and Sydney was in progress, and, on this being completed, there would only remain to connect Western Australia, to have the longitudes of all the chief Australian and New Zealand cities and ports determined upon the same system.

Mr. Ellery recommends that a small expedition should be despatched from Melbourne to New Zealand for the observation of the total eclipse of the sun on September 9 in the present year, when the central line passes through Cook's Straits. Sir W. Jervois, the Governor of New Zealand, had promised all the aid he could render in the matter. The Board of Visitors supported an application to the Government of Victoria for the necessary funds. [Full details of the circumstances of this eclipse were given by Mr. Hind in the *Monthly Notices* of the Royal Astronomical Society for January last.]

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *MARCH* 8–14

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on March 8

Sun rises, 6h. 31m.; souths, 12h. 10m. 51·6s.; sets, 17h. 51m.; decl. on meridian, 4° 42′ S.: Sidereal Time at Sunset, 4h. 57m.

Moon (at Last Quarter at 19h.) rises, 1h. 5m.; souths, 5h. 40m.; sets, 10h. 12m.; decl. on meridian, 17° 25′ S.

Planet	Rises		Souths		Sets		Decl. on Meridian
	h. m.		h. m.		h. m.		° ′
Mercury ...	6 36	...	11 56	...	17 18	...	8 22 S.
Venus ...	6 13	...	11 18	...	16 23	...	11 26 S.
Mars ...	6 28	...	11 52	...	17 16	...	7 44 S.
Jupiter ...	15 46	...	22 58	...	6 10*	...	13 8 N.
Saturn ...	9 56	...	18 0	...	2 5*	...	21 41 N.

* Indicates that the setting is that of the following nominal day.

Occultations of Stars by the Moon

March	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
10 ...	B.A.C. 6287 ...	6 ...	4 25 ...	5 38 ...	90 228
10 ...	B.A.C. 6292 ...	6 ...	5 6 ...	6 26 ...	54 280
11 ...	ρ′ Sagittarii ...	4 ...	5 18 ...	6 38 ...	60 272

Phenomena of Jupiter's Satellites

March	h. m		March	h. m.	
8 ...	2 46	II. ecl. reap.	13 ...	0 27	I. occ. disap.
	6 12	IV. occ. disap.		3 14	I. ecl. reap.
9 ...	20 8	II. tr. egr.		19 1	III. tr. ing.
10 ...	5 23	III. occ. disap.		21 45	I. tr. ing.
11 ...	6 0	I. occ. disap.		22 39	III. tr. egr.
12 ...	3 19	I. tr. ing.	14 ...	0 5	I. tr. egr.
	5 38	I. tr. egr.		18 53	I. occ. disap.
				21 43	I. ecl. reap.

The Occultations of Stars and Phenomena of Jupiter's Satellites are such s are visible at Greenwich.

March 13, 19h.—Mercury in superior conjunction with the Sun.

RECENT ENGINEERING PATENTS[1]

SIR FREDERICK BRAMWELL stated that he had been determined in his choice of a subject by the consideration that H.R.H. the Prince of Wales had seen fit to appoint him chairman of the Executive Council of the International Inventions Exhibition, to be held at South Kensington this year. He therefore proposed to direct attention to some of those objects that ought to be contributed to that Exhibition which were more particularly connected with civil engineering.

Dealing, first, with materials of construction, the President remarked that probably few materials had been more generally useful to the civil engineer, in works which were not of metal, than Portland cement. During the last twenty-two years great improvements had been made in the grinding and in the quality of the cement. As regards bricks, although not now superior in quality to those made by the Romans, there was progress to be noted in the mode of manufacture and the materials employed. The brick-making machine and the Hofmann kiln had economised labour and fuel, while attempts were being made to utilise the waste of slate quarries. Certain artificial stones appeared at last to be produced with such a uniformity and power of endurance as to compare favourably with the best natural stone, or were even better, for they could be produced of the desired dimensions and shape, and were thus ready for use, without labour of preparation. The employment of wood, except in newly-developed countries, was decreasing, for one reason, because it was practically impossible so to use it as to obtain anything approaching to the full tensile strength. Many attempts had been made to render timber proof against rapid decay and ready ignition, and it was in these directions alone that progress could be looked for. With respect to preservation from fire, the wooden structures of the Health Exhibition were coated with asbestos paint, and to this their escope from destruction by a fire was due. Leaving the old-world materials of stone and wood, attention was directed to that form of iron known as steel. The President remarked that, in his judgment, the making of steel in crucibles was not so satisfactory a mode of obtaining uniformity in large masses as was either of the other two great systems of manufacture—the Bessemer and the Siemens—the two processes which had changed the whole complexion of the iron industry. He further said that, eight years ago, in a lecture he delivered at the Royal Institution, he had ventured to predict that steel made by fusion would supersede iron made by the puddling process, and that the use of iron so made would be restricted to the small articles produced by the village blacksmith. The first important revelation in steel manufacture was the ingots shown by Krupp, with other products, in the Great Exhibition of 1851. These showed an enormous step at the time when the production of steel involved the employment of the crucible. Within the last eight years a great improvement had been made by Messrs. Thomas and Gilchrist, by which it had been rendered possible to employ successfully, in the production of steel, iron derived from ores that, prior to the date of this invention, had been found wholly inapplicable for the purpose. In the manufacture of pig-iron improvement had been effected by increasing the dimensions of the furnaces and the temperature of the blast, by the better application of chemistry to the industry, by the total closing of the bottom of the furnace, and by the greater use of the waste gases. Copper, so long used in its alloyed condition of "gun-metal," had, within the last few years, been still further improved by alloying it with other substances so as to produce "phosphor-bronze" and "manganese-bronze," very useful materials to those engaged in the construction of machinery. With the increased dimensions of the main-shafts of engines, and of the solid forgings for the tubes of cannon, obtaining at the present day, composed, as they were, of steel, the operations of light steam-hammers were absolutely harmful, and the blows of even the heaviest hammers were not so efficacious as was pressure applied without blow. The time was not far distant when all steel in its molten state would be subjected to presusre, with the object of diminishing the size of any cavities containing imprisoned gases.

Within the period under consideration the employment of testing-machines had come into the daily practice of the engineer, for determining, experimentally, the various physical properties of materials—and of those materials when assembled into forms to resist strain, as in columns or in girders.

In those matters which might be said to involve the principles of engineering construction, there must of necessity be but little progress to note. Principles were generally very soon determined, and progress ensued, not by additions to the principles, but by improvement in the method of giving to those principles a practical shape, or by combining in one structure principles of construction which had hitherto been used apart.

Taking up, first, the subject of bridge construction—the President thought the St. Louis bridge might fairly be said to embody a principle, novel since 1862, that of employing for the arch ribs tubes composed of steel staves hooped together. Further, in suspension bridges, there had been introduced the light upper chain, from which were suspended the linked truss-rods, doing the actual work of supporting the load, the rods being maintained in straight lines, and without flexure at their joints due to their weight. In the East River Bridge at New York, the wire cables were not made as untwisted cables, and then hoisted into place, imposing severe strains upon many of the wires, but the individual wires were led over from side to side, each having

[1] Abstract of Presidential Address at the Institution of Civil Engineers, by Sir Frederick J. Bramwell, F.R.S., on January 13.