earthquake of January, 1869, the direction of the loud banging sounds like artillery was carefully marked against a peak in the Naga Hill range. Bearings by the prismatic compass subsequently sent to Calcutta to Dr. H. B. Medlicott, turned out to be within 3° of the true line to Cheduba and Ramree, the active volcanic centre, 550 miles off. I cannot exactly see how the difference of the intensity assists us in directing to the sound. I find I judge that best by facing it and remaining still, and verify the direction best by looking (with the eyes only) about 10° to right, and then 10° to left, which, if I do not move the head, soon enables me to fix by eye the direction pretty close.

Sibsagar, Assam, October 27

S. E. PEAL

An Audible Photometer

IN your issue of September 22 (vol. xxiv. p. 491, British Association Reports) Mr. Lant Carpenter mentions an idea of his about an "audible photometer." The same idea occurred to me some six months ago. As my plan seems to be much more simple than Mr. Carpenter's, dispensing with intermitting beams and rotating disks, perhaps you will allow me a little space to describe it. I require only one photophonic receiver, whereas Mr. Carpenter mentions "two precisely similar receivers," which is difficult, if not wholly impossible, to obtain. A is a small battery, B an induction-coil with the ordinary vibrating magnetic interrupter, and with a high-resistance secondary coil; C is the Wheatstone-bridge combination, S E a selenium cell, with its working surface

turned to the scale E; R is a high resistance of about the value of the selenium cell; a is a sliding contact, T a high-resistance telephone. Now I place on the scale E a standard candle at a distance d from selenium cell, and move the sliding contact till no sound is emitted from the telephone. Then the wire connections are left wholly unaltered, and the candle is taken away. Now I place the light I wish to compare with the standard candle on the scale E, and move it along the scale till the telephone is again silent. Be the distance of the light from the selenium cell now n , then its luminous intensity is

$$\frac{D^2}{d^2} \text{ standard candles.}$$

As, on after-thought, I greatly doubted the fitness of selenium for photometric purposes (which doubts became the stronger the more I read about the subject), I did not pursue my idea, which could only result in an addition to the long list of practically useless photometers. The above may perhaps be used as a college experiment for demonstrating the law of the square of distances.

J. W. GILTY

Delft, November 21

Extraordinary Atmospheric Phenomenon

I INCLOSE a paragraph from the Glasgow *Evening Citizen* of this date relating to that peculiar form of lightning known as fire-balls. The explanation of the explosion in the funnel is, I think, erroneous, it having been caused by the explosion of the fire-ball, thus driving out the smoke by the fire-doors. The aurora was very bright here on Wednesday evening, showing Piazza Smyth's line with a small direct vision spectroscope. Before the eye became sufficiently sensitive for measurement, clouds cut off the bright part. The aurora was a general bright northern glow without streamers, and was observed brightest a little after eight

(p.m.). These notes may be of use to you in connection with those of other observers.

J. B. HANNAY

Cove Castle, Loch Long, N.B., November 25

Extraordinary Phenomenon of the Storm

Those on board the Campbellton Steamer *Kinloch* (Capt. Kerr), which left Greenock on its usual run about half-past eleven o'clock on Tuesday morning after the storm that raged during the night, had a somewhat extraordinary experience while passing down the Firth. The vessel was enveloped in a dense shower of hail, and for some time it was awfully dark, and occasionally the vessel was lit up by vivid flashes of lightning. One of the flashes was very bright, and its shape was something like that of the arteries of the human body, with a central column all shattered and broken. About noon, while opposite the Cloch Lighthouse, and not far from the shore, the captain observed immediately over the ship what appeared to be a series of clear balls of lightning, each about a foot in length, and resembling a chain, except that they were disconnected. This phenomenon was quickly succeeded by an explosion in the funnel of the steamer, and several balls of fire upon the bridge running about, and then bounding off into the water. The first impression of the spectators was that something had exploded on board, but on inquiry it was found that this was not the case. The mate stated, however, that a ball of lightning had almost struck him where he stood. A fireman rushed upon deck to see what had happened, as the engine-room was filled with smoke, and a choking sensation was experienced below. The explanation appears to be that a portion of the lightning had passed down the funnel until its force was spent by the fire, and the sudden recovery of the draught of the funnel afterwards accounted for the loud report that was heard. The captain, in his long experience at sea, never encountered such a phenomenon before, and it may be taken as an indication of the extraordinary atmospheric forces which had been at work during the storm, and which seemed to centre in this locality.

Papin

IN the review of my "Life and Letters of Papin"¹ in NATURE, vol. xxiv. p. 378, the hope is expressed that I might succeed "to fill the lacune in the career of this remarkable man." The only important blank remaining now in our knowledge of Papin's life consists in our ignorance of the time of his death. We may rest assured that he died in London, and therefore this blank is not likely to be filled but by a person who is familiar with the city and its inhabitants of the present and of the beginning of last century. Papin died about 1712. During 1709 he lived at "Madam Portal chez M. Charron, apothécaire dans Compton Street, proche St. Anne." As it is not probable that he changed his lodgings before his death a search in the registers of the district to which Compton Street belonged (if they are in existence) would lead to results equally important for the history of science and for that of technology. Maybe a reader of this note who enjoys such opportunities will render me his assistance in this thankful task.

I avail myself of this opportunity of correcting a few slight mistakes which have found their way into the otherwise excellent *résumé*. Not Papin but Leibnitz is the author of the letter of February 4, 1707, which contained the first idea of the "hot-air engine." Leibnitz is therefore the inventor of the same. That boat, in which Papin left Cassel in 1707 to sail to Bremen, was not a "steam propeller boat," but a small ship with paddle-wheels to be worked by the sailors. It was not Papin's intention to proceed to England in that boat. He left Cassel with proofs of the favour and goodwill of the Landgraf, which remained unchanged to the end. Lastly, before Papin no steam-engine existed; he is the real inventor of the same, for he in 1690 first announced the idea, and tested it by experiments of utilising the pressure of steam as motive power for engines. This, his first engine, had a piston inside a cylinder. Such an arrangement was not at all new at that time; other machines had the same, as, for instance, the gunpowder engine of Huyghens, which suggested the invention of Papin. Leibnitz corresponded with the inventor about this engine much later, and made valuable propositions, but the correspondence of these

¹ Leibnitz's und Huygens' Briefwechsel mit Papin, nebst der Biographie Papin's und einigen zugehörigen Briefen und Arten-tücken. Bearbeitet und auf Kosten der Königl. Preussischen Akademie der Wissenschaften herausgegeben von Dr. Ernst Gerland. Berlin, 1881. Verlag der Königl. Akademie der Wissenschaften.