Office during this period show that the conditions were mostly anti-cyclonic, both over this country and the Continent, with the exception of a depression in the south-west, which caused some sharp thunderstorms on the 9th and 10th. On the 18th another depression appeared off our north-west coasts, causing a gale in those parts, while strong winds and lightning occurred generally, with heavy rain in the west. These conditions checked the excessive heat; on the 19th the maximum temperature in London was 15°, and at Paris 25°, lower than on the previous day.

A SENSITIVE SPHEROMETER.

THE ordinary spherometer has three arms carrying three fixed points, with a point moved by a screw in the centre. This form is an improvement on the original spherometer invented by Andrew Ross, and for which the Society of Arts gave him a silver medal in 1841.

A description of Ross's instrument is given by Holtzapffel, vol. iii. p. 1271 of his work on "Turning and Mechanical Manipulation," extracted from vol. liii. of the Transactions of the Society of Arts. This instrument could measure to $\frac{1}{1000}$ of an inch, and by estimation half this amount. An ordinary spherometer, with a screw of $\frac{1}{100}$ of an inch pitch and head divided to hundredths, will measure to $\frac{1}{10000}$ of an inch.

I pointed out in vol. l. page 145, of the Memoirs of the Royal Astronomical Society that the sensitiveness of the ordinary spherometer was much increased by placing the screw not in the centre, but in one of the arms in place of one of the fixed points; this at once increased the sensitiveness of the screw in proportion to the distance of the screw from the nearest fixed point, and this fixed point from a line joining the other two fixed points.

The improvement I wish to bring before those interested in spherometers by this note, is the extension of this principle, for by carrying the middle point much nearer the line joining the other two, a proportionate increase of sensitiveness is obtained.

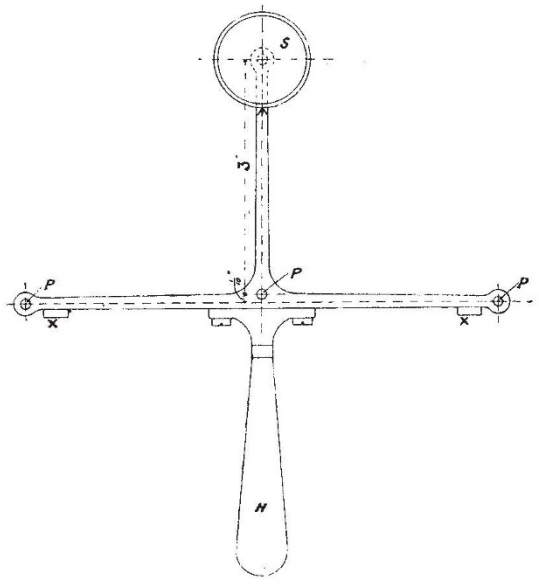
In the case of an instrument I have made on this plan I have increased the sensitiveness thirty times, the distance from the middle point to the screw being three inches, and the distance of the point from the line of the other two being $\frac{1}{10}$ of an inch; with a screw of one hundred threads to the inch and a head divided to hundredths, the ordinary form of instrument will read to $\frac{1}{10000}$, but on the plan I give, the same screw will measure $\frac{1}{300000}$ of an inch.

There is an additional advantage in this form, that the curvature of a part nearly in a line is measured, so that cross measures can be taken.

The form of the instrument is not symmetrical, and it requires to be balanced, so that when the screw is raised it will be possible to estimate the frictional contact of the outside points when the middle one is taking the weight. This balancing is easily done by adding a handle to the part opposite the arm carrying the screw; in practice it is found that this handle is of the greatest value in keeping the heat of the hand from the instrument, as even with the ordinary instrument, holding it for a short time in the hand alters the readings materially.

It is of great advantage to have on the arms carrying the two outer pins two pieces of wood or ivory projecting not quite as much as the measuring points, so that by tilting the instrument up these two pieces come first into contact with the surface to be measured, then by gradually raising the handle the points are brought gently into contact. The figure is a plan of this spherometer, and shows the position of the three fixed points P P P with reference to the measuring screw S, and the position of the balancing handle H with reference to the unsymmetrical arm carrying the measuring screw; X X are the projecting pieces already mentioned.

The movement of the screw being so large for a slight curvature, this instrument is more particularly useful for measuring the slight curvatures of so-called plane mirrors,



PLAN

for which, indeed, it was designed. To make it available for measuring differences between parts of a curved surface of considerable curvature the middle pin should be a screw capable of movement to, and clamping, in a position, that will allow the measuring screw to work.

A. A. COMMON.

JEAN DANIEL COLLADON.

DANIEL COLLADON, the celebrated physicist and engineer, died on June 30, at Cologny, near Geneva.

Colladon was born at Geneva, December 15, 1802. He belonged to a Protestant family from Berry, which removed from France, in the middle of the sixteenth century, on account of religious persecutions, and found refuge in Calvin's town. Many a distinguished magistrate came from this family, amongst others the learned juris-consult, Germain Colladon.

While still quite young Colladon proved to be wonderfully intelligent, and had a remarkably observant mind.

He went through the College and then the Academy of Geneva, which at that time had, among its professors, A. P. de Candolle, M. Aug. Pictet, Th.de Saussure and Prevost. His liking for science could not but develop itself in contact with these eminent men, whose esteem he soon gained.

At the age of ten years he made friends with Charles Sturm, who became a noted mathematician, and was on later occasions his fellow-worker. His inventive nature and talent for experimental inquiry turned itself above all to physics and its mechanical applications.

He was just twenty-two when he received from the Society of Science of Lille a first prize for the invention of a new photometer. At twenty-three he went to finish his studies at Paris. He lived there for about ten years, leading a simple life, almost entirely devoted to work.

He was received in a most flattering manner for such a young man by the pleiades of celebrated men, which the

great town then possessed; Arago, Dulong, Fresnel, Fourier, Ampère. He made true friends with many of them, and had the honour of being a fellow-worker of the two last. At Paris he found the old friend of his childhood, Sturm, with whom, in 1826, he made the wonderful experiments on the Lake of Geneva, relating to "the velocity of sound in water," which united their two names so admirably in all treatises on physics, and which won for them the grand prize of the Institute of France.

By the side of these classical researches, Colladon's first works deal chiefly with electricity. In 1826 he published his experiments made at the College of France, with a galvanometer of his own invention, on the magnetic actions which ordinary electrical machines, Leyden batteries, and atmospheric electricity produce on the magnetic needle. He studied the electrodynamic actions with Ampère, and the conductivity of thin bodies for heat with Fourier.

The celebrity which he had acquired for himself at Paris by his works led to his being asked by the founders of the Central School of Art and Manufacture to join them, and to give a special course of lectures on the steam-engines and their use, which he did with much success from 1831 to 1834. He also made numerous researches and inventions relating to steam-engines. In 1844 the Lords of the English Admiralty adopted a dynamometer which he invented to measure the effective power of steam-engines for navigation, and which he was charged to make at the Royal Arsenal of Woolwich at the cost of the Admiralty.

In spite of the honourable place which he had attained at Paris in the world of science and industry, Colladon, was so attached to his country, that he gave up the many advantages which would accrue from a residence in France, and settled at Geneva in 1834. He proved himself on many occasions most useful in the debates of the little Republic, and was made Professor of the Academy in 1839.

In 1852 he rendered to the industry of his country the great service of representing it at the first Universal Exhibition in London, where he was delegated by the Federal Council as Commissioner for Switzerland.

He took part in two juries relating respectively to physical instruments and clocks. The most diverse branches of industry excited the interest and research of his fruitful mind. One to which he gave most of his attention was illumination by gas. In 1844 he was appointed engineer of the new gas company at Geneva. He invented a great number of improvements in gas-lighting, and the wonderful competence that he acquired has contributed largely to establishing a great number of enterprises of the same sort both in Switzerland and abroad. It was on this account that he was charged to superintend the installation of the Gas Society at Naples.

Hydraulics occupied him on many occasions; he studied the water supply of towns, and invented floating hydraulic wheels with the paddles below. It was he who discovered the ingenious way of lighting a liquid tube from within, by introducing, as it were, with the water a luminous ray, which remains imprisoned by the effects of totally multiple reflections, and illuminates the whole length of the liquid cylinder. The luminous fountain, or, as it is often called, "the Colladon fountain," originated from this delicate experiment. It formed one of the most beautiful ornaments at the Universal Exhibition at Paris, and was tried on a larger scale for the first time at the exhibition of Glasgow in 1884.

But these are not the inventions which render great the name of their inventor; the one which merits this honour, and to which the name of Colladon must ever be united, is that of the use of compressed air for the transference of energy. Profiting by the resources which he had at his disposal as engineer of the gas works at Geneva, from 1849 he made essays on the circulation of compressed gas in pipes, and he demonstrated the possibility of transmitting with economy a considerable energy for a long distance in narrow pipes. It is easy to understand the immense importance in the construction of long tunnels of transmitting energy by compressed air, for with the impulse given to the boring machine, fresh air is brought at the same time to the workmen at the end of the deep galleries. It is this idea, as simple as it is beautiful, which constitutes Colladon's claim to glory; this invention which must immortalise his name: it is this which makes it possible to construct the great subterranean passage which honour our generation, and which have made him one of the benefactors of our time. After the first studies for the tunnel of Mont Cenis, in December, 1852, he gave an excellent memoir on the subject to the Financial Minister of the Italian State, which was followed by a request for a patent for the new processes.

This important memoir, transmitted by the Italian Government to the Royal Academy of Science at Turin, was the object of a special report addressed to the Minister, and it concluded thus:

"The author does not limit his memoir to a simple description of the proposed scheme, but he shows the applicability by theoretical considerations. The commission recognises above all the vast importance the inventions of Monsieur Colladon could be in hastening the construction of the railways destined to cross the Alps." The splendid invention of Colladon was applied with much success by the Italian engineers at the construction of the Mont Cenis tunnel, and it made its reputation there, but all the honour belongs to the discoverer. If Colladon had not the pleasure of making the first applications of his invention, and if he had to leave to others the honour of making the first sub-alpine tunnel, he was able at least to give his ideas full development in the making of the St. Gothard tunnel, by the installation of the powerful compressors at Goeschenen and Airolo, which he executed for the enterprise directed by L. Favre.

Colladon was one of the first specialists in the art of constructing tunnels. It is owing to this that in 1878 he was made a member of the committee connected with the tunnel under the Channel. He was also very busily occupied studying out the boring of the Simplon.

We cannot in this short notice give a complete idea of the greatness, and fruitfulness of Colladon's career. Suffice it to mention his researches on the electricity of the torpedo, atmospheric electricity, the effect of lightning on trees, snow and hail, waterspouts, the use of steam for putting out fires, and on the terraces surrounding the Lake of Geneva.

Colladon had such a many-sided mind, that he could interest himself with the most diverse questions, and he studied them all with remarkable care and conscientiousness. Absolutely disinterested, he worked for the advancement of science, without pushing his inventions for his own profit. On the contrary, he was always at the service of others, and always ready to help them with his advice and assistance without any remuneration.

He was a great worker and was willing to assist others until the last years of his admirable life. He died at the age of ninety-one, preserving nearly to the last the use of his fine and noble faculties. His reputation had extended itself far and wide, and a great number of learned societies of all parts of the world counted him among the number of their members.

ED. SARASIN.

NOTES.

WE learn that Dr. J. W. Gregory arrived at Mombasa on August 19, after a successful expedition to Lake Baringo. He returned *via* Likipia and Mount Kenia, and ascended the latter