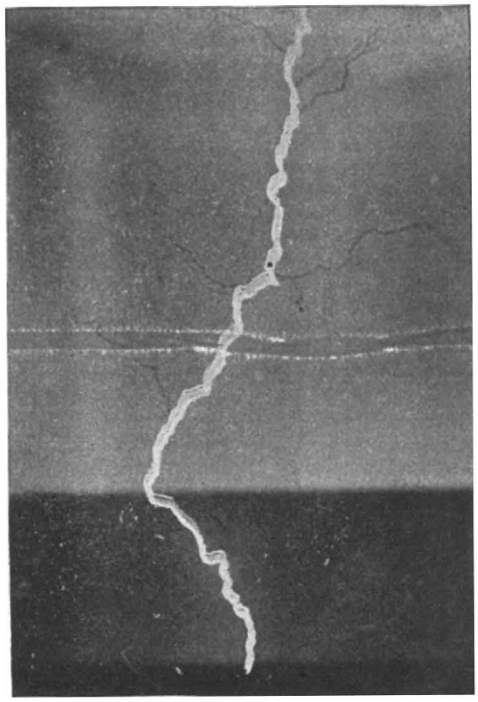
RIBBON AND DARK LIGHTNING.

MR. ALEX. MORTON, secretary and librarian of the Royal Society of Tasmania, has sent some photographs of lightning flashes taken by Mr. W. Aikenhead, one of which is here reproduced. The photographs were taken at night with a hand camera. Referring to them, Mr. Aikenhead remarks:—"The thunderstorm was an unusually severe one, and the atmosphere surcharged with electricity, as evidenced by the frequency and extraordinary vividness of the lightning flashes, whose brilliancy momentarily rendered objects, even at a distance, as clearly discernible as in daylight. The intensity of the 'triple' flash—of which I was so fortunate as to secure a counterfeit—was so great that for some moments I was completely dazzled. I may mention that the thunderstorm lasted fully an hour, and was at its height about 9 o'clock; and it was at this period the exposures were made with my camera."

The accompanying picture is interesting on account of the triple flash represented in it, and the dark lines apparently radiating from it. In an article printed in NATURE several years ago (vol. xlii. p. 151, 1890), Mr. Shelford Bidwell described each of these characteristics of photographs of lightning flashes, and gave explanations of them. He remarked that in nearly, if not quite, every case where broad ribbon lightning has been photographed, the camera was held in the operator's hand—a fact which naturally suggests the idea that the widened image of the flash may be due to the movement of the camera during exposure. Though it might be impossible to move the camera appreciably in the brief duration of a single lightning flash, several flashes sometimes pass in quick succession over the same path, so that they may appear side by side upon the photograph if the camera is shifted during their occurrence. Moreover, Mr. Bidwell pointed out that lightning sometimes leaves a kind of phosphorescence along its track, and this may last long enough to produce a photographic picture, even though the flash itself was instantaneous. A photograph of a triple lightning flash reproduced in NATURE of October 13, 1898 (vol. lviii. p. 570) furnishes decisive evidence that a camera can be moved quickly enough to obtain several pictures of a single luminous track of lightning. The three flashes shown in that picture are identical in shape, and it is estimated that they followed one another along the track with a frequency of about 30–35 per second.

But while it is certain that some photographs of multiple and ribbon lightning are produced by movement of the camera, others represent actual lightning of a broadened or multiple form. Commenting upon some photographs of ribbon lightning obtained by the Rev. J. Stewart-Smith, Prof. Cleveland Abbe remarked in the U.S. *Monthly Weather Review* of August 1898 that he thought that they were not taken by moving the camera during exposure. He considered that a discharge of lightning was too fleeting to be influenced by the motion of the camera. With artificial oscillatory discharges the time of the discharges and the motion of the sensitive film might be so controlled as to produce the appearance of a ribbon; but no motion of the camera seemed likely to explain the many details in the ribbon photographs of natural lightning described. Prof. Abbe thought, however, there was one flash on Mr. Stewart-Smith's plate that had every indication of being certainly an oscillatory discharge, showing lines of flow identical with those photographed by Prof. Trowbridge at Cambridge, Massachusetts, and fully maintaining his conclusion that the lightning flash is an oscillatory discharge repeated frequently to and fro within the crack in the air that is opened by the first discharge.

That lightning flashes can actually present a ribbon-like appearance, and have an appreciable duration, is borne out by a letter which was sent to the Royal Society from Buluwayo at the end of 1895, and was printed in NATURE of January 23, 1896 (vol. liii., p. 272). The writers state that they were sitting in a room when one of them called attention to a very bright lightning flash. "All of us promptly went to the door, whence we witnessed a truly extraordinary sight in the shape of three ribbons of a greenish-white lightning, which hung in the sky, motionless, for what must have been fifteen to twenty seconds. It seemed to be a long way off (in a north-westerly direction), as we heard no report of thunder whatever. There could be no mistake about it—it was as distinct as possible, and it must have lasted fifteen seconds *at least*." With evidence of this kind to consider, the reality of the ribbon appearance cannot be doubted. To obtain more definite information concerning this form of lightning and the nature of the electric discharge in an ordinary lightning flash, systematic attempts should be made to photograph lightning with cameras having a known rate of movement, and an arrangement for determining the angular diameter of the ribbon.



Photograph of lightning taken at Devonport, Tasmania, by Mr. Aikenhead.

As to the dark ramified flashes shown upon the accompanying picture, Mr. A. W. Clayden has shown by experiment that they are due to photographic reversal. If the lens of a camera is covered up immediately a flash has been photographed, the flash comes out bright in the ordinary way in the print; if, however, the lens is allowed to remain uncovered for a minute or so, thus exposing the plate to the diffused light of the sky or the glare of other flashes, the original flash appears black upon the final print.

In the same way, the discharge of an electrical machine can be made to appear dark in a photograph by leaving the lens uncovered for about a minute after the discharge has imprinted itself upon the plate. According to this, the dark ramifications in Mr. Aikenhead's picture represent a discharge of lightning which occurred before the bright triple flash. The glare of the bright flash and the

diffused light of the sky caused the photographic reversal of the first image.

Photography thus gives no support to the view that dark lightning has a real physical existence; and Lord Kelvin's letter printed in NATURE of August 10 (p. 341), together with that by Dr. W. J. Lockyer in last week's number, show conclusively that when it is visually observed it is an effect due to fatigue of the retina.

THE RECENT ERUPTION OF ETNA.

PROF. A. RICCO, Director of the Etna Observatory, informs us that on July 19, at 8 a.m., Mount Etna threw out from its central crater an enormous mass of vapour, stones, lapilli, and cinders, which were lifted to a height of several kilometres, and afterwards covered all the south-east slope of the volcano as far as Zofferana Etnae (altitude 600 m.), where the roads are covered by nearly a centimetre of volcanic ash. A number of stones struck the dome of the Etna Observatory (which is about a kilometre from the central orifice), so that about thirty holes were made in the iron plates, six millimetres in thickness, which cover this dome; five of these holes have a diameter of 30 centimetres, and the stones causing them fell into the observatory containing the refractor. Two stones also pierced the floor, and embedded themselves in the basement; and one broke three steps of the observing chair. Another pierced the wooden base surrounding the foot of the refractor; fortunately, this and the other apparatus of the observatory received no damage. Two other stones passed through the roofs of the side-rooms.

Round the observatory there are about fifty holes, caused by the fall and penetration of the stones in the sandy soil.

A heap of straw which was near the stables of the observatory was reduced to ashes, which proves the high temperature of the eruptive materials; moreover, holes were also burnt in the wooden flooring where it had been pierced by stones.

The steam of the eruption condensing in the air gave place to a warm and acid rain in the higher parts of the volcano, and lower down it caused ordinary rain.

The column of steam had by nine o'clock spread itself enormously in the sky nearly over Catania (a distance of 30 km.), and caused a marked darkening. By 9.30 the column had disappeared.

The eruption was accompanied by no perceptible movement of the earth, except a slight shock at the lower end of the Valle del Bove. The instruments at Catania only indicated a very slight oscillation. At the Etna Observatory two seismometers showed horizontal and vertical movements. The eruption was also accompanied by detonations, which were heard very slightly as far as Catania.

On July 25 there occurred a similar eruption, but of less importance.

PROFESSOR BUNSEN.

ON Wednesday morning, August 16, the illustrious Heidelberg chemist breathed his last, after a long life wholly devoted to the furtherance of science. In April 1881 I communicated to the columns of this journal a sketch of the work of him whose death at the ripe age of eighty-eight all lovers of science now have to deplore. We can only now call attention to the magnitude and extent of that work, and lay on the grave of one of the truest and noblest of men the tribute of our admiration and respect. As expressing the position held by Bunsen amongst the standard-bearers of science, I may, perhaps, be forgiven for quoting the opening sentences of what I wrote eighteen years ago, as I cannot find more appropriate words to indicate what all feel who know what his work was.

"The value of a life devoted to original scientific work is measured by the new paths and new fields which such work opens out. In this respect the labours of Robert Wilhelm Bunsen stand second to those of no chemist of his time. Outwardly the existence of such a man, attached, as Bunsen has been from the first, exclusively to his science, seems to glide silently on without causes for excitement or stirring incident. His inward life, however, is on the contrary full of interests and of incidents of even a striking and exciting kind. The discovery of a fact which overthrows or remodels our ideas on a whole branch of science; the experimental proof of a general law hitherto unrecognised; the employment of a new and happy combination of known facts to effect an invention of general applicability and utility; these are the peaceful victories of the man of science which may well be thought to outweigh the high-sounding achievements of the more public professions."

In the columns which follow the above will be found a statement of the chief experimental researches which have not only raised Bunsen by the common consent of all who can understand the results of accurate and far-reaching methods to the highest point of scientific honour, but also of those more popular discoveries which have made his name a household word in circles far wider than those of purely scientific appreciation. Now, therefore, it is only necessary to recall the main facts of his life work; to note, in the first place, that his desire to unravel the secrets of nature was unalloyed by any attempt to make capital out of any application of his discoveries. "To one man," he often said, "comes the duty of discovery, to another that of applying that discovery to practical uses." Like our great countryman Faraday, Bunsen consistently refused to be drawn away from the paths of purely scientific investigation, and, though too clear-sighted a mind to belittle the importance of the application of scientific discovery to every-day life, rightly judged that to him belonged the undoubtedly higher and nobler work of enlarging the boundaries of knowledge.

The next thing to be noted about Bunsen's work is its originality and its accuracy. It matters not whether we look into his purely chemical investigations, at his chemico-geological researches, or at those—perhaps the most remarkable amongst the many questions he answered—which lie on the borderland of physics and chemistry, in every case we rise from the study not merely feeling that we have to do with a master's mind and hand, but that each investigation is stamped by an original mode of treatment and by an accuracy of thought and of manipulative power which, it is not too much to say, has rarely if ever been equalled.

In no instance was this rare combination of mental and manual dexterity more strikingly shown than in his investigation of the compounds of cæsium, the rarest of the two alkali metals which he discovered by means of spectrum analysis. In order to prepare the pure salts of this metal, some scores of tons (I write this away from books, and therefore cannot give the exact figures) of Dürkheim mineral water had to be evaporated, and from this residue it was only possible to obtain some five or six grams of the pure chloride. Nevertheless, from this comparatively minute quantity Bunsen succeeded not only in preparing and analysing all the important salts of cæsium, but in ascertaining by goniometric methods their exact crystalline form. So that he was able to supply all the information requisite to a complete understanding of the position of this new element and its compounds to those of its well-known relations potassium and sodium.

Then look at his gasometric methods. He was the first to attempt anything like exactitude in the measurement of