exist, and the decomposition of acidulated water was in­creased, by substituting copper in place of platinum poles, in which case hydrogen only was set free. An increased temperature augmented the current and the decomposition. Μ. Botto obtained still more powerful effects by a pile of bismuth and antimony, consisting of 140 elements forming a parallelopiped, with a base of 2¼ inches, and a height of 1 inch.

A distinct electric spark has also been obtained from the thermo-electric pile, by the Chevalier Antinori of Florence. Professor Linari@@l of Sienna verified this result with a Nobili’s pile of 25 elements and temporary magnet, with an electro-dynamic spiral 805 feet long. With this appara­tus he obtained a brilliant spark visible in open day, when­ever the contact was broken. With this pile and tempe­ratures from freezing to boiling water, he readily decom­posed water, and also nitrate of silver. The same thermo-electric current magnetised an unmagnetic needle, and produced the phenomenon of the palpitation of mercury. Professor Wheatstone verified these experiments in 1837, by a thermo-electric pile of 33 elements of bismuth and antimony, forming a bundle three-fourths of an inch in diame­ter, and 11/5th long. The poles were connected by two thick wires, with a spiral of copper ribbon 50 feet long and 14 inch broad, the coils being insulated by brown paper and silk. One face of the pile was heated by red-hot iron brought near it, and the other cooled by ice. Two strong wires connected the poles of the pile and the spiral, and the contact was broken, when necessary, in a mercury cup, between one extremity of the spiral and one of these wires. A distinct spark was seen in open day whenever the con­tact was broken.@@2

The thermo-electric pile has been greatly improved by Mr Watkins, who employs a flat copper ribbon coil. In piles varying from 15 to 30 pairs of elements, he obtains brilliant sparks, by merely pouring hot water on one end, while the other has the temperature of the air.

Professor Andrews of Belfast has recently succeeded in developing thermo-electric currents, by simply bringing two metallic wires at different temperatures into contact with a fused salt, between which and the wires no chemi­cal action takes place. This result he first obtained by means of fused borax. He took two similar wires of pla­tina, and connected them with the extremities of the cop­per wire of one of Gourjon’s galvanometers, and fused a small globule of borax in the flame of a spirit-lamp on the free extremity of one of the platina wires, and having introduced the free extremity of the other into the flame, he brought the latter, raised to a higher temperature than the former, into contact with the fused globule. When this was done, the needle of the galvanometer was instantly driven with great violence to the limit of the scale. The direction of the current was always from the hotter platina wire, through the salt, to the colder wire. Professor An­drews obtained a permanent electric current in the same direction, by simply fusing the globule between the two wires, and applying the flame of the lamp in such a manner, that the wires, at their points of contact with the fused salt, had different temperatures. Fused carbonate of soda gave similar, but more powerful currents than borax. Car­bonate of potash, chloride and iodide of potassium, sulphate of soda, chloride of strontium, heated glass, &c. produced similar currents; and even boracic acid, though such an imperfect conductor, deflected the needle 40°.

The currents thus produced have an intensity inferior to that of the hydro-electric currents, and they are capable of decomposing with great facility water and other electrolytes.

Before the salts were actually fused, Professor Andrews

found that electrical currents were generated whose direc­tions no longer followed the simple law, but varied in the most singular and perplexing manner, passing first from the hot to the cold wire, then by more heat from the cold to the hot, and by more heat still from the hot to the cold wire.

Professor Andrews obtained similar currents, by inter­posing certain minerals between unequally-heated platina wires. *Mica,* heated very strongly, caused a deflection in the needle of 7°, and *Stilbite* a deflection of 25°, the cur­rent being in both cases from the hot to the cold wire@@3.

Thermo-electric rotations were, we believe, first pro­duced by Professor Cumming, by means of a very simple apparatus. He formed a rectangle of silver and platina, as shewn in fig. 93. The three upper sides are formed of silver, and the lower of platina. When suspended, as shewn in the figure, and when one of the junctions was heated. It revolved from *left* to *right,* when the pole of a magnet was presented to another junction. When the rectangle was suspended upon the loadstone itself, and heat applied to one of the junc­tions, the rectangle soon began to turn.

When a chain or wire, consisting of alternate links, or pieces of *platinum* and *silver,* is made part of the voltaic circuit, the links or portions of *platinum* wire will become *red-hot,* while those of *silver* remain *dark,* and compara­tively *cold.*

In studying the effects of thermo-electric currents, Μ. Peltier made the interesting discovery, that *cold,* instead of heat, is produced at the points of junction of certain crystallisable metals. The instrument by which he obtained these interesting results is shewn in fig. 94, where A B are two thermo-electric couples in bis­muth and anti­mony, C a copper wire which unites the antimony *a'* of the upper couple to the bismuth *b* of the lower cou­ple. D, E, cop­per wires com­municating with the galvanome­ter G of 84 coils, and completing the circuit be­tween the upper bismuth B'', and the lower anti­mony *a'.* F, Hare the free extremities of *a", b",* which form a pair of pincers, which press against each other by a spring. The bar JK is formed by a bar of antimony *α"',* and of bismuth *b"',* which ought to traverse the electric current. L, M, M, are conduc­tors of the pile P, N a plate of copper, with a graduated circle and magnetic needle O, for measuring the quantity of elec­tricity which passes through the entire circuit M M,, N, K, *b'", a"',* L, P. The galvanometer G indicates the electri­city produced by the variations of temperature of the ends F, H, resulting from those of the bars J, K, the closed cir­cuit of this electricity being *a'*, C, *a'''*, E', *c*, D, *b''*, *a'*. The ball A of an air thermometer (with its capillary tube E plunged in a vessel *d* of coloured alcohol) is crossed by a compound

@@@, L’Indicatore Sanese, No. 50, Dec. 1836.

@@@, Lond. and Edin. Phil. Mag. vol. x. p. 415, May 1836.

@@@\* Lond. and Edin. Phil. Mag. vol. x. p. 433, June 1837.