late and large unemployment will be the result.

Start with new intentions and projects today, don't say tomorrow, next week, next month - then it will be never.

I sincerely wish that your industry may survive, may flourish and grow, here or in Seoul or somewhere else in Korea, if some of you want to move away and are allowed to do so. It is never too late to be confident, if an open-minded strong will still exists.

I thank you for your kind attention today, and for your generous hospitality and the reception I was always given in your factories.

I apologize that I could not visit all of you in your factories, as I intended originally.

I wish you all the best for the future and good luck. Thank you.

A session of questions and answers followed, with the following topics:

In gem-cutting active countries;

largest consuming countries;

gem industry in Israel;

export share of cut diamonds;

outlook for synthetic diamonds;

polishing malachite;

silicon carbide - carborundum;

polishing agents;

improvement of hole-drilling;

ultrasonic machines.