in New Hampshire produced 40,000 lbs., valued at $40,000, and 160 tons of scrap valued at $2,000. Of the North Carolina mines none were in steady operation, and the production of that State, aggregating 6,700 pounds, of a value of $7,000, was the result of irregular and spasmodic efforts. The balance of the product viz.:—2,800 pounds of cut mica valued at $3,000, and 36 tons of scrap came from one mine in Virginia which was exhausted early in the year. In the Black Hills region, South Dakota, where, in 1884, eleven mines were in operation with a production of over 18,000 pounds of mica, only one produced in 1889 and that only a small amount. The whole industry employed but 174 persons, and $58,335 was expended in wages, supplies and other outlays.

In 1882, cut mica was worth $3.50 per lb.; in 1883, $2.50; in 1884, $2.53; in 1885-6-7, $1.75; in 1889, a fraction over a dollar; in 1890 there were signs of improvement and the total product in the United States, aggregating 60,000 lbs., was valued at $75,000; in 1891 it had increased to 75,000 lbs., of a value of $100,000.

Imports of Mica into the United States—In October, 1890, the McKinley Tariff placed mica on its dutiable list at 35 per cent. *ad valorem*. Notwithstanding this protection the imports into the United States in that year were more than double that of any previous year, having increased from $1,165 in 1869, to $9,274 in 1879, and $97,351 in 1889 to $207,375 in 1890. A comparision of the sources from which the United States draws its supplies may be gathered from the following returns for the year ended 30th June, 1890:—Germany, $3,500; England, $64,611; Canada, $25,105; British East Indies, $49,058; Sweden and Norway, $4,695.

Mica Production of Canada—On the other hand the value of the production in Canada has steadily advanced as may be gathered from the following figures quoted from the returns of the Geological Survey of Canada. 1886, $29,008; 1887, $29,810; 1888, $30,207; 1889, $28,718; 1890, 68,074; 1891, $71,510. For the twelve months ended 31st December last year (1892) the value of the exports from Canada had increased to over $100,000, of which the Ottawa district contributed no less than $54,729.82 to the United States.

This leads me to note briefly some of the uses to which the product is applied.

Stove Panels—In 1876 when I first became associated with the industry through my connection with Mr. E. Grant Powell, of Ottawa, at that time agent for the sale of the product of the British and Canadian Mica and Mining Company's mine in the township of Villeneuve, Ottawa County, Que., manufacturers of stoves in Canada and the United States consumed 95 per cent. of the output. The Villeneuve mine in Ottawa county, and the properties worked by Smith & Lacey at Sydenham, Ont., were the principal producers, though several surface deposits were opened by farmers, who worked them occasionally when business was dull, and realized fair profits on their production. It was then almost wholly utilized for the pannelling of stove and furnace doors. For this purpose it had to be clear, free from spots and of a uniform color throughout the sheet.

Electrical Insulation—The great factor in increasing the consumption of mica has been its demand for electrical purposes. "The insulating power of mica," says an eminent electrician, "is superior to that of any other substance applicable to armatures. An advantage, peculiar to itself, is its even laminated structure. How wonderful is the thinness of its individual layers! A piece of ordinary writing paper is about .005 inch, mica layers have been obtained of a thinness of .00003 inch. Mechanical difficulties prevent its being split thinner. By pasting it upon a hard surface and splitting it off as much as possible, the remaining fragments are so thin as to become beautifully iridescent. The builders of armatures can therefore split the sheets into any desired and uniform thickness with great ease and accuracy. An interesting property of mica and one not generally recognized, is its homogenity of structure and clear transparency, although so black when thick. A valuable property of mica in connection with commutator insulation is its proper degree of hardness, whereby it does not wear away too rapidly under the action of the brushes. If rubber was used for example, even if it did not burn, yet it would wear off and sparking result, because the commutator surface would not be truly cylinderical. The brushes would be set into vibration.

"Again, mica is capable of the finest pulverization, so that any wearing which does take place does not result in the liberation of gritty particles, which would cause sparking. Such mishaps occur with hardened artificial plastic insulators. The insulation should be just so thick that the current cannot jump across from one section to the other."

"Of all substances," says the same authority, "mica is probably the best material for use in armatures, if it is desired to obtain not only efficient electric insulation, but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short circuit or bad construction, will have no injurious effect on mica. Mica, thick or thin, may be held in a glass flame without burning or melting. It remains unaffected."

The introduction of mica into practice appears to have been brought about in the following manner:—An accident would happen to an armature, and before the next night it must needs be repaired. In order to make the temporary remedy, mica sheets or bars would be interposed. In case of subsequent accidents the portion required by mica was the last to yield. Therefore it was proposed to build the armature primarily with mica.

The Canadian mica, on account of its superior cleavage, is preferred by electricians in the United States to the home product and after gaining a foothold in the American markets it has more than held its own against the local and foreign product. An instance of this may be cited in the following communication to the Geological Survey of Canada from the Edison General Electric Company of New York (See Annual Report Mineral Statistics, 1890, pp. 104 and 105 s.), which says: "The bulk of mica used by us is Canadian mica, which is known in the market as 'amber mica,' being of amber color and clear. It is essential that the mica should be smooth, free from wrinkles and crevices, it must split readily and must be flexible, so much so that a piece of mica .010 in. thick would bend to a curvature of about 3 in. diameter without cracking. Mica that has dark spots or spots similar to rainbow colors, or what is known as smoky mica, is not at all suitable for electrical purposes. Mica must also stand a flame of intense heat without crumbling up or showing any disintegration. We give you below the principal sizes of mica used by us, and would say that at the present time we have orders out for some of the sizes ranging from 200 to 600 pounds:—Commutator mica: 1½ x 4 in., 1¼ x 6⅝, 1⅜ x 4¼, 1⅜ x 6½, 1⅜ x 8, 1¾ x 8, 2 x 5, 2½ x 5, 2 x 7, 2 x 12, 2½ x 12, 4 x 4, 5 x 8. Binding mica, 1¼ in. wide."

Micanite—In a paper read this year before the American Institute of Electrical Engineers, a Mr. Thompson describes the use for insulation of pulverized or comminuted mica mixed with a liquid cement and rolled or compressed in various forms known as Micanite. Mr. Thompson says: "Although so superior for armature insulation, mica is, in its natural structure accompanied by certain objections, which, in trying to overcome, were more serious than had been anticipated, as it was not until after a long series of trials that a successful article was produced, and not until a novel apparatus for cheapening the process of manufacture was devised. The apparatus is now in operation on a large scale.

He claimed first:—Mica, as found in nature, occurs in flat sheets only. It has a high degree of elasticity, so that when once bent and released, it assumes its original form. If folded, its brittleness causes fracture. If the natural sheets are compressed in a mold, to try to form armature insulator heads for instance, it is completely broken up.

Secondly. Natural mica sheets correspond financially to plate glass. The larger the sheet, the higher the cost per square inch. Mica in small pieces, from four to six square inches, is exceedingly abundant and very cheap. It is often called waste mica, because very limited in its uses, and consisting often of trimmings from larger and more useful sheets. In medium and large sizes of armatures, the naturally built up mica is so expensive as to be objectionable, although not so much so as to entirely prevent its employment.

Thirdly. Between the hundreds, nay, thousands, of thin layers, damp air can enter, and also water, accidentally, which cannot easily or effectually be removed.

Fourthly. Mica splits so easily that handling causes injury.

Fifthly. Mica cannot be cut transversely to advantage. The edges are unworkmanlike, being ragged and jagged. Neatness in drilling, sawing and turning is difficult.

Among the attempts which have been made to overcome these objections are those involving the use of pulverized or comminuted mica, which is mixed with a liquid cement and stirred into a paste. While still soft, the mixture is rolled or compressed into any desired form, as if consisting of so much plaster-of-paris. In order to give it sufficient strength, one-third of the product is cement. The mica sparkles here and there on the surface, as it glitters on granite. This article should be called a cement insulator, and not a mica insulator, because the current can flow in a straight circuit through the plate without encountering any mica. The cement forms numerous rectilinear paths for the current, independently of the mica; and therefore the product is in no sense an equivalent of mica.

A modification of this tpye of insulator consists of a coarse and thick textile fabric, whose pores and meshes are filled with a mixture composed of comminuted mica and a suitable adhesive substance. Another consists of finely divided asbestos mixed with pulverized mica, silicate of soda, and sulphur compounds. It is molded by pressure into any desired form.

The comminuted mica-cement type is useful in trolley wire supports and similar insulators, but for dynamos it is useless not only for the reason stated, but because of its softening and running under slight heat, being so necessarily rich in cement. If the cement is that kind that chars, the mica crumbles apart. Mineral powders have been mixed with it, to render it more fire-proof.

An example of the manner of using non-comminuted mica between the core and the windings consists in covering the core with paper, laying sheets of mica over the paper, then laying on another sheet of paper, fastening the whole together by convolutions of cord or similar ligatures, and finally applying the coils. During operation, the paper and mica may shift from their positions, and thereby affect the rigidity of the armature as a whole. Again, the process of applying the pieces, and keeping them temporarily in position, requires repeated efforts and results in a display of crude workmanship."

Mica for Glasses and Spectacles—The best employment of the immense quantities of scraps and fragments of waste mica which suggests itself as worthy of a wider field than it now possesses is the substitution of mica for glass in spectacles worn by workmen, especially stone and metal workers, to protect their eyes from chips and splinters. As already made in Germany, these mica glasses are concaved in the shape of watch glasses, and are about one twenty-fifth of an inch in thickness. The advantages gained by this utilization are greater than would at first be imagined. Mica spectacles cannot be broken. Pounding with a sledge hammer merely flattens them, nor does molten metal poured on the mica affect it. The shower of pointed iron particles which issues from lathes merely rebounds from the elastic mica glasses.

Paints, Wall Papers and Ornamental Uses—Another use for mica is its application, when previously colored or metalized, to ornamental purposes. From its unalterable nature the material preserves gilding, silvering or coloring from deterioration; and from its diaphanity, the article so treated will preserve all their brilliancy. Finely ground mica, or colored gelatin, also shows handsome effects, and when mixed with a solution of gumarabic, it makes a good silver ink. The gelatin combination is used for inlaying buttons. Another beautiful application of mica is in the production of bronze-like colors, which bear the names brocades, crystal colors and mica bronzes. Among the advantages of these are that they are indifferent to sulphurous exhalations, are very light in weight, and in some colors are even more brilliant than the metal bronzes. When small particles of mica silver are spread over articles coated with asphalt varnish, the result is a good imitation of granite. The crystal colors are also suitable for calico printing; and fabrics to which they are applied surpass in brilliancy the heavy bronze and glass dust fancy fabrics of Lyons. Such colors have been used to decorate procelain and glassware, the articles undergoing a second heating up to the fusing point of their glazing. By suitable dyes, the material is colored to a variety of hues.

As a Lubricant—The mineral is somewhat extensively used in the manufacture of mica grease. As a lubricant for railroad purposes its value lies in the fact that it is absolutely anti-friction, and it is claimed with its use hot boxes or journals are simply impossible. A visit to the works of the Railroad Mica Lubricating Company at Denver, Colorado, is thus described.

The mica comes to the factory in carloads, just as it is taken from the mine. It is fed by boys into two machines, which cut it into fragments about half an inch in size. By a system of pneumatic tubes, the mica, so cut, is delivered to the atomizing machines, which grind it into powder.

These machines one must see to fully realize their peculiar action and construction. Each machine consists of two steel shafts three feet long, with a series of gun metal spirally arranged beaters, which revolve in a closed case forming a figure. When in operation these machines make from 5,000 to 7,000 revolutions in a minute. The beaters on the revolving shafts are so arranged that the fingers on one pass between the fingers on the other shaft, so that when the material is passed through the pneumatic tubes from the feeding machine to the atomizers at a velocity of 15,000 feet a minute, the work of atomizing is instantaneous.

The mica, now reduced to atoms, continues its course at the same velocity through another set of pneumatic tubes to the sifting bins. Here the current is so retarded by the peculiar mechanism that it causes the material to settle in the various compartments, of which there are six, at the same time grading the material according to its fineness. The powdered mica is now settled in the hoppers or bins, immediately over the mixing pans. Here the several grades are drawn into the pans, which are provided with mechanical mixers, and the lubricant is made up by the use of the proper percentage of oils, mica and such other ingredients as the company uses in the manufacture of the product.

Directly over the hoppers are located the oil-tanks, which supply the mixers by a pipe running down on the outside of the hopper, on the end of which is a faucet.

At the south end of the bins there is located a large cylindrical machine four feet in diameter and ten feet high, that is called a dust arrester. Any of the material that is so light and fine that it will not settle is driven into this machine by air currents, which thoroughly separate the mica dust from the air, where it settles in the bottom of the machine and is drawn off as needed

It is stated that the capacity of machinery heretofore made for pulverizing mica has been from 300 to 400 pounds a day, and then the material has not been sufficiently fine for lubricating purposes. It is claimed for this new concern that it can pulverize about five tons a day, or in ten hours running."

Other Uses—Mica has been used on board war vessels, in localities where glass would be broken by the concussion due to the firing of heavy guns. It is made into reflectors, sea compasses, inlaying for wood instead of enamel. It is also employed for roofing purposes, and in several patented processes forms a water and fireproof covering for strata of rubber, tar, canvas, felt, and similar materials.

THE CHAIRMAN—We are much indebted to Mr. Bell for this valuable collection of information on the subject. Mica has excited a great deal of interest among us in coming in when the phosphate industry was declining; and as it has come in in connection with the phosphate we have been tempted to throw it away. I remember selling 200 tons of it for 75 cents a ton, while now the better kinds bring from $300 to $400 a ton. We have heard from Mr. Bell several of its uses, and no doubt several more uses to which it can be put will be discovered. I met a gentleman who told me that a certain distinguished professor had said that mica was sure to become an important factor in the industries of the future; and this remarkable discovery as an insulator for electrical purposes certainly opens a wide field in that direction.