

ever, and as such a self-evident piece of stupidity as to render further discussion useless.

Mr. Fitzgerald further says that Professor Wood has pointed out my mistakes. Is he willing to say what mistakes? I am convinced that Mr. Fitzgerald has never read any criticism by Professor Wood which he is willing to indorse; but, since he has himself made reference to these criticisms, I now ask Mr. Fitzgerald to state which of Professor Wood's positions against me he regards as sound. I do not believe he can find one.

Mr. Fitzgerald is unable to find any excuse for me when I introduce the idea of a pencil of rays of infinitesimal angle, unless it be that I have overlooked the fact that the energy of such a pencil is infinitesimal. I beg leave to say that the excuse and the assumption are both entirely gratuitous on his part, and not in accordance with the facts. In the algebraic investigation made in the original paper, as well as in that given above, the angle is not assumed to be infinitesimal, or even small. The sole excuse, and the real one, was that it was a form of argument which it seemed to me would put in a clear light the truth which I had otherwise established, that such a process as had been proposed would heat *B* at the expense of *A*.

In conclusion I may be permitted to say, that when Mr. Fitzgerald attempts to treat the controversy which he has himself inaugurated as not worth his consideration, and gives notice that he therefore thinks it not worth while to continue it, he must know that he lays himself open to the suspicion that poverty of arguments, and not disinclination to controversy, leads him to this decision. If Mr. Fitzgerald regards it as compatible with his dignity to beat a retreat on any such pretext, I, for one, cannot agree with him.

H. T. EDDY.

Cincinnati, June 10.

### Temperature of the spheroidal state.

In some experiments made to determine this point, to avoid radiation, the temperature was measured by a thermo-electric couple, as in Mr. Hesehus's studies. The element used was composed of german-silver and iron, No. 22 wire. The wires were hard soldered together, and then bent into a loop, and inserted in a glass tube filled with plaster-of-Paris. The tube was about twelve centimetres long and five millimetres bore; and the polished loop projected about eight millimetres, with a width of four millimetres. This element was connected directly with a reflecting galvanometer with twenty-five ohms in circuit. The spheroids were formed in a spoon heated over a spirit-lamp, and no special precautions were taken to secure equal temperatures. The loop was plunged in the spheroid, and deflection noted. Ten readings were thus taken with very small variations, and then the loop was placed in a beaker of water almost in contact with the bulbs of two thermometers. The water was then heated till the deflection was the same as that given by the spheroid, and the thermometers were read at this point both while heating and cooling. The variations of temperature were less than  $1^{\circ}$ ; and this part of the experiment was repeated several times. The whole experiment was repeated a number of times on different days, with results all within  $1^{\circ}$ .

The temperature thus found was, for water,  $90^{\circ}$ , and for alcohol,  $69^{\circ}$ .

The size of the spheroid had no effect on the temperature, as the deflection remained constant as long as there was enough liquid to protect the loop from

radiation. In the case of alcohol, the globule could be surrounded with vapor-flames until greatly reduced in size, without visibly increasing the deflection. Ether was experimented on; but the temperature proved to be so low, barely above that of the room, that no satisfactory results could be obtained.

The series of experiments hints at a lower and less variable temperature than has usually been assigned to the spheroidal state.

LOUIS BELL.

Dartmouth college, June 9.

### The inventor of the vertical camera in photography.

In *Science*, No. 70, Mr. G. Brown Goode says, concerning the invention of the vertical camera, "As a matter of fact, the vertical camera now used for photographing natural-history specimens, etc., is the outcome of a suggestion made in December, 1869, by Professor Baird."

As this letter is written to put on record the history of the invention of the vertical camera, it is necessary, in justice to myself and other inventors of a vertical camera, to state that the notes concerning the history of the invention were omitted from my original article (*Science*, No. 62) at the suggestion of the editor. The facts concerning the invention and use of the vertical camera known to me at present are as follows:—

In 1863 J. Gerlach published 'Die photographie als hilfsmittel zu mikroskopischer forschung,' in which was figured and described a vertical camera. In 1866 Montessier, in 'La photographie appliquée aux recherches micrographique,' described and figured a very much improved vertical camera. Both of these are figured and described in Frey, 'The microscope and microscopical technology' (New York, 1872). In 1872 John C. Moss invented a swinging vertical camera, which was described and figured in the U. S. patent-office report, October, 1877, p. 961, plate page 279. This camera was also figured in the *Scientific American* (1877) and in *Leisure hours* (1879). In 1877 also appeared a description and figure of a vertical camera by Schaefer, in 'The microscope and histology,' p. 295. The above, together with the letter of Mr. Goode, the note concerning Dr. Danna-dieu's camera, and the papers by myself, constitute, so far as I know, all the published notices of a vertical camera.

By the courtesy of the gentlemen named below, I am enabled to make important additions to the history of this subject. John C. Moss, president of the Moss engraving company, in a private letter, says, "I remember having used a camera in a vertical position in 1858 to copy daguerrotypes and tints. . . . I also used the same arrangement to photograph some shells and other small objects." Dr. Deecke says, "I have used the camera in a vertical position since 1873. The simple alterations on the camera were devised by myself, and executed in the shops of the asylum." Prof. E. Ramsey Wright, of Toronto university, also uses a vertical camera; but the date of its invention by him is not known to me. To briefly summarize: the first figure and description of a vertical camera known to me were those of Gerlach, in 1863; while the first to use the vertical camera was John C. Moss, in 1858. Every person using this instrument, so far as appears at present, was an originator, but John C. Moss, seems to have been the originator, of the idea of a vertical camera.

SIMON H. GAGE.

Ithaca, June 21.