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**NOTE ON THE MARKETING AND UTILISATION
OF MICA**

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CONTENTS.

	PAGE.
Introduction	1
Marketing :—	
Producers	2
Consumers	3
The Broker	3
Co-operative marketing	4
Direct purchase in operation	4
Lessons for the Indian producer	5
Packing	7
Block mica or splittings	8
Utilization :—	
Micanite manufacture	10
Micanite manufacture in India	10
Testing	11
Mica washers	12
Ground Mica	13
Specific uses	13
Continuity of supply	14
Mining practice	16
Summary	17

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OF MICA.

Introduction:

Whilst on study leave in Great Britain and America, during 1927, the present writer took the opportunity to make some enquiries into the utilization of mica and the special problems relating to the marketing of the raw material; whilst making these enquiries visits were made to some of the largest consumers of mica both in Great Britain and the United States of America.

In prosecuting such enquiries not a little difficulty is encountered because the handling of mica constitutes what may be called a 'close trade' in which dealers and manufacturers are loath to facilitate outside enquiry; though the present writer must acknowledge that, in certain instances, information and the opportunity to inspect manufacturing plants were freely given.

MARKETING.

At the present time the two most important mica markets in the world are undoubtedly London and New York. The great bulk of the material sold in these two centres is marketed through brokers and the question at once arises whether this system is in the best interests of the producers.

If the weight of mica exported from India during the period 1922 to 1925, as reported in the *Records of the Geological Survey of India*, be divided into the value of the exports for the corresponding period, the somewhat surprising result is obtained that the Indian exporter received, during the four years in question, an average price of a fraction over one rupee per pound. During that period the rate of exchange approximated very closely to one shilling and four pence to the rupee, so that one shilling and four pence may be taken as the average price per pound received for all grades and sizes of mica. It may be taken that a mica consumer will be unable to buy block mica or splittings, of any sort whatever, at a figure below three shillings per pound; whilst the price will be much higher for an average of all sizes and grades. Taking, however, the average price received by the exporter, determined in the way described, and this absolute minimum that will be paid by the consumer it is found that the price increases by a minimum of 125 per cent. between the exporter and the consumer; the true difference will undoubtedly be greater, even after freight and other charges have been paid.

In view of the above it is desirable to appraise the value of the service rendered by the brokers for this remuneration and to examine the possibility of eliminating third-parties by direct marketing.

As a result of his enquiries the present writer is of the opinion that whilst the price increase between the producer and the consumer does not appear to be commensurate with the service rendered, and is probably only made possible by close working agreement between the limited number of brokers concerned, the entire elimination of the middleman would be, in the present state of the trade, a matter of considerable difficulty.

Producers.

Thus any producer of mica will have all sizes for sale and in the case of muscovite will have anything up to four grades for sale; thus he may have to market from twenty to forty separate products and the inclusion of splittings will add another three or four to the number. On the other hand, the consumer will, as a rule, require only two or three of this range of products, the number depending on the type of goods being manufactured. Thus it is obvious that if a producer is to dispose

of his entire output directly to consumers he will have to be in touch with a great number of buyers in every trade that consumes mica. Furthermore the average manufacturer using mica does not purchase far ahead of his requirements and hence looks for early delivery when once he places an order: therefore the producer who attempts direct marketing will be forced to carry very large stocks, with consequent immobilization of capital, in order to be in a position to meet the requirements of his customers promptly.

It must be recognized that in the event of a producer attempting direct marketing, and securing orders for his entire output of some sizes in certain grades, he would almost certainly be boycotted by the brokers; and in the event of failure to secure orders for his remaining products he would be forced to sell to the brokers at less than the market rates. Thus the attendant risk for the producer attempting direct sales is considerable.

Consumers.

From the consumer's point of view too the situation is one of no little difficulty. It is probable that, whilst realizing that the price he pays bears no very reasonable relation to that received by the producer, he regards this state of affairs as the price paid for security of supply and delivery up to sample, and so long as all his competitors are similarly situated he merely passes the enhanced cost of the mica on to the ultimate purchaser. The enhanced cost, however, tends to hamper the wider use of mica with consequences detrimental to the producer.

As has already been stated, the average consumer does not purchase mica far ahead of his requirements and therefore has to be in touch with someone who is able to give prompt delivery; this is a function of the brokers. Again, mica is always purchased against samples and the average consumer prefers to rely upon local brokers either in London or New York, to whom he can readily address a complaint in the event of delivery not being up to sample, and from whom he can obtain ready adjustment of any claim; rather than to feel that in the event of any hitch in the transaction redress can only be obtained from a producer thousands of miles away in India or elsewhere, with consequent delay, and over whom he feels he has less hold.

The Broker.

Thus the broker appears to serve a useful purpose as a sort of clearing house for mica. He is prepared to purchase all classes of mica, more or less in any quantity, and he carries stocks from which a consumer can receive prompt delivery in ordinary cases, though a demand for exceptionally large consignments or for uncommon sizes will probably have to be met by shipment from producers.

The expert technical knowledge of the brokers concerning different types of mica from various localities and the sizing and grading of mica is also of value to those consumers whose purchase of mica constitutes so small a fraction of their business that it would not pay them to maintain a mica expert on their staff.

By dealing with a local broker considerable time is saved in negotiations, and settlement of disputes is greatly facilitated. As pointed out later the tendency of some Indian producers to carry the time honoured Eastern system of trading into Western markets aggravates the loss of time in negotiations and settlements and this militates against the more general adoption of direct purchase.

It is for the above reasons that the present writer does not foresee the elimination of the middleman in the near future unless some drastic change in the whole system of marketing is adopted. Though some progress has been made in direct purchase, as will be described later, no very general expansion of the system seems possible under the conditions of supply and demand as they exist.

Co-operative marketing.

Some system of co-operative marketing by the producers, with local representatives in the larger consuming countries, seems to the present writer to constitute the most feasible plan for the elimination of the wide margin between the producer's sale price and the consumer's purchase price. In this way the producers would in effect become their own brokers and thereby a slightly enhanced price could be obtained by the producer, though it would be a fatal step to utilize such a marketing system to try and obtain prices out of proportion to production costs in their widest sense; and the consumer would obtain his supplies at a lower figure, this in turn tending towards an increased use of the material with consequent gain to the producers.

The writer is aware that so far as producers in India are concerned a great change of heart would have to take place before such a scheme of co-operative marketing could be brought into being; the mutual distrust amongst producers would have to give place to co-operative trust among all for the common good. It is the present writer's opinion that much of the present feeling or distrust can be traced directly to the prevalence of the thieving of mica on the largest Indian field, a matter briefly discussed later.

Direct purchase in operation.

Whilst in the United States of America the writer found one large firm of manufacturers that consumed mica in fairly large quantities, which had for many years persistently followed a policy of direct purchase of mica and whose Director of Purchases informed the writer that

now they had really got their system established and working fairly smoothly. It must, however, be realized that this firm is in a strong position inasmuch as their purchases are of such value that keen competition for their orders takes place amongst brokers as well as producers. The product they require is more or less standard and one readily obtained from almost any Indian producer. From this commanding position the firm are able to purchase at the most favourable rates and can so safeguard their purchasing contracts that losses due to failure to deliver up to sample have been practically eliminated. Shipments of mica not up to sample have been received from time to time, but by drastic action the firm have either educated the producers out of such practices or have struck offenders off their lists.

The experience of this firm shows that really big consumers of mica can adopt a policy of direct purchase if they are prepared to pass through a preliminary period during which they are educating suppliers to conform with their requirements as to price, quality, and system of delivery. In the case of large consumers whose requirements are rather more varied, though not in any way abnormal as to type of product required, the position would probably be easier still.

What is true of large consumers is probably also true of large producers, but since a large producer of mica operates on a relatively small scale when measured against a large general manufacturer, it is the writer's opinion that it would still be in his best interests for the large producer to join in any co-operative marketing scheme should one be started.

Lessons for the Indian Producer.

It will serve a useful purpose to place on record a few of the experiences of the above mentioned firm with some Indian producers during the prosecution of their policy of direct purchase, because it is only by avoiding the practices mentioned that the producer could ever hope to market his product directly with success.

The first essential in direct dealing is the strict maintenance of delivery up to sample, because, as already stated, the consumer feels at a disadvantage, when dealing with a far distant producer, in the event of any dispute arising as to the quality of mica delivered; for this reason many consumers prefer to deal with a local broker even at an enhanced price. The local broker will of course pass on any complaint to the shipper of the mica in question, but in the meantime he will effect prompt adjustment with his customer.

Very large consumers, such as the firm already mentioned, are in a position to safeguard themselves against shipment of mica not up to sample by a threat to strike the offending shipper off their purchasing

list; further if some mica should be received not up to sample it will constitute only a small proportion of their total supplies and they can afford to place it on one side pending adjustment. This cannot be done by the smaller consumers, who are not in the same position to safeguard themselves in the first instance, and who cannot afford to place a consignment of doubtful mica on one side for any length of time pending adjustment. Their claim must be settled in the shortest possible time so that mica of suitable quality is quickly forthcoming to be taken into use. This then is a point that deters smaller buyers from direct purchase and since a large proportion of mica is purchased in small lots delivery up to sample must be carefully controlled by producers.

In this matter of delivery up to sample there is another undesirable practice detected by the firm mentioned; this must be avoided. It being impossible to examine all mica before sending it to the workshops it is customary to examine an odd case here and there, as representative. One case was opened in which it was found that mica of a larger size than that ordered had been packed. As this mica would command a higher price than the contract allowed suspicion was aroused; other cases of the consignment were therefore opened and some found to contain undersize mica. The shipper's explanation was that finding himself a little short of the requisite size of splittings he had had to use a certain proportion of undersized material and had included oversized mica to maintain the average. Examination of the total consignment, however, revealed the fact that the balance had not been evenly maintained, but was much in favour of the shipper. Thus the finding of oversized mica is regarded just as seriously as the finding of undersized material.

Another instance illustrates the danger of employing in Western markets business methods which are current in the East. An order for mica of a given size and quality was placed at a certain price and the order fulfilled. A repeat order was given and the Indian producer evidently felt that this was an indication that a slightly higher price could in fact have been squeezed out of the buyer in the first instance and he accordingly wrote—did not even cable—to say that the price for the repeat order had to be a certain slightly higher figure. The company in question ignored such correspondence and placed the order elsewhere. The first exporter hearing of this, again wrote to ask why he was not given a chance to see whether he could possibly fulfil the order at the original price. This form of bargaining is not understood or tolerated by Western business houses and the Indian exporter must realize that when asked for a quotation he must state the price he is prepared to accept in the first instance. As already stated the average mica

consumer, since he does not buy far ahead of his requirements, must get prompt delivery and there is no time for bargaining by correspondence, even had the consumer the inclination. Similarly if a repeat order is given this must be completed at the original price unless, of course, market conditions have changed in the meantime and rendered it economically impossible to give delivery at that price; furthermore if the market has moved in the opposite direction, rendering a lower price possible, any saving should be voluntarily passed on to the consumer as a matter of good business; and finally the price of a cable is a small item to set off against a satisfactory order that may be lost by saving the price of the cable.

These instances serve to show how certain producers spoil their chances in the market by failure to maintain rigid adherence to the terms of their contracts or by the adoption of business methods not favoured in the markets in which they hope to operate; there are doubtless other cases of a like nature.

Packing.

In the marketing of mica a factor that in certain instances appears to receive insufficient attention is the packing of the mica. In the various warehouses, in Great Britain and America, the writer saw cases of mica which were so badly broken that even if actual loss of mica had not occurred, as it certainly had in many instances, the mica was liable to be badly contaminated by foreign matter. This contamination is particularly serious in the case of mica splittings, and all manufacturers had to adopt measures for the removal of any foreign matter, which would of course be fatal to the insulating powers of the finished product if allowed to remain. Revolving sieves are commonly employed for the removal of dirt and broken scraps of mica, and these have the disadvantage of tending to break up the mica still further; whilst a picking belt consisting of a cotton cloth illuminated from below may be employed for the removal of bits of straw, faulty splittings, etc., this necessitating hand picking. All this costs time and money and might be reduced by more care in the original packing.

It may be argued that the cases have been broken by mis-handling in transit and though this is probably true in some instances the writer saw cases that were so poorly made, of poor materials, and so insecurely fastened that it was inevitable that they should burst open. Well-made and well-secured cases will repay the producer by enhancing his reputation in the market; and such cases need not be unduly heavy if made of three-ply panelling on a suitable framework, and if reinforced, after being packed, by hoop iron or machine wiring. Some effort to prevent

contamination from outside by the use of some form of internal lining would be worth consideration. Finally of course every effort should be made to ensure that the mica put into the case in the first instance is free from foreign matter; in one instance a case of splittings was found to contain an old splitting knife.

Another aspect of this question is that of uniformity of the product packed in any one case. In this matter it is the other producing countries, such as South America and South Africa, that have been the worst offenders, all sizes and grades together with scrap mica being packed in a case. Nevertheless the Indian producer may well remember that uniformity of product in any one case is looked for by the purchaser and repaid by preference given to shippers known to carry this out. As an extreme case in the opposite direction to some of the bad packing seen, the present writer was shown some 'domestic mica' in America that had been carefully cut to precise linear measurements and thickness and packed in bundles of a definite number, wrapped in brown paper and fastened up, with the details of the contents written on the outside so that the mica could change hands and be issued for use without ever being opened except when it finally came into use. The writer would not suggest that such a practice is desirable when handling large quantities, or even possible when dealing with 'sickle trimmed' mica, but it serves to show the importance placed, in America, on this matter of packing, and the probability that a reputation for good packing will carry no little weight in the placing of orders.

Block mica or splittings.

There is no doubt that the invention of the process for building up thin splittings of mica to form insulating material known as 'micanite' or 'mica plate' has profoundly changed the balance in the mica trade. Whilst 'block mica' was at one time the only saleable article, and in certain instances still commands a high price, the present demand is mainly for splittings; a tendency ever increasing. Though these splittings command a relatively low price their preparation finds an outlet for much that was originally a waste product and by the volume of business done, the handling of splittings now constitutes the most important section of the trade. As an instance of this change of balance it may be mentioned that 'heater units' for electric irons, until recently made only from block mica, are now successfully made with built up plate; and other cases could be quoted.

This fact is all in favour of the Indian producer, since the manufacture of splittings is almost an Indian monopoly. In spite of the invention of numerous machines for the production of splittings either by cutting, rolling, or the injection of liquids between

the laminae, no satisfactory splitting produced mechanically is yet on the market and the very nature of the process seems to render mechanical accomplishment almost impossible. The production of splittings then resolves itself into a question of labour and it is on account of the supply of relatively cheap labour in India that this country is able to hold the position it does. The Canadian phlogopite is split by French-Canadian girls in the eastern cities of Canada, but their *per capita* output compares unfavourably with that of average Indian labour, and wages are of course higher. Thus India at present holds an enviable position in a trade of growing importance; in fact the writer believes that Canadian and Madagascar phlogopite has even been shipped to India for splitting and then re-exported.

The Indian producer must not, however, be lulled into a false sense of security by the hold that India has on the market for splittings. It must always be remembered that this hold is not due to any intrinsic merit in Indian mica for splitting, but to cheap manufacture and that countries like Guatemala, South America and South Africa are competitors in the mica market. The latter country at present is making strenuous efforts to develop its mica resources and it only requires the training of the cheap labour available there for the Indian position to be threatened. It therefore behoves the Indian producer further to consolidate his position and render competition an unprofitable undertaking by turning out only the best splittings, at the lowest possible price, marketed in the best condition, and in the soundest way.

As already mentioned any threat from mechanically prepared splittings seems at present negligible. Whilst in America the present writer saw some so-called splittings made from phlogopite by machinery. These consisted of pieces of mica of all sizes and varying enormously in thickness, which had evidently been produced by passing mica through corrugated rollers. The mica had been mangled apart to a greater or lesser extent and each piece was marked by striations due to the corrugations of the rollers, the resultant product being utterly useless as splittings.

In the case of mechanically built up mica plate the use of 'pan splittings' is not possible in the machines until the 'pans' have been divided up and hence the preparation of such splittings will become less and less remunerative. For the highest class of work the preparation of 'book splittings' is of value and these can be readily used in the machines. Such splittings are merely 'books' of mica split in the usual way, but the splittings from each 'book' are kept together and not all jumbled up; when carefully packed these 'book splittings' present the material to the consumer in an almost ideal manner.

UTILIZATION.

Micanite manufacture.

In Great Britain and America the writer was privileged to see the latest developments in the mechanical building up of mica plate or micanite. Some of the processes give intermittent action, producing plates of a definite standard size; whilst one process gives continuous action, producing plate of a standard width which is cut off into standard lengths as it emerges from the machine.

It would be out of place in this bulletin to attempt any description of these methods; it is sufficient to stress the fact that the production of plate of a more uniform nature is thereby made possible at a lower cost. This lower cost and greater uniformity tends to an increased use of the product with consequent benefit to the producers of the raw material.

A recent development in this section of the industry is the use of a synthetic resin as a binder to replace the shellac that up to now has formed the only satisfactory material and is still used in most instances. The plate built up with this material goes by the name of 'Super Micanite' and does not have the brown colour of shellac bound plate, but is transparent and as colourless as the mica splittings used. This binder yields an excellent ringing plate which appears to be as satisfactory in every way as that made with shellac; in fact the makers claim superior qualities for this product. Owing to the transparency of the plate, particles of foreign matter are easily detected and their presence is very serious because, whilst mineral impurities are extremely bad in any case owing to the reduction in electrical resistance that they cause, there are other impurities such as hairs, bits of straw or vegetable matter, which do not seriously affect the electrical resistance of the plate, but in a transparent plate are readily detected and the buyer may reject the plate on account of their presence. Thus an appreciable increase in the manufacture of such transparent plate would increase the importance of proper packing, a point already stressed.

Micanite manufacture in India.

It has been maintained for many years that since the two most important raw materials for the manufacture of micanite are produced in India, namely splittings and shellac, that therefore the manufacture of the product should be carried out in India. The arguments in favour of this proposal were strengthened by the fact that considerable hand labour was employed in placing the splittings in position and applying the binder. The development of plate building machines has robbed

this argument of much of its force, whilst the use of a synthetic binder will possibly eliminate the use of shellac, one of the raw materials the production of which is an Indian monopoly. Thus the case for the establishment of micanite manufacture in India is no longer a very potent one, particularly when the degree to which the technique of this business has been developed, together with the elaborate testing equipment now used, in Great Britain, America and elsewhere, is appreciated.

Quite apart from these considerations the present writer is of the opinion that the climate in India might not be suitable for the production of the highest class of work. For example, many of the shapes demanded by the electrical industries are stamped out, by the micanite manufacturers, in presses into which the plate is fed in a heated and therefore pliable condition and is afterwards cooled down, so that when taken out it retains the form impressed upon it; this cooling is assisted by water circulation in the press and even so a certain 'time lag' has to be allowed in the press. In a hot climate the 'time lag' would have to be considerably increased thus reducing the output. Also deformation after manufacture and before incorporation in the final machine would be a constant danger and potential source of loss. If it be suggested that the Indian Factory would only produce the 'plate' then the question arises as to who would make the required shapes that the foreign micanite manufacturer is prepared to make with his own 'plate'. Even with plain 'plate' there would be the danger of sticking during transit.

Testing.

To the writer it has appeared to be somewhat of an anomaly that whilst the general tendency in manufacture is to test and re-test all raw materials before they are made use of, no system appears to have been devised, as yet, whereby the mica used in the electrical industry, which in these days practically means the splittings used in the manufacture of micanate, is tested prior to manufacture.

After any article has been made it can be tested up to a quarter of a million volts or more, and by a system of oil baths, etc., working conditions can be imitated very closely in such tests. The test is then made until the air dielectric breaks down, that is, until the spark jumps across the outside of the article under test. If there is any flaw in the article it will be punctured and break down under test, and being thereby rendered useless will be discarded. This is a very drastic method since 99 per cent. of the material may be sound and have to be discarded because 1 per cent. is flawed. It is probably because such puncturing

of the mica insulation is so rare that this method of testing the finished article has been allowed to persist.

Turning now to the producer of mica we find that his only method of testing material is the extremely crude one of human inspection, and, on this account, when an order is received for mica to withstand the highest electrical pressures the mica producer must ransack his stock to find material that by visual inspection he feels will withstand the test, the almost inevitable result being that large quantities of mica have to be rejected to be used in a lower grade of work, that by actual test might be found satisfactory.

It therefore appears that there is an urgent need for some method whereby the raw material can be tested so that the producer will be in a position accurately to grade his product according to its dielectric strength. The manufacturer could then purchase material guaranteed to have a certain minimum electrical resistance and could use only such grades as may be necessary for the work in hand. As it is at present, the factor of safety in the mica insulation is and, must necessarily be, of an exceptionally high order.

Another recent development in testing is by means of the X-ray, whereby any mineral matter or other impurity accidentally left in the plate can at once be detected. This method is particularly useful for the inspection of 'X-ray tubes' to see that the internal conductor has retained a truly central position during the process of making the right angle bend at one end.

Mica washers.

Mica washers have been in common use in all forms of electric devices for a number of years, and recent developments in wireless broadcasting have led to a great increase in their use; especially those of very small sizes. The majority of these washers are made from the trimmings from mica sheets used in the preparation of other articles, though the larger sizes are cut from sheet mica and also made of micanite. The above-mentioned trimmings pass to the washer department where, for the larger sizes, the centre hole is punched out in a hand press; the pieces are then threaded on a spindle and the whole turned up in a lathe to the requisite outside diameter. The smaller washers are made by first punching out discs of the required external diameter; the discs are then placed in a suitable holder and the centre hole drilled out. The manufacture of these washers, therefore, constitutes an outlet for material that would otherwise be a waste product from the block mica cutting room.

The manufacture of such washers, in India, from much of the waste from the trimming sheds, should provide a profitable outlet for some of the waste; though indiscriminate production might easily glut the market.

Ground mica.

The question of the grinding of mica in order to find some use for the enormous quantities of waste mica from the Indian factories has been advocated from time to time for many years. The present writer is of the opinion that the matter is worthy of attention, but one requiring very careful preliminary investigation. The reduction of mica to a fine state of comminution is not such an easy matter as may at first appear and the fact that this industry is, at present, almost entirely an American one is due to the considerable attention paid by the Americans to the development of the technique of mica grinding. Furthermore as in the case of mica washers it must be remembered that it would not be a difficult matter so to increase production as to reduce the selling price below the economic limit.

Specific uses.

It is beyond the scope of this bulletin to discuss the multitudinous uses to which mica is put, but some brief remarks on this subject appear to be called for. The electrical industries are, and will remain, by far the largest consumers of mica, and the rapid growth in the consumption of electric power all over the world will call for increasing quantities of high grade mica, even if no additional uses are found for this perfect insulator. In electrical work the mention of mica calls to mind the insulation of commutators in direct current motors and generators by mica V-rings and segments, mica washers, condenser plates, and such familiar products; but the writer sees no reason why the application of mica in the electrical industry should not be much wider. For example, the insulation of cable joints is now being advocated and the writer was shown the ingenious spacer and sleeve assembly that has been developed for this purpose; the assembly is made from micanite and sold under the name 'Conducele.' Similarly micanite is the ideal material for the manufacture of tubes of all sizes and shapes for carrying high tension conductors through power station walls; and instances could be multiplied considerably. If electrical engineers could be persuaded to submit their insulation problems to the manufacturers of micanite or mica plate, who retain highly technical specialists to advise on the solution of those problems, it would be found that in almost every case a micanite insulator could be devised to perform the work and to perform it more efficiently than anything else. Propaganda among electrical engineers along these lines appears to be a profitable avenue of effort.

Whilst some of the less important uses for mica, such as its use in stoves and furnace peep holes appear to be dying out—due in the case quoted to the competition of highly refractory glass—there are new uses being developed and these will probably maintain the demand for miscellaneous purposes. The present writer was shown examples of lamp shades made from micanite in which the colour and suggestion of pattern, due to the splittings, resulted in an extremely pleasing article, suitable for decoration in various ways, and very durable.

As a result of a notice in 'The Gramophone,' concerning a paper by the writer¹, an enthusiastic amateur informed him that he had heard all the various patent soundboxes for gramophones, at present on the market, but that in his opinion the mica soundbox was still the best. If this opinion should ultimately become general then a revival of the demand for mica discs for this purpose may be looked for.

Thus it may be seen that on all grounds it is reasonable to suppose that the market for mica will continue to be a growing one and since there is no natural or artificial substance that combines so many properties useful in the arts and at present there appears to be no likelihood of the development of a synthetic competitor—it seems safe to assume that the market will remain a buoyant one and that the 'long view' is justified and indeed necessary in all matters concerning the trade.

CONTINUITY OF SUPPLY.

During the course of discussions on the trade in general the present writer found that there existed in America a feeling of apprehension regarding the continuity of supplies of Indian mica. This feeling was based on two grounds :—

- (1) On the fear of the pinching out of the natural deposits of the mineral.
- (2) On the possibility of the adverse working conditions causing a premature closing down by operators.

Apprehension under heading (1) was probably based on Canadian experience, as in that country it is apparently considered that the mica bearing rocks either do not persist below a depth of 200 feet or do not carry mica below this depth. The writer was prepared to reassure consumers on this account; there are no geological grounds for supposing that the Indian mica will not persist in depth; indeed experience in the Bihar field points to the opposite being the case, so that even when the superficial mica has been won, which will not be for many years yet, the supply will be maintained, though at an enhanced cost perhaps,

¹ Mica and its international relationships, *Bull. I. M. M.*, March, 1927, London.

from deeper workings. The only danger from this point of view is that the hand-to-mouth methods of working at present employed, either due to ignorance or from the operation of factors discussed under heading (2), will inevitably increase the difficulties of subsequent deeper working and possibly place them outside the economic sphere. On purely natural grounds there is no cause for apprehension.

(2) Apprehension was expressed that, on account of the systematic theft of mica in the largest Indian field, the important producers of mica, as distinct from mere dealers, might be forced out of business and that a consequent collapse in production from this important area would take place. The prevalence of this systematic theft is apparently as well known to certain large consumers of mica in Great Britain and the United States of America as it is to the operators in the Bihar field: it is, therefore, a question which has passed from one of purely Provincial interest to one of international importance, and is no mean factor when considering the question of the future supply of Indian mica, which still constitutes the bulk of the world's supply.

On this point, unfortunately, the writer was unable to reassure the consumers who raised it, since from personal experience and a study of statistics he was well aware that such theft was a serious menace to the producing industry in the Bihar field. Even taking the total figures, which include those for Madras and Rajputana, where theft is unknown, it is found that mining returns account for no more than half the quantity of mica exported annually from India; and even discounting faulty and incomplete returns, import and re-export, and similar small items it is evident that a very large quantity of mica reaches the exporting stage every year without ever being ostensibly produced; when figures for value instead of weight are taken the discrepancy is considerably higher. Thus the fact that systematic theft does occur cannot be denied; the producer's mining costs are thereby more than doubled, since his costs include those necessary to extract the mica he produces, according to his returns, and those necessary to develop, up to production stage, the mica that is stolen. That this is indeed a serious matter is obvious, as is further emphasized by the fact that the necessity for closing down has been seriously considered by certain operators. The seriousness of the situation has been recognized by the Government of the Province concerned in the introduction of a Bill to afford assistance and protection to the industry, which Bill, however, was rejected by the Legislative Council in February 1928.

That this unsatisfactory condition of affairs will be permitted to continue seems unlikely, but in the meantime the consumers will continue uncertain as to the security of supplies from this source, since the

closing down by operators would shut off not only their own contribution to the supply, but also the supply of mica stolen from their mines. In these circumstances it would not be surprising if consumers should turn their attention to other possible sources of supply, with disastrous consequences to the Indian industry.

MINING PRACTICE.

The methods of mining are also outside the strict scope of this bulletin, but since the writer saw something of Canadian practice, whilst touring that country, and since in many respects this differs from Indian practice, a few words on this subject may not be out of place.

In Canada the Lacey Mine, near Sydenham, Ontario, the largest phlogopite mine in the world, and the Blackburn Mine in the neighbourhood of Buckingham, near Ottawa, were visited.

Whilst the maximum of hand labour and the minimum of machinery is the rule in Indian mines the reverse is the case in Canada, due primarily to the higher wages of labour in that country. The total output of the Lacey Mine is secured by some eight or nine men. Modern methods of machine drilling and deep hole blasting are employed and are evidently satisfactory. Such methods would appear to be even more suitable for the Indian occurrences in which the mica is much more scattered, so that the danger of possible damage to the mica is greatly reduced.

If a hole appears to be passing into the edge of a "book" of mica the hole is abandoned and another drilled nearby; if the hole strikes a 'book' normal to the cleavage plane the hole is continued as the only resulting damage is a clean hole through the mica and this is not sufficiently serious to warrant abandoning the hole. It is found that the actual blasting causes little or no damage even when the charge is resting in close proximity to a 'book' of mica. Of course considerable technical skill and experience are necessary to decide when a hole should be abandoned and particularly to determine the blasting charge necessary to break the ground without shattering it.

The use of the diamond drill for prospecting has also demonstrated its value and has revealed parallel belts of mica-bearing ground on each side of the original belt at the Lacey mine. The drill has also been used to explore the ground below the 200-foot level. Such a method of prospecting may be of value in Bihar when all the surface indications have been exhausted or in areas covered by alluvium; the Madras field might be profitably explored in this way. The Indian occurrences, however, are much more irregular than those in Canada and thus are

more likely to be missed by bore holes, so that at present expenditure on this method of prospecting does not appear warranted.

Though hand labour in India is plentiful and apparently cheap, the writer is of opinion that, if measured by output, machine mining would compare favourably in cost and would result in a better type of mine. Whilst the training of indigenous labour in the use of the power drills would not be a difficult problem, the new methods of mining would call for a higher degree of technical skill on the part of the supervising staffs and a more liberal capitalization of concerns, so that the present hand-to-mouth methods of work could be replaced by systematic development and lay out; thereby minimising the damage done to the natural asset by the methods now so often used, which lead to the extraction of cheap mica, but only by mortgaging the future of the deposit. Such capitalization, development, and employment of skilled technical men, can only be undertaken when there is security as to the future; it is just this security that is undermined by the thefts at present so prevalent.

SUMMARY.

To summarise the situation, it appears reasonably certain that the market for mica will be a steadily increasing one and that the demand for splittings will increase at the expense, to some extent, of that for block mica.

The Indian position in the market is still one of great strength, the increase in the demand for splittings contributing very considerably to this strength. The demand frequently made by consumers for Indian mica only, is often based, not on any intrinsic superiority of Indian mica over that from other countries, but on the more satisfactory grading and marketing of the product. It is pointed out, however, that other countries are now alive to these facts and the Indian producer must not, because of the commanding hold India has on the market, be led to relax his efforts instead, he should by constant attempts improve the condition in which his product is marketed, so as to offset the growing competition from other countries.

It is necessary that immediate steps should be taken, by the proper authority, to ensure the protection against illegitimate trading that the producer may fairly look for, and thereby dissipate the feeling of doubt as to the security of future Indian supplies that is spreading among consumers; for consumers may otherwise turn their attention to other sources of supply.

The producer, when thus protected should, as the owners of the natural asset have a right to expect, turn his attention to more up-to-

date methods of exploitation and should no longer be content, or be allowed, to remove the superficial mica in the cheapest possible way, if thereby the hazard and expense of future work be increased.

At present the elimination of the broker does not appear to be practicable, but producers by the avoidance of certain business methods and practices, as enumerated, can do much to foster direct trading. With the elimination of mutual distrust amongst producers and the growth of a spirit of mutual help the development of a scheme of co-operative marketing appears to offer distinct possibilities; whilst trade propaganda to encourage the wider use of mica appears to be a logical amplification of the publicity work undertaken by the mica-plate manufacturing firms, which only partially covers the field.

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