developed by a metallic radiator of a low temperature, to be enabled to demonstrate the correctness or fallacy of Dulong's formula. Numerous experiments have been made for this purpose with apparatus of different forms, the results having proved substantially alike. The device most readily described consists of a spherical vessel charged with water, suspended within an exhausted spherical enclosure kept at a constant temperature. Repeated trials show that, when the differential temperature is 65°, the enclosure being maintained at 60°, while the sphere is 125°, the dynamic energy transmitted to the enclosure by a sphere the convex area of which is one square foot, amounts to 5·22 thermal units per minute. The accuracy of this determination is confirmed by the fact that during the summer solstice at noon, when the sun's differential radiant intensity is 65°, the solar calorimeter indicates a dynamic energy of 5·12 units per minute on one square foot of surface.

Our practical investigations, then, show that a differential temperature of 3,000° developes by radiation a dynamic energy of 1,013 thermal units per minute upon an area of one square foot; and that a differential temperature of 65° develops 5·22 units per minute upon an equal area. The ratio of radiant energy at the first mentioned intensity will therefore amount to $\frac{1013}{3000} = 0{\cdot}337$ units for each degree of differential temperature; while for the low intensity it will be $\frac{5{\cdot}22}{65} = 0{\cdot}080$ unit for each degree of differential temperature. Consequently, the ratio o the radiating energy will be $\frac{0{\cdot}337}{0{\cdot}080} = 4{\cdot}21$ times greater at 3,000° than at 65°. Now, M. Vicaire, on the authority of Dulong, states that the ratio will be a hundred fold greater for an increase of only 600°. According to Newton's theory, based on dynamic laws, the proportion between the differential temperature and the radiant energy of bodies is constant; while Dulong and Petit, basing their conclusions upon an erroneous estimate of the time of cooling, assert that the ratio of energy increases

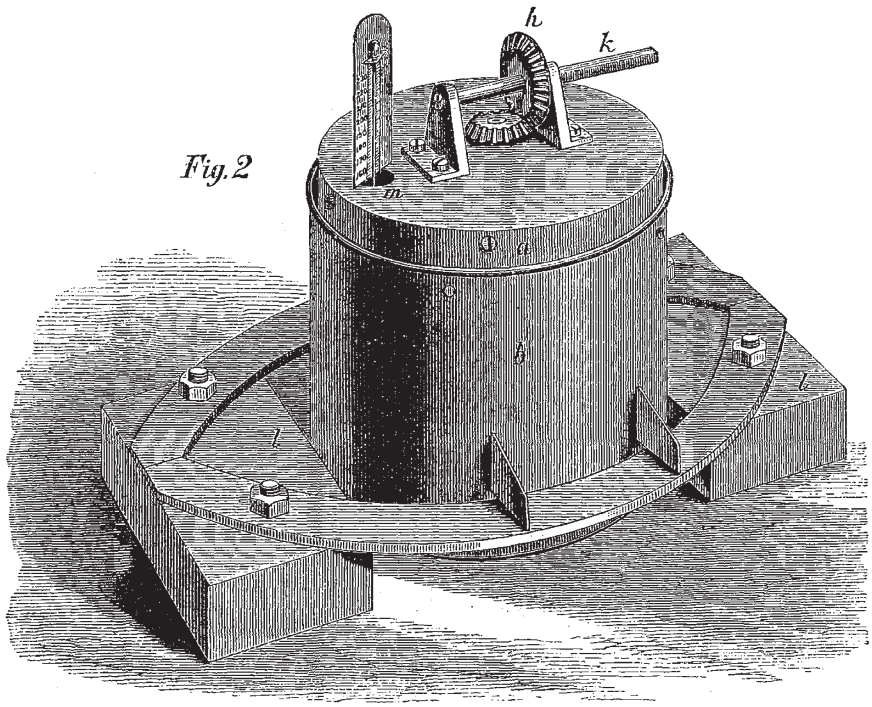

Fig. 2

several thousand times when the temperature is increased from 65° to 3,000°. Newton, then, as our experiments prove, is incomparably nearer the truth than the French experimenters; and possibly future research will prove that his law, when properly applied, will be found absolutely correct. It should be mentioned that the result of our experiments with the fused metal, compared with the result of other experiments with solid metals at various temperatures, show that the emissive power of cast iron is relatively greater in a state of fusion than when solid, or merely incandescent. This observed increase of emissive power, now being thoroughly investigated, will no doubt account for the deviation from the Newtonian law indicated by the preceding comparison, which, let us recollect, is based upon the difference of radiant energy of fused metal at 3,000°, and solid metal at 65°. Considering this extreme range of temperature, and the totally different conditions of the radiators, the observed discrepancy is not too great to admit of satisfactory explanation.

The fallacy of Dulong's formula relating to high temperatures having been conclusively shown, it will not be necessary to examine the calculations of Messrs. M. E. Vicaire and Sainte-Claire Deville, presented to the Academy of Sciences at Paris. Besides, the question of solar temperature cannot be properly investigated without considering the leading points connected with the propagation of radiant heat through space—a subject of too wide a range to be discussed in this article. It should, however, be mentioned that the result of the measurement of solar intensity March 7, 1872, before referred to, proves the correctness of our previous demonstrations, showing that the temperature of the surface of the sun is at least 4,036,000 F.

J. ERICSSON

THE CYCLONE IN THE WEST INDIES

A CORRESPONDENT in your number of October 12, 1871, expresses a wish for an article to appear in your paper, on the Cyclone which passed over Antigua, and several other of the Leeward Islands in the West

Indies, on the 21st of August last. If no other better qualified person has complied with that wish, I beg leave to tender the following account.

Perhaps a few preliminary observations in reference to the working of the barometer in these parts of the Tropics are necessary. A well-regulated mercurial barometer, at or about the sea level, under all ordinary conditions of the atmosphere, with the trades blowing from the east, stands at 30·00 or 30·10. A south-east wind, and the approach of heavy rains, will cause the barometer to fall, at times, to 29·80. At other times a N.E. trade wind, if not a storm wind—though it may bring occasional heavy showers—will cause the barometer to rise to 30·30. Thus the range of the mercury in these islands, when no cyclone is passing, is limited to five-tenths of an inch; but the variation seldom exceeds three-tenths. The atmospheric tide (if I may so call it), which causes the barometer to rise and fall half-a-tenth twice in the twenty-four hours, is very distinctly marked in these islands. The barometer being the highest at 10 A.M. and 10 P.M., and the lowest at 4 A.M. and 4 P.M. Any variation from this rule during the hurricane season calls for vigilance.

The following observations of the movements of the barometer during the late cyclone were taken at an elevation of about twenty-five feet above the sea-level.

The hurricane season of this year was preceded by a long dry season, and though the months of June and July were very hot, and sometimes oppressive, we had very little thunder and lightning. During the month of July we had some very squally weather, but the barometer was not much influenced by it. During the latter part of July and the first weeks of August, the wind often shifted towards the north, which is quite unusual at that time of the year, the barometer at the same time falling below 30·00. These indications caused some anxiety in the minds of those who were accustomed to observe the state of the weather.

The first indications of the approaching storm were noticed at 10 o'clock on the morning of the 20th. A light, but unsteady, wind was blowing at the time from E.N.E., the barometer had not risen after 4 A.M. as usual, and though standing at 30·00, the surface of the mercury was concave, indicating a fall. During the day the wind continued to blow moderately, but in gusts; the barometer slowly falling. Between 4 and 5 o'clock P.M. there was a heavy squall of wind and rain from N. by E., followed by a comparative calm. The appearance of the sky at sunset was most remarkable and alarming to those who understood anything of the indications of an approaching storm. A pale, sickly light, of a coppery hue, was spread over every object, and continued some time after sunset; and at the same time there was the appearance of a wind-gale in the east. At this time I sent a notice of the approaching storm to those living on the North-east coast, a part of the island likely to be very much exposed to its fury. Some persons did the best they could to secure their houses; but because there was no heavy swell in the sea, the fishermen disregarded the warning, and consequently lost their boats.

It is a singular fact, that about 6 P.M. the barometer not only ceased to fall, but a slight rise was perceptible, which at first led to the supposition that the storm might be only passing, and not approaching, the island. This hope was soon dissipated by the increasing force of the gusts of wind, with another squall of wind and rain about 9 P.M. with a falling barometer.

At midnight the barometer had fallen to 29·50, or about half an inch. Between two and three o'clock A.M., the wind shifted more towards the east, blowing with increased violence, breaking off the branches from the trees, and stripping shingles from the houses; but up to this time no great damage had been done. About 3·30 A.M., a singular circumstance occurred—one which I have never witnessed before, though, during a residence of thirty-three years in these islands, I have experienced many cyclones. The barometer ceased to fall for half an hour; the mercury standing firm at 29·30. This, for the time, led to the conclusion, which soon proved to be erroneous, that the centre of the storm was then passing, and that we had experienced the worst of it. At 4 A.M., the barometer again began to fall, at first slowly, and afterwards rapidly, until, at 6·40, it stood at 28·57, having fallen about an inch and a half below its usual height.

As the barometer fell, the gusts of wind became more violent, shaking large and strongly-built houses to their very foundations, tearing off verandahs, spouting, and window-shutters, and, in some instances, carrying them to great distances. Between 5 and 6 A.M. we experienced the full force of this fearful storm, and it was about this time that a large number of houses, both in town and country, with churches, school-rooms, and estate works, were destroyed.

It was soon after 5 A.M. that the writer was able, from a sheltered position, to have a full view of the awful grandeur of the storm. Low, black clouds, like dark ocean billows driven rapidly overhead; the driving rain like sheets of water; the trees whirled round and beaten nearly to the earth, until rooted up or broken off; the constant flashing of intensely red lightning, with the heavy crash of thunder, mingling with the roaring of the wind—altogether, formed a scene grand and terrific in the extreme; but which was well worth the risk to witness.

About 7 A.M. the centre of the storm passed the south of the island; the barometer began to rise, and the wind changed to S.E. and S. The storm had entirely passed over by 10·30 A.M.

The centre of this storm just touched the extreme south of Antigua; passed directly over St. Kitts, where a calm of twenty minutes was experienced, before the wind burst from the opposite quarter; and also over St. Thomas and Tortola. From thence it passed over the southern islands of the Bahama group. After that I have not been able to trace its course.

Antigua was the first island over which the hurricane passed. Being a comparatively level island—all the high land being situated at the extreme south—it suffered the most severely. Nevis and St. Kitts having mountains from 2,000 to 3,000 feet high, which broke the fury of the storm, only suffered severely in certain parts, principally on the north and east coasts. As the destruction caused by this hurricane has been fully detailed by the newspapers, I need not dwell on that subject in the present paper, but will proceed to state some interesting particulars in reference to the movements of this cyclone.

Its course appears to have been nearly from E. by S. to W. by N. As there was no heavy sea on the shores of Antigua, within a few hours of its arrival, it is evident that it originated within 200 or 300 miles of the island, and during the first hours of its existence was by no means a violent storm.

Its progressive movement was also very slow at first. The first circles struck Antigua soon after 4 P.M. on Sunday, but the centre did not pass until 7 A.M. on Monday; whilst the last half of the storm was only three hours in passing over. It is also evident that from 3·30 to 4 A.M., during the time that the barometer ceased to fall, its progressive movement was altogether suspended, though the rotary motion continued.

After 4 A.M. it began to move with great rapidity, and travelled at a speed, which, as far as I know, has not been equalled by any previous hurricane among these islands. The centre of this cyclone passed Antigua at 7 A.M., and arrived at St. Kitts at 9 A.M., having travelled at the speed of thirty miles per hour. In that island the lofty range of mountains not only broke the force of the rotary motion, but also impeded its progress; so that between St. Kitts and St. Thomas, a distance of 160 miles, it travelled at a

speed of a little more than twenty-two miles per hour, the centre arriving at St. Thomas about 4 P.M. on the 21st. What was the speed and force of its rotary motion, I have no means of correctly ascertaining; but there is no doubt that near the centre it very greatly exceeded that of its progressive motion. The diameter of the storm was about eighty miles, the outer circles taking in at the same time Montserrat in the south, and Barbuda in the north; but was not felt beyond those islands. In its progress towards the west and north it may have extended itself, as is frequently the case with these storms.

On the afternoon of September 25, we again had indications of an approaching cyclone, though not so marked and distinct as on the former occasion. The gale set in about 10 P.M., from N. by E., and continued till 10 A.M. on the 26th, the wind changing to N.N.W. and S.W. The centre just touched the north of the island at 4 A.M. on the 26th. The force of the wind was at no time very great, and did not prove destructive on land—though causing much anxiety and alarm during its progress. The barometer did not fall on this occasion more than half-an-inch.

G. W. WESTERBY

Antigua

PROFESSOR S. F. B. MORSE

INTELLIGENCE has already been received in this country of the death of Samuel Finley Breese Morse, the eminent electrician, who died at New York on the 2nd inst. at the age of eighty-one. Prof. Morse was the son of the Rev. Jedediah Morse, well known as a geographer, and was born at Charlestown, Massachusetts, on the 27th of April, 1791. He was educated at Yale College, but, having determined to become a painter, he came to England in 1811, formed a friendship with Leslie, and in 1813 exhibited at the Royal Academy a colossal picture of "The Dying Hercules." He returned to America, and for a few years followed the profession of a portrait painter. In 1829 he again visited England, and on his return voyage was accompanied by Prof. Jackson, the eminent American chemist and geologist, through whose influence he turned his attention to the conduction of electricity through metallic wire, a subject in which the chemical tastes displayed by him while at College gave him additional interest, and to which he now devoted the whole powers of his mind.

Between 1835 and 1837 Prof. Morse invented several machines which more or less foreshadowed the electric telegraph; and obtained from Congress a vote of 30,000 dollars, with which to make an experimental essay between Washington and Baltimore. The first electric telegraph completed in the United States was the line between these cities, which was finished in 1844. Since that time the Recording Electric Telegraph of Morse has been adopted over the whole country, and at the time of his death there were not less than twenty thousand miles of electric wires, stretching over the States between the Atlantic and the Pacific Ocean.

Prof. Morse received during his life recognition of his services to science from a large number of foreign Governments and scientific societies, not the least remarkable being the one inspired by the late Emperor of the French. At his suggestion delegates from France, Russia, Sweden, Belgium, Holland, Austria, Sardinia, Tuscany, the Holy See, and Turkey, met at Paris, and voted an award of 400,000 frs. to Prof. Morse as a testimonial of appreciation of his services.

A record of Prof. Morse's scientific career would not, however, be complete, without referring to a controversy which some years ago occupied the attention of the scientific world in the United States, in which he was engaged with Prof. Henry, now President of the Smithsonian Institution at Washington. So much personal matter was introduced into the dispute that a special committee of the Board of Regents of the Smithsonian Institution was appointed to investigate the matter, the report of which now lies before us. The result of this investigation is summed up as follows:—

"We have shown that Mr. Morse himself has acknowledged the value of the discoveries of Prof. Henry to his electric telegraph; that his associate and scientific assistant, Dr. Gale, has distinctly affirmed that these discoveries were applied to his telegraph, and that previous to such application it was impossible for Mr. Morse to operate his instrument at a distance; that Prof. Henry's experiments were witnessed by Prof. Hall and others in 1832, and that these experiments showed the possibility of transmitting to a distance a force capable of producing mechanical effects adequate to making telegraphic signals; that Mr. Henry's deposition of 1849 . . . . is strictly correct in all the historical details, and that, so far as it relates to Mr. Henry's own claim as a discoverer, is within what he might have claimed with entire justice; that he gave the deposition reluctantly, and in no spirit of hostility to Mr. Morse; that on that and other occasions he fully admitted the merit of Mr. Morse as an inventor; and that Mr. Morse's patent was extended through the influence of the favourable opinion expressed by Prof. Henry."

The conclusion therefore which must be arrived at, and it is one of no small importance in the history of electrical and telegraphic science, is that to Prof. Henry, and not to Prof. Morse, is unquestionably due the honour of the discovery of a principle which proves the practicability of exciting magnetism through a long coil, or at a distance, either to deflect a needle or to magnetise soft iron.

Prof. Morse's services to science as a successful applier of this principle in its practical details are so unquestionable, that we feel we are but doing a duty in setting this question right on this side the Atlantic.

NOTES

THE following are the names of the candidates who have been selected by the Council of the Royal Society for admission into that body at the forthcoming annual election:—Surgeon-Major Andrew Leith Adams, Prof. W. G. Adams, F. Le Gros Clarke, M.R.C.S., Prof. John Cleland, M.D., Dr. M. Foster, Dr. Wilson Fox, Dr. Arthur Gamgee, Rev. Thomas Hincks, Prof. W. Stanley Jevons, Prof. T. Rupert Jones, Dr. George Johnson, Major T. G. Montgomerie, R.E., Dr. E. L. Ormerod, E. J. Routh, and Dr. W. J. Russell.

AT the meeting of the Royal Geographical Society, held on Monday evening last, a letter was read addressed to the President by Dr. Kirk, H.B.M. consul at Zanzibar, in which that gentleman expressed himself very hopefully of Dr. Livingstone's safety. He thinks there is nothing discouraging in the last news received of him, and that we cannot expect to hear again unti the war at Unyanyembe is closed.

H.R.H. THE DUKE OF EDINBURGH will hold a reception on Saturday evening next in the Picture Galleries of the International Exhibition and in the Royal Albert Hall, on behalf of the Prince of Wales and the Royal Commissioners.

WE understand that Lieut-Colonel Strange, F.R.S., will exhibit at the ordinary meeting of the Royal Society on Thursday, May 2nd, the Great Theodolite designed by him for the Great Indian Trigonometrical Survey of India, and will read a paper descriptive of it.

THE electors of the Waynflete Professorship in Chemistry at Oxford have given notice that it is their intention to proceed to the election of a Professor some time in Act term next. The endowment assigned to the Professorship is 600*l.* per annum,