is shown that scour, at pier noses, is due to the water, diverted by the pier, diving downwards towards the upstream toe of the pier. The action of scour is due to the 'flow pattern' and is scarcely affected by the upstream bed level.

Rigid vertically-exaggerated models, though with great care may be made to reproduce correctly conditions for a given discharge, may fail with longer or smaller discharges. Much patient 'trial and error' work spread over a number of years along with large data may enable prediction of conditions outside the verified range. But direct informations about scour and consequent changes in flow cannot be got. A rigid model of a 20-mile length of the Hoogly above Calcutta is being studied at Poona to determine lines of flow and places of scour bed action, as preliminary, to a more exhaustive investigation of bank-scour problem with semi-rigid or mobile part-models, using larger discharges.

Semi-rigid models can reproduce similarity much more accurately than the whole mobile models. But throughout the length of the channel conditions are imposed, the model being incapable of scour, its banks being rigid or changing its course thus precluding studies of future changes of river course and their consequent effects.

In the case of mobile channels, as a result of Lacey equations, slope exaggeration must equal vertical exaggeration for the same silt factor in model and prototype. A coarser silt increases the slope exaggeration whereas it decreases the vertical exaggeration. Choosing of correct silt conditions in a model is thus very essential. Hence channels can be more satisfactorily designed by the use of formulæ than by model studies.

Silt movement and hence the amount of scour and silting are always relatively much less, in a natural mobile model than in its prototype. With a low discharge, silt movement will occur in rivers whereas in a model it will not commence till a flow is a considerable fraction of the flood discharge. Use of finer silt in models though increases silt charge, has little effect on the velocity at which silt movement begins and ends. In the 1/300 Sukkur Barrage model, when regulated as at the Barrage, silt movement does not begin till the discharge exceeds half the normal maximum flood discharge. In many river problems, scour after floods greatly affects subsequent flow conditions and this scour is not correctly reproduced in models, leaving us to depend either on experience and judgment or to distort the model scales to effect silt movement at low discharges.

Bank slopes and rigid structures are exaggerated according to the depth exaggeration scale. Such exaggeration fails to reproduce correctly the "flow pattern" thus necessitating recourse to large-scale part-models, essential for studying bank effect.

To prevent distortion in plan, models are foreshortened longitudinally in the ratio of the vertical exaggeration, this foreshortening leading generally to distortion of the lines of flow or eddy pattern, due to inadequate length.

Long and short river models have specific advantages but in both these cases, great care must be bestowed on entry condition as on its correctness depends a reliable reproduction of the meandering course of a river. Generally models varying from geometrical similarity to various scales of vertical exaggeration would be needed to help proper understanding.

For several years, various scale experiments have been conducted with mobile models at Poona, to study effects of variation of slope scales, discharge scales, silt charge and vertical exaggeration. They have indicated the limitations of river model studies; a wide range of experiments with large models generally yield highly accurate qualitative results with some measure of quantitative accuracy. Conditions that have existed in the prototype under a known discharge and silt charge, can be reproduced accurately in a model and at best, mobile river model can serve as a valuable guide to the engineer.

C. GOPALAKRISHNAN.

CENTENARIES

Cooper, Astley Paston (1768–1841)

ASTLEY PASTON COOPER, a British surgeon, was born at Brooke Hall about seven miles from Norwich 23 August 1768. His father was a vicar; but his grandfather and uncle were both surgeons. He passed a spirited boyhood without much schooling. He learned classics from his father and his mother, who was an authoress of no mean repute, taught him history and grammar. He was thus neither overtaught nor overstrained in his boyhood. When he completed his sixteenth year, he was apprenticed to his uncle, surgeon to Guy's Hospital, and later to Henry Cline, surgeon to St. Thomas's Hospital. He specialised in anatomy and completed his course by spending seven months in Edinburgh, in close association with the most renowned surgeons of that place.

In 1789 Cooper was appointed demonstrator of anatomy at St. Thomas's Hospital and two years later he was promoted lecturer. He followed the Hunterian model which was scoffed at by the elders. The students accustomed to the teaching of such scoffers began to desert Cooper. After investigation Cooper found that it was due to their ignorance of Hunterian terminology and their lack of experience. To counteract these difficulties, Cooper adopted the plan of bringing before the class cases of disease and injury and further illustrating by morbid specimens and experimental results. This method he practised with great success throughout his teaching career of forty years.

In 1800 Cooper was appointed surgeon to the Guy's Hospital. In 1805 he took an important part in founding the Medico-Chirurgical Society. Its *Transactions* contains several contributions by him. His two volumes on *Hernia* (1804–1807) are justly famous. In 1822 Cooper brought out his well-known *Dislocations and fractures of the joints*. In 1827, he became President of the College of Surgeons and in the next year he was appointed surgeon to the King.

In 1820 Cooper operated upon King George IV for a tumour of the scalp. This brought him a baronetcy. An anecdote connected with this operation shows the change in surgical practice that has come since those times. Cooper was summoned hurriedly to the Palace one evening. On his return he asked Bransby Cooper, his nephew, "Pray tell me, do you see anything particular about me, for the King did not seem in good tune; he looked very hard at me from head to foot, and I cannot understand why—do you see anything?" "Why" said Bransby, "I should have put on a white cravat and a clean shirt, or at least have washed my hands before I waited on His Majesty." The fact is, Sir Astley had performed a slight operation just before he went to the Palace, by which some blood had stained the sleeve of his shirt where it projected at the wrist, and his hands also were not perfectly free from it. Mr. Cooper then looking at what he had pointed out to him said "God bless me, so I ought, but I was not aware of it. The King, sir, is a very particular person; he was lying on a couch under a canopy with a red turban on his head, and he looked displeased and now I see the reason of it."

A statue of Cooper was erected in St. Paul's Cathedral. He died 12 February 1841.

Gregory, Olinthus Gilbert (1774–1841)

OLINTHUS GILBERT GREGORY, a British mathematician, was born of humble parents at Yaxley 29 January 1774. After studying in the village school, he learned Mathematics from Richard Weston, a botanist, with such good effect that as early as 1793 he published a small book of *Lessons, astronomical and philosophical*. He also wrote a book on the slide rule, which brought him to the notice of Charles Hutton, professor of mathematics at the Royal Military Academy at Woolwich.

In 1796 he settled as a bookseller in Cambridge and gave private tuition in mathematics. The latter occupation soon became so profitable that he gave up the bookselling business. In 1802 he was appointed mathematical master at the Royal Military Acadamy; and he became professor on Hutton's resignation in 1807.

He obtained honorary degrees from several institutions and became a fellow of the Royal Society. He was one of the original founders of the Royal Astronomical Society and one of the projectors of the University College, London. His name was inscribed in the foundation-stone of that college laid in Gower street, 30 April 1827.

He was a prolific writer. His *Treatise in astronomy* (1802), his *Treatise of mechanics*, 3v. (1806) and the *Elements of plane and spherical trigonometry* are the most well known. His works are characterised by sound knowledge, good arrangement and clearness of exposition.

Gregory died 2 February 1841.

S. R. RANGANATHAN.

University Library,
Madras.

SCIENCE NOTES AND NEWS

An Optical Hygrometer.—Dr. L. D. Mahajan, Physics Research Laboratory, Mahendra College, Patiala writes:—

An optical hygrometer has been devised in this laboratory in order to study the variation in the humidity of the air.

To a zinc rod (balance beam), about 1 mm. thick and 10 cms. long, a cup of zinc of 1 cm. square and 2 mms. deep is fixed rigidly to each end. In the middle of the beam, a revolving rod of copper, about 1 mm. thick and 7 mms. long, is rigidly attached at right angles to it. A small spherical mirror of about 2 metres focal length is fixed to the revolving rod, just on one side of the junction of the revolving rod and the balance beam.

The two ends of the revolving rod are made to rest on two fine, well polished and equally levelled glass plates fitted on a stand. One of the cups is filled with a powder containing about 97 per cent. Plaster of Paris and 3 per cent. calcium chloride. It has been found by various trials and observations that the mixture of these two powders has high power of absorption and desorption of moisture. Suitable weights are added into the other pan till the beam is almost horizontal.

A beam of light is thrown from a lamp and scale arrangement on the spherical mirror and the reflected beam is allowed to fall somewhere in the middle of a vertical scale at a distance of about 200 cms. from the revolving instrument. The whole instrument is placed inside a rectangular glass vessel perforated with holes at the base to permit free circulation of air inside it and to avoid any disturbance to the revolving arrangement due to any direct and strong currents of air. Then the instrument is ready for measurements.

With a small change in the humidity of the air, the spot of light moves through a great distance on the vertical scale. The shift of the spot of light is proportional to the change in the relative humidity of the air.

The author is indebted to His Highness' Government, Patiala, for having provided facilities to carry out this work in the Physics Research Laboratory, Mahendra College, Patiala.

December 21, 1940.