given of their solvent condition, and the prospects of increased revenue next year. That their anticipations will be realised is our hearty wish, as the collapse of such a company would be in itself a national calamity. Other associations, with monetary transactions of equal magnitude, might fail without bringing about one tithe of the effects that would accrue from such a disaster here. Including the splendid establishments in London and Southampton, no less than fourteen principal and subsidiary establishments have to be kept up, and there are employed altogether 8,250 persons afloat, and 4,351 on shore, making a total of 12,601. But this does not give the actual number of individuals dependent upon the expenditure of the company, which at a low estimate cannot be less than 40,000, and may be 50,000. And if we take into consideration those that are indirectly benefited by their monetary operations, we may double or treble these numbers. Viewing it in this light, the company is a great floating colony, administering affairs equal to some small continental state or dependency of the British Crown. But that which makes it of most importance to England, is being a practical school for seamanship, and the training of our youth in the art of navigation. The officers on board the Peninsular and Oriental Company's steam ships are gentlemen who will compare favourably with the officers of her Majesty's Navy in the details of their profession, especially as pilots for the difficult navigation of the eastern seas, which, as we have seen, they have done with an infinitesimal loss of life, and comparatively trifling loss of property. Under these circumstances it is to be hoped that the directors will continue manfully to face their difficulties, and restore the Peninsular and Oriental Steam Navigation Company to its former prosperity, and their vessels command that amount of public favour which will render their line preferable to that of any foreign company, in economical charges and good accommodation. We are glad to see that they have concluded a new contract with the Government for a longer period than before, and on more favourable terms. The contract is to be for twelve years. There is to be a yearly payment of £400,000, unless the fund accruing for dividend from all sources should, *from causes not within the company's control*, fall below the amount required to pay six per cent. on their capital, in which case the subsidy is to be increased by the amount of the deficiency. On the other hand, should the profits permit the declaration of a dividend of more than eight per cent., the company undertake to pay to the Post-office one-fourth of the excess. The tender provides for a weekly service between Southampton and Alexandria, between Marseilles and Alexandria, and between Bombay and Suez; and for a service every alternate week between Suez and Hong Kong, Hong Kong and Shanghai, Shanghai and Yokohama, Bombay and Galle, and Galle and Calcutta. The rate of speed is to be ten knots an hour on the lines to and from Alexandria, and nine and a-half knots on the lines eastward of Suez. The stipulation guaranteeing a certain dividend, although an important novelty in the case of the Peninsular and Oriental Company, is not without precedent, the contract with the Kingston and Holyhead line including a similar provision. In arranging this contract her Majesty's Government have, we are glad to see, taken a broad view of a matter which is not departmental, but national in importance. The public have no wish that the company should be a loser by the services rendered, and are quite satisfied that, so far as our intercourse with the East is concerned, our communications could not be in better hands.

SIR CHARLES WHEATSTONE.

THIRTY years have elapsed since the subject of this memoir established the first practical result of his many investigations connected with electro-telegraphy, by laying, on the London and Blackwall Railway, the first electro-magnetic telegraph. The wires employed were of copper, enclosed in an iron tube, each wire being separated from its neighbour by some non-conducting material. A submarine electric telegraph had also been, from the commencement of Mr. Wheatstone's experiments, a prominent object in his thoughts. The laying of the Atlantic Cable, in August, 1866, was signalised by honours awarded to those who took an executive share in that great event; while Wheatstone, "but for whose marvellous following in the track of his gifted predecessors, there could as yet have been no electric telegraph at all, was left out in the cold, without being named!" Mr. Wheatstone has since received the honour of knighthood, as commonly thought, in recognition of his share in this great work of national importance—the electric telegraph. This, however, is but a portion of the labours of a series of years devoted to scientific researches, which had been rewarded by medals and other distinctions from the leading academies of the Continent, ere they were fully recognised in the country which gave our philosopher birth.

Charles Wheatstone was born in 1802, in Gloucester, a city noted as the birthplace of divines and scholars. In early life he was engaged in the manufacture of musical instruments, which led him to study the laws of Sound. In 1833, he presented to the Royal Society a paper "On Acoustic Figures;" and in 1835 he read to the Royal Institution an account of the different attempts which had been made to invent a speaking machine; and exhibited a copy of a machine from Germany, which distinctly pronounced *mamma, papa, mother, father*, and other words.

Light and Electricity were the sciences which Wheatstone was next led to investigate; and in 1834 he communicated to the Royal Society his experiments to measure the velocity of electric currents, and the duration of the electric spark. In the former it appeared that the human eye is capable of perceiving phenomena of light whose duration is limited to the millionth part of a second; and by Wheatstone's apparatus the spark was ascertained not to exceed the twenty-five thousandth part of second: a cannon-ball, if illumined in its flight by a flash of lightning, would, in consequence of the momentary duration of the light, appear to be stationary; and even the wings of an insect, that move ten thousand times in a second, would seem at rest. In the year when these interesting results were obtained, Wheatstone received the appointment of Professor of Experimental Philosophy in King's College, London.

In 1838, Professor Wheatstone submitted to the British Association at Newcastle his Stereoscope, an instrument contrived by him for illustrating the phenomena of binocular vision, the principle of which is thus simplified. When we look at any round object, first with one eye, and then with the other, we discover that with the right eye we see most of the right-hand side of the object, and with the left eye most of the left-hand side. When these two images are combined, we see an object which we know to be round. This is effected by the Stereoscope, which consists of two mirrors placed each at an angle of 45 degrees, or of two semi-lenses turned with their curved sides towards each other. To view its phenomena two pictures are

obtained by the camera on photographic paper of any object in two positions, corresponding with the conditions of viewing it with the two eyes. By the mirrors on the lenses these dissimilar pictures are combined within the eye, and the vision of an actually solid object is produced from the pictures represented on a plane surface. Hence the name of the instrument, which signifies *solid I see* (Hunt's "Poetry of Science"). Thus, when once the availability of one great primitive agent is worked out, it is easy to foresee how extensively it will assist in unravelling other secrets in natural science. The simple principle of the Stereoscope might have been discovered a century ago, for the reasoning which led to it was independent of all the properties of light; but it could never have been illustrated, far less multiplied as it now is, without Photography; and if, in the order of things, the cheap popular toy which the Stereoscope now represents, was necessary for the use of man, the Photograph was first necessary for the service of the Stereoscope. Sir John Herschel characterised Wheatstone's discovery as one of the most curious and beautiful for its simplicity in the whole range of experimental optics. And, although a controversy arose between Wheatstone and the late Sir David Brewster, as to the theory of the stereoscope, Sir David admitted Professor Wheatstone to have the merit of being the first to exhibit practically the striking result, and added, "In prosecuting this subject, my attention has been particularly fixed upon the interesting paper of my distinguished friend Mr. Wheatstone. It is impossible to over-estimate the importance of this paper, or to admire too highly the value and beauty of the leading discovery which it describes."

In the spring of 1844, when the Museum of George III was deposited at King's College, his Royal Highness Prince Albert was present; and Professor Wheatstone, with one of his telegraphs, formed a communication between the College and the lofty shot-tower on the opposite bank of the Thames. The wire was laid along the parapets of the terrace of Somerset House and Waterloo Bridge, and thence to the top of the shot-tower, about 150 feet high, where a telegraph was placed; the wire then descended, and a plate of zinc attached to its extremity was plunged into the mud of the river, whilst a similar plate attached to the extremity at the north side was immersed in the water. The circuit was thus completed by the entire breadth of the Thames. Unfortunately, at the moment the experiment was to be noted, a barge came along, and broke the wire; but it was speedily restored, and the telegraph acted as well as if the circuit had been entirely metallic.

The leading data of the researches which preceded the invention of the electric telegraph may be recapitulated here. In 1819, Oersted made his grand discovery of the deflection, by a current of electricity, of a magnetic needle at right angles to such current, which discovery, Dr. Hamel, of St. Petersburg, states Baron Schilling was the first to apply to telegraphy. In 1835, Gauss and Weber established a system of electric communication between the Observatory at Gottingen and the University. In 1836, Professor Muncke, of Heidelberg, who had inspected Schilling's telegraphic apparatus, explained the same to Mr. William Fothergill Cooke, who, in the following year, returned to England, and subsequently, with Professor Wheatstone, introduced the telegraph upon the railway as already stated.* Meanwhile a misunderstanding had arisen relative to the positions of Messrs. Cooke and Wheatstone, in connection with the invention; when Sir I. M. Brunel and Professor Daniell drew up a document stating that:—

"Whilst Mr. Cooke is entitled to stand alone, as the gentleman to whom this country is indebted for having practically introduced and carried out the electric telegraph as a useful undertaking, promising to be of national importance, Professor Wheatstone is acknowledged as the scientific man, whose profound and successful researches had already prepared the public to receive it as a project capable of practical application. It is to the united labours of two gentlemen so well qualified for mutual assistance, that we must attribute the rapid progress which this important invention has made during the five years since they have been associated."

This document is dated 27th April, 1841, and is acknowledged by Messrs. Wheatstone and Cooke to be correct; but it refers only to the first patent in which they were associated. Professor Daniell considers the document to make no assertion whatever as to the originality of the invention on either side, and adds, that he considers Professor Wheatstone's "undoubted inventions of incomparable beauty and simplicity, and by themselves sufficient to supply all the purposes of the most extended telegraphic communication;" and that Wheatstone's "contrivances would have been of no avail for telegraphic purposes without the investigations which he was the first to make of the laws of electric magnets when acted on through great lengths of wire."

The Abbé Moigno, who was in England in the spring of 1846, whilst Professor Wheatstone's experiments were in preparation, states, that in 1840, Mr. Quetelet had announced Mr. Wheatstone to have invented the means of transmitting signals between England and France, which he (the Abbé) had witnessed; thus attesting Wheatstone's claim to the Submarine Telegraph. Vice-Admiral Smyth, in 1850, attested Wheatstone as, "undoubtedly, the first contriver of the electric telegraph in the form which made it available for popular use;" adding, of "his submarine telegraph he showed me plans, and publicly explained the details upwards of eighteen years ago" (this was written in 1850). De la Rive, in his "Treatise on Electricity," 1858, wrote: "The philosopher who was the first to contribute by his labours, as ingenious as they were persevering, in giving to electric telegraphy the practical character that it now possesses, is, without any doubt, Mr. Wheatstone. This illustrious philosopher was led to this beautiful result by the researches that he had made in 1834 upon the velocity of electricity, researches in which he had employed insulated wires of several miles in length, and which had demonstrated to him the possibility of making voltaic and magneto-electric currents to pass through circuits of this length."

Four years previous to this date, a paper in the "Quarterly Review," ascribing the sole merit of the invention of the electric telegraph to Professor Wheatstone, provoked a rejoinder from Mr. Cooke, in a pamphlet, of which four editions have appeared. Two large octavo volumes of pamphlets and arbitration papers have also been published by Mr. Cooke; and in January, 1868, there appeared a volume of 164 pages by the Rev. Thomas Fothergill Cooke, in assertion of his brother Mr. Cooke's rights, the main points in which are the vindication of the Brunel award, and extracts from the arbitration evidence; the whole of which is so far a matter of detail, as to prevent our entering into the controversy.* Meanwhile, it is hoped that

* Lord Wrottesley, in 1858, stated that Wheatstone first tried his telegraph on the line of the London and Birmingham railway, in July, 1837.

* This volume, apart from the documentary quotations, contains a large amount of information upon the grand discovery and invention of the Electric Telegraph. Three pages recording the proceedings of the "Pioneer of Electric Telegraphy," prior to the great realization in 1836-7, are especially attractive.

the Government do not intend to overlook the claims of Mr. Cooke, as the introducer of the practical telegraph. The Society of Arts awarded their fourth gold medal to Mr. Cooke and Mr. Wheatstone; but the latter gentleman, cordially acknowledging Mr. Cooke's claim for "the practical introduction," did not even claim his duplicate medal.

From a Photograph by H. Lenthall.

C. Wheatstone

Here we may mention the automatic instrument completed by Wheatstone in 1867, by which, properly manipulated, he can transmit 600 distinctly visible signs or letters in a minute. The system of wires, which we see stretching across the sky-line of the great thoroughfares of the metropolis, has been appropriately termed "the nerves of London," and is Wheatstone's latest scheme, in which, by a simplified apparatus, messages are sent along the lines at the rate of 100 letters a minute; the process of reading or renewing the message is, of course, proportionally rapid; and the new instruments for this purpose bear the same relation to the old ones, that the works of a watch bear to the stronger machinery of an eight-day clock. The cables are fine copper-wire, along which the battery (the magneto-electric machine of Faraday) transmits the electric impulse, produced from a very small magnet. The area of London being divided by a system of triangulation, the parts that form the meeting-points of three series of cables become the points at which these multitudinous wires have to be distributed at intervals.

Wheatstone's Universal Military Telegraph is accepted for field and rifle practice; it is worked by magnetic power, is only six inches square, and is always ready for immediate use. The communication in the field, or between the target and the gun, is maintained in the ordinary alphabetical language by the most simple means, so that any person who can read and spell is able to work it. This telegraph was used by the French in their Italian war, and is now in use in various public offices. Another of Wheatstone's latest discoveries is, that an electro-magnet, if it possess the slightest polarity, may become a powerful magnet by the gradually augmented currents originated by itself.

Sir Charles Wheatstone, D.C.L., LL.D., F.R.S., is a corresponding member of the Academies of Science of Paris, Brussels, Berlin, Munich, Stockholm, Turin, Milan, Rome, Washington, etc.; and is Chevalier of the Legion of Honour. Sir Charles has just been appointed a member of the Italian Scientific Society of "Forty," in the place of the late Professor Faraday. A gold medal has also been awarded to Sir Charles Wheatstone; and the President of the "Forty," in his letter, writes: "I

will not here pass in review the various memoirs in physics which you have published in the 'Philosophical Transactions,' since all carry the impression of the inventive genius which ever distinguishes all that you have done." The method of measuring the velocity of electricity and the duration of the spark are then mentioned; and next, the applications of the rotating mirror, so important and various in experimental physics; the invention of the stereoscope; the "rheostat;" and the "Wheatstone's Bridge," for the measurement of electric currents, of the resistance of circuits, and of electromotive forces. "To you," adds the President, "we principally owe the practical invention and the true realisation of the electric telegraph. All these great acquisitions, procured by you, to physical science, render you well worthy of this distinction from the Italian Society of Science. May you be preserved in health and activity; and your country and all your admirers and friends are certain to find in the discoveries still to be added while you continue to work, some compensation for that immense and irreparable loss which natural philosophy has sustained by the death of Faraday."

MY FIRST ENCOUNTER WITH A TIGER.

When I first came to India, now many years ago, I was posted to a district in which there were many hills, much jungle, and very good shooting. By good shooting, I mean of large game, such as tiger, bear, cheetah, sambre (the elk), and so forth. There is abundance of other descriptions of shooting in nearly every part of India, such as antelope, bustard, wild duck, grouse, jungle-cock, and snipe; but all such sport is tame and uninteresting compared with the excitement of the pursuit of the larger kinds of game. My duty obliged me to be constantly moving from place to place, and whenever I was in the neighbourhood of jungle (or forest), and could spare the time, I always devoted a day to shooting. It was early in the year 1857, just prior to the commencement of the great mutiny, that I had pitched my camp in a beautiful little valley, well watered, and surrounded on three sides by hills. On the east, nearly opposite to my tent, the hills were about one thousand feet high, and near their summits densely wooded with small forest trees, from the depths of which in the early morning could be heard the sonorous trumpeting of sambre. To the north, the hills were lower, and not so thickly wooded; but they were split up into deep ravines, in which the black bear and the wild pig were to be found. To the west, and behind my camp, the hills were comparatively bare, showing near their summits bluff inaccessible cliffs, two or three hundred feet sheer precipice, in the crevices of which were numerous and large combs of wild honey.

Previous to retiring for the night, I had been contemplating the prospect of a day's shooting, and the reddy (head man) of the village, who was a keen old shikaree (or hunter) had been going over with me the pros and cons of the possibility of my meeting with a cheetah. Bears and sambre we were sure of; but, although I had frequently seen cheetahs in my rambles, I had never been able to get a shot at one, and now that I was near a well-known haunt of cheetahs, I did not wish to lose the opportunity afforded me. The cheetah, or leopard, is a very handsome but very cowardly beast; attacks and carries off sheep, goats, and dogs, but has seldom been known to attack a man, except when severely wounded and brought to bay.

The skin is a rich light brown, covered with irregular nearly circular spots, which near the belly are dark brown, but become almost black as they approach the back. The animal is about three feet high, and from five to six feet in length; has a very vicious cat-like face, and is usually seen creeping through the jungle with its belly almost touching the ground. I have, however, once seen a cheetah at full gallop, tail extended, head up, and a young kid in its mouth. The reddy and I parted without coming to any conclusion, except that some difficulty would be experienced in collecting the necessary number of beaters, and I shortly afterwards retired for the night.

I think it must have been one or two o'clock in the morning, when I was awakened by one of the most unearthly howls I ever heard; so prolonged, so dismal, yet so horrible was the sound, that I sat up on the cot feeling quite scared. I listened, but not a sound broke the stillness of the night, and I began to think that the howl was but the effect of imagination; that, in fact, I had been dreaming, when again, and this time apparently close to me, the same terrible yell broke forth, and echoed through the valley. I sprang out of bed and rushed to the door of the tent, and there, not ten paces from me, was a cheetah, evidently preparing for a third howl. The beast was really calling its mate. Startled, I suppose, by my sudden appearance, the beast made off into the adjacent forest; but I was now resolved to devote the following, or rather the present, day to the pursuit of this animal, and, if possible, become more intimately acquainted with my unpleasant visitor. The reddy was sent for, and no sooner did he and his people hear that a cheetah had been down from the hills than all difficulties about beaters and shikarees vanished. The reddy himself was too ill and weakened, from a late attack of fever, to accompany me; but by four o'clock he had collected seven shikarees, each with his long matchlock loaded and primed, matches alight, and powder horn slung in front, and about fifty beaters. About five a.m. we started; the shikarees in front as guides, and the beaters bringing up the rear. For the first half mile or so a continual chatter was kept up, but as we entered the jungle, the whole party broke into single file, and conversation quite ceased. So we plodded on, occasionally starting a spotted deer, a peacock, etc., until about eight a.m., when we stopped to rest under the shade of a wild mangoe tree, and by the side of a little hill stream. About nine a.m. we reached the appointed place, and after a long consultation, in which every one joined, it was decided that I, with six shikarees, should remain under a tree, while one shikaree and all the beaters were to form a half-circle and drive out our friend the cheetah, who had been tracked down to this neighbourhood. Waiting is weary work, and it will therefore suffice to say that after several ineffectual beats we all met again, disappointed and somewhat dispirited, at about two p.m. Breakfast was the first thing to think of, and, accordingly, while my servant prepared something for me, each native commenced upon his own store of rice, which he had no sooner swallowed than he laid himself down and went to sleep—a common practice with the natives of India. About three p.m. we started again, and I promised that if we could meet with no fresh tracks we would get back to camp.

We had proceeded about one hundred paces, when from thick bamboo jungle we suddenly emerged into a little open glade, and there met a woodcutter, who in a great state of excitement informed us that a female cheetah and an "immense number" of cubs had just passed that way. Sure enough we found in the sandy