

The Solar Prominences

IT may interest some of your readers to hear that the bright lines of the hydrogen "flames" extending beyond the sun's disc can be seen with much less instrumental aid than has hitherto been considered indispensable. I have succeeded in seeing them quite unmistakably by the following very simple means. I fixed one of Mr. Browning's direct vision spectroscopes (having seven prisms) on a board which also carried a two-inch object-glass belonging to a good field telescope. I mounted the instrument thus arranged (shall I say as an altazimuth) on the back of an ordinary bed-room mirror, and directed it at the sun. The slit was set so as nicely to divide the D line, and a blue glass was generally interposed in front of the slit to sift the light. As the image of the sun traversed the slit at intervals, the flames appeared as bright prolongations of the F line extending beyond the sun's limb. It was also clearly seen at times that these prolongations were narrower than the F line and were not in the centre of it, also that they were frequently detached from the sun's limb, and sometimes they were not straight: appearances depending as is generally supposed on the velocity and pressure of the gas in the flame. The flames were also readily seen in the C line. In observing the solar spectrum I have found coloured glasses in front of the slit very useful to shut out as much as possible of the light from the parts of the spectrum not under observation. By using the spectroscope without its slit and collimating lens, and directing it towards the great nebula in Orion, it shows close together three bright images of the nebula exhibited on a continuous spectrum.

Streatham Hill, April 8.

ERNEST CARPMAEL

Modern Geometry and the University of London

THE letter entitled "Euclid as a Text-book," which appeared in last week's NATURE, seems to me to call for immediate reply. Many students about to present themselves for examination at the University of London and other places during the next year have been told by their tutors that a thorough and accurate knowledge of geometry would be better appreciated than the power to make verbal transcriptions of Euclid; and the letter referred to is calculated to shake the confidence of such students in the method they have been advised to pursue, and to produce a feeling of uncertainty as to the way in which demonstrations differing from Euclid's will be received by the examiners. But I think that an inspection of the calendars will re-assure them, and show that they have no cause to fear the result of examination, especially when the University of London is the examining body.

The papers consist of certain propositions common to Euclid and modern text-books, and a number of problems readily solved by a student of modern geometry, but almost impossible to one who has simply committed to memory Euclid's text. My own strong conviction is, that the latter would find some difficulty in passing the recent examinations. The questions given fall strictly within the University programme, and treat of important properties of geometrical figures which no student possessing a knowledge of approved modern methods could possibly be ignorant of. The "alternative" or modern side has been carefully kept in view and placed on a footing of equality with the ancient system.

During the year 1869 eight of my pupils who had *not* read Euclid were candidates for matriculation; all passed, and none were placed lower than the first class; so that I cannot see the advisability of boys returning to Euclid "in order that their prospect of good places may be enhanced."

Mr. Tucker apparently desires a series of questions which could only be answered on modern principles. This would amount to a system of protection, and could not fail to be objectionable.

The student of the New Geometry has, in fact, a great advantage. To the learner of Euclid a fact clothed in terms slightly varying from Euclid's is often new and startling, but to the modern student who learns every proposition in its most general form, and assimilates the idea apart from the external or verbal form in which it may accidentally be presented, it is already familiar and trite. The statement that a change in the London syllabus has been or will be made "as a sop to Cerberus," will strike many as singularly infelicitous and ungenerous. The Senate of the University does not say one thing and mean another; it has always shown unflinching courage in the reform of English methods of education, legislating as an initiator rather than as a follower. The tendency of the University

throughout its existence has been to discourage cramming in every shape and form, in the teeth of numerous difficulties and influences to which the term "obstructive" rightly applies rather than to the University itself. It is to be regretted that a letter dating from University College School should show so little confidence in the intrinsic superiority of modern methods, and still more that it should impeach the integrity of men who have not so deserved.

Brixton, March 28

RICHARD WORMELL

DEATH OF PROFESSOR MAGNUS

ON the 4th of April, 1870, at a quarter-past 10 p.m., died peacefully, after a long illness, Dr. Gustav Magnus, Professor of Physics, and Director of the Physical Cabinet in the University of Berlin. He was an experimental philosopher of great and varied excellence, executing his work with the choicest apparatus and with the most conscientious care. His numerous labours are known to all students of physics, and they are such as to secure for him an enduring fame. On the 28th of April, 1851, I first saw Professor Magnus on his own doorstep in Berlin. His aspect won my immediate regard, which was strengthened to affection by our subsequent intercourse. He gave me a working place in his laboratory, and it was there I carried out the investigation on Diamagnetism and Magne-crystallic Action, which is published in the *Philosophical Magazine* for Sept. 1851. In 1853 I was again in Berlin, and found under his roof the same ready help and sympathy. Professor Hirst and myself paid him a visit last summer; and he afterwards attended the Exeter Meeting of the British Association, where his frank, genial, and gentlemanly demeanour were conspicuous to all. Over and above his direct contributions to Science, Prof. Magnus exercised a powerful indirect influence, through the kindly aid and countenance which he lent to young inquirers. When I bade him good-bye in 1851 his last words to me were, "If you should meet any really able young fellow, willing to work, and to whom such assistance as I can render would be valuable, send him to me." There are many such, now no longer young, who, like myself, will mingle a grateful memory of his goodness with their grief for his loss.

Royal Institution, 11th April

JOHN TYNDALL

THE SOURCES OF THE NILE*

THE main point of interest in the latest travels of Livingstone, and that which gives to them a distinctive importance over the great accomplishments of his former journeys, is, that in these, Livingstone has undoubtedly visited and beheld the long-sought-for sources of the Nile. It is true that there still remains considerable doubt as to which of the basins that he has explored will ultimately be acknowledged as the cradle of the Nile, but this at least is certain, that the real head streams have been seen by him, and the vexed question has by these explorations resolved itself into a choice between two or perhaps three streams. Livingstone himself has apparently no bias in favour of one or other, so that the discussion is a perfectly open one. The three rival head streams are, first, the feeders of Lake Liemba, and second the Chambeze River and its lake chain, both of which rise near the eastern edge of the great longitudinal plateau of the side of Africa next the Indian Ocean; the third is the source recently claimed for the Nile by

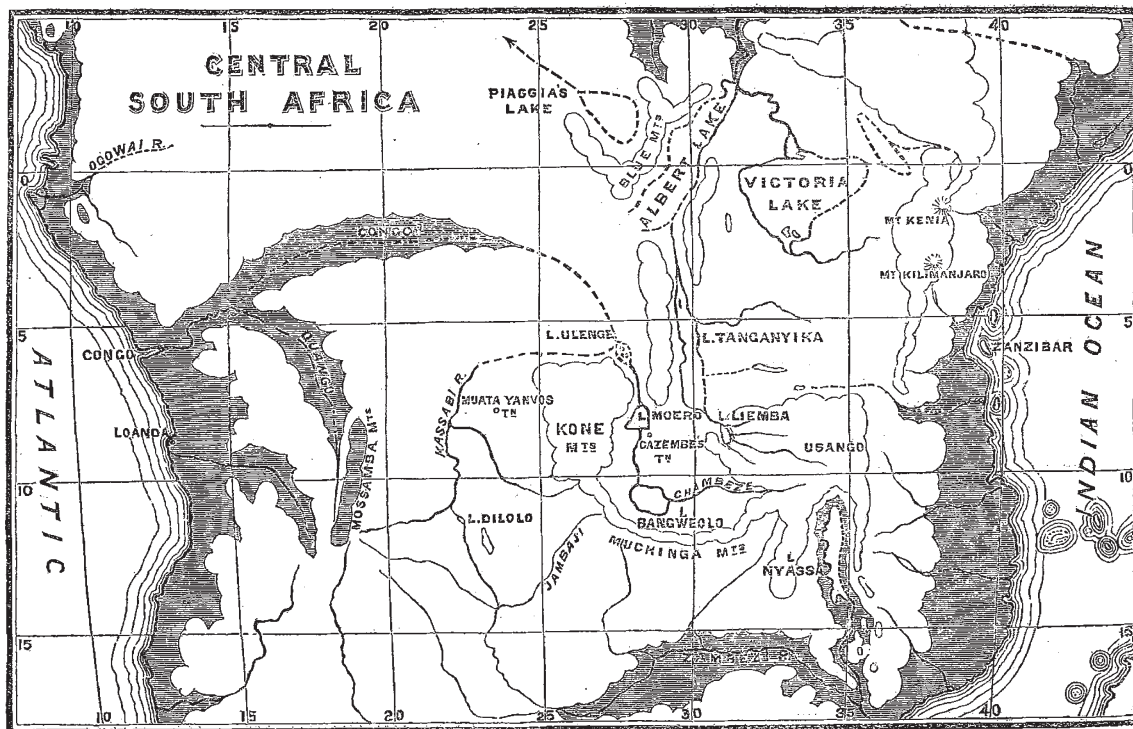
* An abstract of part of a paper read before the Royal Society of Edinburgh, March 21st.

Dr. Beke, in his solution of the Nile Problem, the great* Casai, or Kassabi River, which rises nearer the Atlantic side of the continent.

Of the first of these presumptive sources, the feeders of Lake Liemba, it may be said with almost absolute certainty that they are tributaries of the Nile, and it seems most probable that they are the sources of that river. Livingstone has found these "four considerable streams" flowing into Lake Liemba; a river-like prolongation unites Liemba and Tanganyika, these two lakes appearing thus to be at the same level; then Tanganyika and Nyige Chowambe, which is evidently the Albert N'yanza, are "one water," and that this last is a reservoir of the Nile is undoubted.

The union of the second possible head stream, the Chambeze, with the Nile, is less apparent; indeed the balance of evidence seems to show that it must be the head of another great river of Africa, the Congo or Zaire. If the Chambeze prove to join the Nile, then the streams

country west of Tanganyika. This north-westerly turn would carry the river quite out of the direction of the Nile basin, and the higher side of the continent being to the east, the probability is that the river would continue to curve to the westward. If, however, the Albert Lake prove to have a great south-westerly extension, this one difficulty is overcome. Again, the valley of the Chambeze in the plateau where Livingstone crossed it, is no doubt one of the greatest hollows in the highland, so that the height of the river bed here may be taken at 3,000 feet, the lowest level of the limits which Livingstone gives to the undulation of the plateau, or only 200 feet above Tanganyika. Descending into the "great valley" * to Lake Bangweolo from the plateau, the Chambeze must have a considerable fall, from Bangweolo to Moero there must be a second descent. The Cazembe's country, which extends round to the south of Tanganyika, is described as flat, and its rivers are currentless and stagnant. If Moero were at a higher level than Tanganyika, would not the



MAP OF EQUATORIAL AFRICA WITH CONTOUR LINES

to Lake Liemba become mere tributaries, since the course of the Chambeze is by far the longer of the two. The Chambeze flows down into the central valley through lake Bangweolo, and then northward through Lake Moero. Livingstone describes Lake Moero as beginning twelve miles below the position of the town of Lunda, the capital of the Cazembe (lat. $8^{\circ} 40' S.$, long. $28^{\circ} 20' E.$), whose position may be laid down with tolerable accuracy from the former journeys of the Portuguese travellers. Since Livingstone proceeded north from Cazembe's town along the eastern shore of the Moero in his attempt to reach Ujiji in 1867, the great bulk of this lake must lie to westward of the meridian of Lunda, or about 120 miles west of Tanganyika. Dr. Livingstone has seen the river at its outflow from the lake, and also at the point where it emerged from the crack in the mountains of Rua, when, according to his own observation, the river turned north-north-west to form Ulenge, a third lake or marsh in the

river which leaves it take a course over this flat country instead of facing towards and making its way through a "crack in the mountains northward?" Seeing that the river does force its way through the mountains of Rua (which appear to be a continuation of the "ranges of tree-covered mountains" which "flank Lake Moero on both sides") the presumption is that Moero is at a lower level than Tanganyika; and if this be the case, the river which descends from it through the mountains cannot ascend to the level of any one of the Nile lakes to join them, but must find some other course. With regard to the third advocated source, the Kassabi River, of which Dr. Beke affirms it to be his belief that it is the head stream of the Nile of Egypt, the difficulties of its joining the Nile appear to be even greater than the last. The upper course only of this river has been explored.

* It has been objected that Lake Bangweolo does not lie in a valley, but on the plateau; but Livingstone's letters could scarcely be clearer on this point, since he speaks of "the great valley enclosed between Usango (the eastern plateau) and the Kone range."

* *Athenaeum* of February 5th, 1870.

It springs in the Mossamba Mountains, which are on the inner borders of Angola and Benguela, its sources being close to those of the Quango River, a tributary of the Congo. The Kassabi is known to flow northward as far as the 8th parallel of latitude, and to the westward of the capital of the Muata Yanvo, the great negro potentate of Central South Africa. Livingstone crossed its head on his journey from the Zambesi to Loanda, and reports which he collected from the subjects of the Yanvo's kingdom all tend to prove that whatever direction its middle course may take, in its lower course the Kassabi flows round to westward, and is joined by the Quango. The trader Graça, who penetrated to the Muata Yanvo's capital in 1846, says that the territory of this chief is "shut in" by the great rivers Kassabi and Lurua (a tributary of the Kassabi), and he affirms that the Kassabi has an easterly direction beyond this.

The Hungarian traveller, Ladislaus Magyar, has penetrated furthest of the three Europeans who have visited this region, and his report agrees well with this last. He states that the Kassabi, after forming the waterfall of Muewe (in about 11° S.) bends gently to northward, but further on takes an easterly direction in its lower course, and attains a great breadth at the place where it "*touches upon*" the extensive lake Mouva, or Uhanja.* Now if we turn the Kassabi River eastward in latitude 8° south, in agreement with the above description, we find that it meets the position which Dr. Livingstone's letters give to Ulenge, the lake or marsh to which the Chambeze ultimately flows, and whose waters Livingstone tells us by report are "*taken up*" by the Lufira, a "large river which by many confluent drains the western side of the great valley." Is not the Lufira, then, the lower course of the Kassabi River, and Lake Ulenge of Livingstone, the Uhanja of Magyar? If this be the case, the same difficulties which appear in the way of the Chambeze River joining the Nile, hold also against the Kassabi, which would seem to join this river at Lake Ulenge.

Next, the question arises, If these rivers do not form a part of the Nile system, where shall we find an outlet for them? The answer to this is plainly, in the Congo River.

The Congo was described by the Jesuit missionaries who first visited its mouth as "so violent and so powerful from the quantity of its waters and the rapidity of its current, that it enters the sea on the west side of Africa, forcing a broad and free passage (in spite of the ocean) with so much violence that for the space of twenty leagues it preserves its fresh waters unbroken by the briny billows which encompass it on each side." In the introduction to his narrative of the British expedition to the Congo River in 1816, Tuckey says: "If the calculation be true that the Congo at its lowest state discharges into the sea two millions of cubic feet of water in a second, the Nile, the Indus, and the Ganges are but rivulets compared with it, as the Ganges, which is the largest of the three, discharges only about one-fifth of that quantity at its highest flood." This statement may be somewhat exaggerated, but Tuckey actually found that this vast river has a width of two, three, or even four miles, whilst flowing with a current of two or three miles an hour,† and this not at its mouth, but inland beyond the mountainous coast region. The northward wall-like continuation of the Mossamba mountains, on the 20th meridian, to beyond the equator, which Dr. Beke supposes to exist,‡ would not admit of a longer course than about 500 miles for the Congo, and a basin of that extent is utterly inadequate to collect and maintain such a body of water as that which this river is known to have, in a region where the annual rainfall averages only 12 to

15 inches (Livingstone's observation at Loanda). Such a vast river cannot be formed in a short course, but must have its rise far in the interior of the continent; and if the Kassabi River and its drainage be taken to the Nile, where shall we find a sufficiently lengthened course for the Congo?

Tuckey's unelaborated notes give the opinion that the "extraordinarily quiet rise* of the river (Congo) shows it to issue from some lake which had received almost the whole of its waters from the north of the line;" and again he says, "I cannot help thinking that the Congo will be found to issue from some large lake or chain of lakes considerably to northward of the equator." The reason of Tuckey's supposition that the lakes, which are evidently necessary to maintain the volume of water in the Congo throughout the year, would be found north of the equator, is, that he found the rising of the river beginning on the first days of September. At the time of his journey little or nothing was known of the times of the rainy seasons in Central Africa from actual experience. The observations of travellers in the continent since that time have greatly increased our knowledge of these seasons, and show them to be regulated by the apparent movement of the sun between the tropics. An area of low atmospheric pressure, with its attendant inflowing winds and rains, is constantly moving up and down the part of Africa which lies between the tropics, following the vertical sun. If every part of Africa were level and equally surrounded by water, it would result from this movement of the area of low pressure, that a rainy season would begin at each point shortly after its latitude had passed vertically beneath the sun, and a double rainy season would thus be produced: a *greater* when the low pressure area is moving equatorward in each hemisphere drawing in the sea winds; and a *lesser* when that area is passing north or south outward from the equator towards the extremities of the continent, inducing rather the land winds, whose moisture is already in great part spent. This rule holds good on the low coast lands, where other exterior influences do not disturb the arrangement, but over the high plateau of the interior of South Africa, † the commencement of the rains seems rather to precede than to follow the vertical sun, and in the equatorial regions two of the rainy seasons are prolonged into one, which lasts for eight months of the year. Under the equator at the mouth of the Ogowai River, on the west coast, Du Chaillu found the rainy season beginning in October; farther inland, in the Fan country, the rains set in in September, and in the same latitude, between Victoria Lake and Tanganyika, Burton tells us that the rainy season begins in August. Between 5° and 10° south latitude Livingstone's observation shows that on the west coast at St. Paul de Loanda the lesser rains begin in November, but in the same latitude in the centre of the continent Burton reports the rains of the Tanganyika basin beginning in September, or two months earlier; and Livingstone in his latest journey could not proceed to Lake Bangweolo from the Cazembe's town, where he arrived about the middle of September, because the rains had set in. Lake Ulenge lies between these latitudes, or in about 5° south, so that the rise of the waters of the Congo River, if its upper course be through this lake, is perfectly explicable, without the necessity of taking its reservoir lakes to the north of the equator. The lower course of the Congo is probably in a curve to north-westward from Ulenge, afterward turning south-west to meet the farthest point which Tuckey reached, where it was flowing from north-east. The rains would begin to fill Lake Ulenge, as well as the part of its lower course below this which is in the centre of the continent, in

* The maximum rise of the Congo was observed to be only 11 feet, generally 8 or 9, or less than that of perhaps any river of equal magnitude. That of the Zambesi (above the confluence of the Shiré), a lakeless basin, has been found by Livingstone to be as much as 80 feet perpendicularly; and at Khartoum the White Nile rises nearly 18 feet.

† As also in the Abyssinian highland.

* Magyar's journey in Petermann's Mittheilungen, 1860.

† P. 342 of the Narrative.

‡ Map to accompany a paper on Dr. Livingstone's discoveries in "Illustrated Travels," Part xv.

August; lower down still the rains apparently begin in September, but, as before noticed, towards the coast they are later, and so do not begin at the mouth of the river till well on in September, after the river has begun to rise. The dry season in the country west of Ulenge also agrees well with the movements of the Congo river, for Dr. Livingstone remarks that the floods in the country between Moero and Ulenge last till May or June, and the lowest state of the Congo was observed to occur in July and August.

With the Kassabi and Chambeze for its head streams, the Congo has a sufficient, though not too great area of drainage to collect the vast quantity of water which it returns to the ocean. On this supposition the area of its basin measures about 800,000 square miles, and that of the Nile nearly 1,300,000 square miles; so that the great African rivers stand in order thus:—Nile, Congo, Niger, and Zambezi.

KEITH JOHNSTON, JUN.

NOTES

WE are informed that the Duke of Devonshire will probably be the President of the Royal Commission to inquire into the Present State of Science in this country.

THERE is so little evidence of scientific training or thought in most things which are done in high places, that it is almost pleasant to be taxed even by a Chancellor of the Exchequer who attempts to do it on scientific principles, or at all events quotes scientific authority as Mr. Lowe does, who, referring to the results of the recent Deep-Sea Dredging Expedition in his Budget speech, compared the British taxpayer to the frail animals which enjoy life at the bottom of the Atlantic at a pressure of three tons to the square inch. We strongly advise Mr. Lowe to sanction another dredging expedition during the present autumn, not that it may be shown how much more vitality there is at a reduced pressure—a vitality more approaching that of "My Lords"—but that even greater pressures may be found and quoted as precedents should the next Budget prove a less satisfactory one. There is a point in the Budget, moreover, of the greatest importance to men of science. The postage on printed matter not exceeding 2 oz., and on newspapers not exceeding 6 oz., is to be reduced to one halfpenny. We have waited a long time for this change: not too long, however, to welcome it warmly now it has come, for the tax on all authors of the postage of scientific papers, copies of which they wish to distribute, has been very great.

THE following are the lecture arrangements at the Royal Institution after Easter:—Four lectures by Prof. Blackie on the Principles of Moral and Political Philosophy, on Tuesdays, April 26th to May 17th. Seven lectures by Prof. Tyndall (subject not announced), on Thursdays, April 28th to June 9th. Seven lectures by Prof. Robert Grant, on Comets, on Saturdays, April 30th to June 11th. Three lectures by Prof. Seeley on History, on Tuesdays, May 24th to June 7th. The probable arrangements for the Friday evening meetings are as follows, viz.: April 29th, Prof. Blackie—The Interpretation of Popular Myths. May 6th, Mr. R. A. Proctor—Star Grouping, Star Drifts, Star Mist. May 13th, Rev. Canon Moseley—The cause of the Descent of Glaciers. May 20th, Prof. Williamson—On Atoms. May 27th, Principal Dawson—The Primitive Vegetation of the Earth. June 3rd, Prof. Max Müller—The Migration of Fables. June 10th, Prof. Odling (subject not fixed).

THE *Pall Mall Gazette*, which gives so much space to all matters of scientific or general interest, quoting from the St. John's (New Brunswick) *Telegraph* of the 18th of March, describes an extraordinary phenomenon which took place in the harbour of that city on the previous day. Early in the morning, just before the commencement of a snowstorm, while the wind was rising so as

to be heard within doors, a strange noise, similar to that accompanying the earthquake on the 22nd of October last, was heard by the residents near the harbour. It was then seen that the old ferry, which should be several feet above water, had vanished. A piece about twenty feet by seventy broke off and settled squarely down into the water. A frontage several hundred feet in extent, running from the line of the demolished wharf towards the break-water, had also gone down, leaving a steep embankment. The soundings since made show that where the old ballast or reefer was the day before, rising above the water eight feet, were found six fathoms of water, the bottom had settled just thirty-two feet. Near where the portion of the wharf settled away, or where a moderately sized vessel used to ground at low water, there is now between six and seven fathoms at low tide. One of Messrs. Adams's buoys, moored about four or five hundred feet from the shore, had disappeared; and last evening, when the tide was at its lowest level, the current was just showing a ripple over the top of it. As the tides rise and fall about thirty feet in St. John's harbour, and the chain of this buoy had several fathoms of scope, it may be inferred that the bottom sank as much as nine or ten fathoms at this point. So far as could be ascertained, the *Telegraph* states this subsidence took place over an area of about three acres in extent.

MR. ARCHIBALD GEIKIE, F.R.S., the director of the Geological Survey of Scotland, is now at the Lipari Islands, his object being to study the volcanic phenomena of those Islands, and of some adjacent parts of Italy. He anticipates that the numerous coast sections of these islands will furnish evidence from which light may be thrown on the history of the volcanic rocks of the British Islands; the manner in which different volcanic rocks yield to the forces of denudation, subaerial and marine, is also a matter of importance that will be carefully studied.

ON Monday evening a distribution of prizes (certificates of merit) took place at the South London Working Men's College, Professor Huxley being in the chair. Previous to the distribution a lecture on the "Biography of a Plant" was given by Mr. Harland Coultas. Professor Huxley, in the course of his remarks, said that they had presented to them an analogy between vegetable and human life, and that analogy he would carry a little further, by reminding them that there was nothing more poisonous or dangerous than an uncultivated mind. He hoped that these educational establishments would do for society what the plant does for the air; namely, absorb all the poison of ignorance, and, by a similar change to that exercised in the chemical action of the plant, give off those benefits which education alone could diffuse.

IT is not often that the daily newspaper press invades a college in search of [an editor, and still less often is a learned scientific professor the elect one. We have a case in point, however, of such a condition of things. Professor Jack, M.A., who has for several years held the chair of Natural Philosophy in Owens College, Manchester, has been requested, and has consented, to take the editorial management of one of the oldest and most successful papers north of the Tweed, the *Glasgow Daily Herald*, a paper which frequently discusses scientific subjects with a fulness of knowledge. Mr. Jack has not hitherto been in the toils of daily newspaper life, but he ought to have no mean qualifications for his new vocation, considering the literary and scientific culture and worldly experience which he has acquired as an alumnus of Glasgow College and of St. Peter's College, Oxford; as one of Her Majesty's Inspectors of Schools in the West of Scotland, and as a scientific professor in Cottonopolis.

THE wave of low temperature which passed over the South of England during the latter half of March, was a very remarkable one. From the 22nd of March till the 6th of April the thermometer fell below the freezing point every night, with