LETTERS TO THE EDITOR

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[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The Divisibility of the Electric Light

THE English and American periodicals devoted to electrical science now announce, "on authority," that the electric light discovered by Edison is a light by incandescence. If this be true there is nothing new or startling either in the discovery of the light or of its divisibility. Lighting by incandescence has been studied for a long time; indeed, it has been studied much more thoroughly than any other kind of electric lighting. Thirty-three years ago a method of producing and sub-dividing the light was patented in England by a Mr. King. The light was produced by heating to white heat in a vacuum, by means of the electric current, either platinum or carbons; and, the specification adds, "when the current is of sufficient intensity, two or a larger number of lights may be placed in the same circuit." For some years after this discovery several improvements on King's invention were patented in America, France, and England; "but," says M. Fontaine, "none of these appear more complete, more explicit, and more practicable than King's; it is, then, useless to continue our nomenclature." The principle of lighting by incandescence, although not neglected or forgotten, seems to have made but little progress until 1871, when M. Lodyguine showed an experiment in the Admiralty Dockyard in St. Petersburg, when he divided the circuit into no less than two hundred lights. This naturally made a great sensation at the time—as great a sensation as that caused by Mr. Edison's telegram of the 7th ult. The Academy of Science awarded to M. Lodyguine the large Lomonossow prize of 50,000 roubles. A company was formed in St. Petersburg with a capital of 200,000 roubles, and the excitement in Europe was then almost as great as has been witnessed in England lately. It was soon found, however, that Lodyguine's discoveries, like those of his predecessors in the same field were, after all, impracticable, and that his illimitable division of the light, however ingenious, was only a fanciful experiment. Every penny subscribed to the company referred to was lost, and Lodyguine's great discovery is now, where it was then—in his laboratory.

It has, however, been urged that these early inventors of the electric light knew only of the galvanic battery as a generator of a powerful current, and that had they known of the Gramme machine, or other dynamo- or magneto-electric machine, the results might have been different. The remark, however, only applies to King and the improvers who immediately succeeded him. The great division of the light by Lodyguine, to which reference has just been made, was in a circuit produced by two "Alliance" machines. Even, however, if such were not the case, there are at present before the world, in more or less detail, four recent inventions for the production of a divided light by incandescence. These are the inventions of M. Reynier, of M. Arnaud, of Mr. Edison, and most recent of all, M. Werdermann. From the way in which these discoveries—if they are discoveries—have been ushered into the world, it is found that great claims are made on their behalf, and there are, therefore, naturally great expectations on the part of the public in regard to them. It cannot be urged now in mitigation of the shortcomings of the incandescent light, as it has been urged in the past, that it has not had a fair trial, on the ground that the lamps in existence were imperfect in conception, and complex in construction. The lamp of M. Reynier seems admirable in its way, and if light by incandescence were to be the light of the future, the claims of this lamp would have to be very carefully considered, and, in any case, it will certainly hold an important place in all investigations into the subject. The lamp of M. Werdermann appears to be identical in principle with, and only slightly different in detail from, that of M. Reynier, and we may fully expect that these inventors will have to come to terms with each other—so much alike are their inventions. Of the details of Mr. Edison's invention—if there are any, nothing is known beyond the fact stated in the *Scientific American*, that it is a light produced from a spiral of incandescent platinum; while the reports in the American daily press show such an effervescent ignorance of the

fundamental principles both of electricity and of dynamics, that no reliance whatever can be placed upon them.

Experience, then, has shown that a light by incandescence comes before us in a very questionable shape, and it is essentially a light which discourages the notion of its practical application. The question indeed may be very properly asked: How is it that light by incandescence has always proved such an utter failure? It has had a period of thirty-three years in which to develop; it has been divided into various lesser lights, numbering from two to two hundred: and it has arrested the attention and taxed the skill of the greatest electricians in the world. How is it that it is obliged to give way to light by the voltaic arc? The answer is at hand. The light by incandescence can only be obtained and divided by a great sacrifice of light and power. This is imperative from the fundamental principles of electrical science. The diminution according to the "square," and not according to simple proportion, applies to electricity just as it applies to light, heat, sound, gravitation, and other physical phenomena. Thus if a circuit be divided into two branches whose resistances are equal, a current of half the strength passes through each branch, producing at the point of resistance, not half the light, but only a quarter, because the effect follows the square of the current strength. If the current had been divided into three equal branches, in each branch only one-ninth part of the original light would be obtained, and so on; so that if an electric light of 1,000 candles were divided into ten equal lights, the result would be ten lights of ten candles each, instead of one of 1,000 candles. When this law is borne in mind, and when it is also remembered that to produce the electric light by incandescence at least one-half of the current is lost, it will easily be imagined what a wasteful light it is. Recent experiments prove this. It was recently stated, in reference to M. Werdermann's incandescent light, that he produced two lights of 320 candles each (total, 640 candles), with a prime mover of 2 horse-power; and this was considered a great result—as indeed it was for an incandescent light. But how this sinks into insignificance when compared with the results of lighting by the voltaic arc. A few days ago M. Rapieff, with two of his regulators and a small Gramme machine known as the M machine, and which M. Gramme says requires only $1\frac{1}{2}$ horse-power, produced two lights, which, when carefully measured by the photometer, were found to be each equal to 1,150 candles, or a total of 2,300 candles, while with one of M. Gramme's A machines, requiring $2\frac{1}{2}$ horse-power, a light of 6,000 candles can be obtained from one of M. Rapieff's regulators. Some experiments detailed in M. Fontaine's book on "Electric Lighting" gave a similar result. M. Fontaine's experiments with an incandescent light show that, under the most favourable circumstances, with a Bunsen battery of forty-eight cells, eight inches high, the diminution of the sub-divided light was so great that, where he put five lights in one circuit, he only obtained a total illuminating power of a quarter of a burner, with four lamps only three-quarters of a burner, with two lamps six-and-a-half burners, and with one lamp fifty-four burners. These numbers give the following ratio: 1, 3, 8, 26, 216, thus showing how rapidly the light diminishes when divided. With the voltaic arc, however, and with the same battery, he was able, by a Serrin lamp, to obtain a light of 105 burners.

It will be seen, then, from what has been above stated, that the production and the divisibility of the light by incandescence is a very wasteful process—so wasteful, indeed, as to render its practical application impossible for general lighting. If, therefore, all Mr. Edison has to announce to the world is that he has succeeded in dividing an incandescent light—and the announcement that such is so is made on authority—his discovery amounts to very little. Both the light and its divisibility were discovered long ago. It will easily be seen that it is not in that direction that any great practical results can be obtained. The voltaic arc supplies the only divisible light of any utility and economy, and it is in its development that any real progress must be looked for.

WILLIAM TRANT

Duplexing the Atlantic Cable

I HAVE read with surprise in your number of the 14th inst. (vol. xix. p. 38), an article, in which it is implied that the application of the duplex method of signalling to an Atlantic cable has now for the first time been successfully accomplished by Mr. Stearns.

The publication in the *Times* of Sir James Anderson's letter on "the duplex system in telegraphing," on the day after the publication of your article, was a coincidence of which I trust