simultaneously along a parallel of latitude, and, if possible, to combine these with regular series of ascents at places distributed as nearly as possible along a meridian. When this has been done a firm foundation for a survey of the atmosphere will have been laid.

There is a certain lack of coherence about the present work, so that although each individual contribution is excellent, the collection does not reach the same standard. Something of this kind is perhaps inevitable where different authors, separated from each other by the Atlantic, undertake to write different sections of a scientific report which are closely related to each other, and require to be published without undue delay.

E. GOLD.

PRECISION OF LEVELLING OPERATIONS.[1]

THE volume referred to below, containing the account and discussion of the precise levelling operations in India from 1858 to 1909, is published at an opportune time. The revision of the main lines of levels in this country and the establishment of really permanent bench marks is, we understand, a task that our Ordnance Survey intends to take up at an early date. The experience gained in the Indian work as recorded in this volume cannot fail to be of great value.

As with any other physical measurement, we find in the case of levelling that increased precision means that problems unimportant or often unthought of in earlier days rise to prominence and demand solution. Thus at the very outset of the subject we are confronted by a question of definition; what do we mean when we say that two points are at the same level? Do we mean that the distance of each point from the surface which would correspond with the mean sea surface, assuming the land to be removed, measured along the normal is identical, or do we mean that our two points lie on the same equipotential surface? The former definition gives us the so-called "orthometric" height, while the latter gives what has, perhaps not very happily, been called the "dynamic" height.

Thus consider the case of a lake. The dynamic height of every point on the water surface is evidently the same, but the actual vertical distance above sea-level varies from point to point, the rate of variation being a maximum along a north and south line and zero, if we exclude second-order distortions of the spheroid, along an east and west line.

Authorities vary as to which system is on the whole the more convenient for practical use, so that the Indian Survey has followed the safe plan of printing both values. We may, however, venture the remark that a convention which assigns different "levels" to different points upon the surface of still water is repugnant to a very large class of practical men, namely, the engineers. The difference between the heights of a station, measured on the two systems, amounts to a maximum of nearly two feet in the case of Bangalore, 3000 feet above the sea, a figure which would obviously be largely exceeded if the levelling were extended to regions of great elevation, and if the mean latitude were differently selected. It is not quite clear in choosing a mean latitude of 24° for the zero of their dynamic heights, and thereby making the system valid only for India, that the Survey experts have adopted the best course. It is an arguable question, which we merely mention here without, be it understood, expressing any definite opinion, whether, if dynamic heights are to be used at all, they should not be based upon a universal datum, and therefore referred to a mean latitude of 45°.

The discussion of the level errors is of great interest and importance. The conclusion arrived at is that for the Indian work the error of a circuit varies neither directly as the length nor as the square root of the length, but in accordance with an intermediate formula:—

$$\text{Error in feet} = \sqrt{(0{\cdot}004)^2 M + (0{\cdot}00034)^2 M^2},$$

where M is the distance in miles.

This gives one-tenth of a foot for a line of 235 miles, and one foot for about 2800 miles, a very satisfactory degree of precision.

The importance of both accurate and permanent bench marks is rightly insisted upon. Many cases have been found where the marks have moved, and obviously no deductions can be drawn as to elevations or subsidences in the earth's crust unless the stability of the bench marks is beyond suspicion.

E. H. H.

[1] "Account of the Operations of the Great Trigonometrical Survey of India." Vol. xix., Levelling of Precision in India (1858–1909). By Colonel S. G. Burrard, R.E., F.R.S. Pp. xiii+484+xviii plates. (Dehra-Dun: Office of the Trigonometrical Survey of India, 1910.) Price 10.8 rupees.

DR. HENRY TAYLOR BOVEY, F.R.S.

WE announced with regret last week the death of Dr. H. T. Bovey, late rector of the Imperial College of Science and Technology, and formerly dean of the faculty of applied science in McGill University, Montreal, which occurred at his residence in Eastbourne on February 2. The funeral service was held at St. John's Church, Eastbourne, on February 6, and his remains were interred in Eastbourne Cemetery.

Dr. Bovey was born at Torquay in 1852, and after being educated in a local school, entered Queens' College, Cambridge, in 1870. He graduated in 1873 as twelfth wrangler, and was elected a fellow of his college in 1876. He entered the profession of engineering, and joined the staff of the Mersey Docks and Harbour Board. Whilst at Liverpool he took part in founding the Liverpool Society of Civil Engineers, and he had every reason to look forward to a prosperous professional life in England. But an accident occurred which gave his life a new bent, and afforded opportunity for a brilliant career elsewhere. Like the best type of Cambridge honours man, Dr. Bovey was a keen supporter of athletics. Whilst taking part in a game of football, he was thrown down and had several ribs broken. He made a good recovery, but one lung had been slightly injured, and he was advised to spend the next winter in a dry climate, lest the wound should become a focus for pulmonary disease. He therefore accepted from Sir William Dawson, principal of McGill University, the offer of a chair in civil engineering and applied mechanics, but declined to bind himself to hold this post for longer than a year.

When Dr. Bovey arrived in Montreal in 1881, he found that his post was indeed a sinecure. Not only was there no laboratory of any description, but his chair was attached to the "Arts" faculty, and his subject had to compete with literary subjects as an option for a degree. At that time in McGill the principal qualification for the success of an optional subject was constituted by its claims to be considered a "soft snap," *i.e.* by demanding light work and having easy terminal examinations. The mathematical teaching provided by the University was quite unsuited to engineering students, and Dr. Bovey's efforts to have it modified met with no success. Next year, therefore, Dr. Bovey resigned his chair, and was about to return to England, but he was pressed by

the principal to draw up a scheme for the better instruction of engineering students. This he did, and the scheme provided for the establishment of a separate faculty of applied science, with its own chair of mathematics. The principal then said that if Dr. Bovey would remain his scheme would be carried into effect as soon as funds permitted. Dr. Bovey agreed to remain, and by constant and heroic struggles during the next twenty-five years, he gradually built up one of the finest engineering schools in the world.

Money came in at first very slowly, and only Dr. Bovey's marvellous tact and the respect and affection which he everywhere inspired enabled him to make any headway with his scheme. At last he succeeded in interesting Mr. (now Sir William) Macdonald, a rich and respected Montreal merchant, in his plans. This gentleman travelled with Dr. Bovey over the United States in order to inspect the fine engineering schools of that country. Dr. Bovey stimulated his friend's Canadian patriotism by pointing out how far behind Canada was in this matter. On their return to Canada Sir William Macdonald announced his intention of building and endowing the finest engineering school on the continent. This was Sir William Macdonald's first important donation to McGill; it was followed by so many others that he can justly be regarded as the second founder of the University. At Dr. Bovey's suggestion, Sir William built and equipped the splendid physical laboratory, and founded the chair in physics, the two first occupants of which have been Profs. Callendar and Rutherford. Dr. Bovey adhered with unflinching firmness, in spite of the grumbling of his more "practical" colleagues, to the necessity of a thorough mathematical training for engineering students; and as the excellence of McGill engineering graduates became known, they were so much sought after that Dr. Bovey used to have on his desk more offers of positions for his graduates than his entire graduating class could occupy.

As his success became evident, honours flowed in on him. He was given honorary degrees, was elected fellow of the Royal Society, honorary fellow of his college at Cambridge, and he was finally, in 1908, selected as first rector of the Imperial College of Science and Technology. At that time the faculty of applied science in McGill comprised more than 600 students, and was attracting men from all over America, and even from England. Alas! unknown to Dr. Bovey himself, the fatal disease which was to cut short his career had already fastened on him, and his short tenure of the rectorship of the Imperial College was a struggle against increasing ill-health until his resignation in 1909. Nevertheless he did the College invaluable service. Though a mathematician and engineer, his sympathies were not confined to those subjects; he took the broadest view of the possible services of the College to science, and gave cordial and effective support to the reorganisation and re-equipment of the biological departments of the College.

Dr. Bovey married in 1882 Miss Emily Redpath, a lady equally popular with himself, and a member of a leading Montreal family. He is survived by his widow, two sons, and three daughters. The elder son is pursuing a brilliant career at the Montreal Bar; the younger is a King's scholar at Westminster. No words could do justice to the attractiveness of Dr. Bovey's character. His sympathy, wise counsel, and practical helpfulness will long live in the memory of his friends, amongst whom were all the junior members of his staff in McGill, and especially those new to Canadian life. To those who, like the writer, were privileged to enjoy his intimate friendship, his death is an irreparable loss. E. W. M.

SIR WILLIAM ALLCHIN.

SIR WILLIAM ALLCHIN died in a nursing home in London on February 8, in his sixty-sixth year, some days after an operation and after several months of illness. The son of a doctor in Bayswater, he was, like his father, educated medically at University College Hospital. After being medical officer to the s.s. *Great Eastern*, which was employed in laying the submarine cable, he became assistant physician, and subsequently dean of the medical school at the Westminster hospital, with which he remained connected in the capacities of physician, consulting physician, and vice-president until his death. He was also consulting physician to the Victoria Hospital for Children, the Western Dispensary, and the St. Marylebone General Dispensary. He played a very active part in medicine in London, holding numerous offices and lectureships at the Royal College of Physicians, and at the Medical Society of London, of which he was president in 1901–2. He contributed articles mainly on abdominal diseases to standard works on medicine, such as Allbutt's "System of Medicine," Quain's Dictionary and the "Encyclopædia Medica," and edited, for Messrs. Macmillan, "A Manual of Medicine," in five volumes, the last of which appeared in 1903. His distinction as a physician was shown by his appointment as Physician Extraordinary to H.M. the King.

Sir William Allchin devoted much time and trouble to the University of London, and had an exhaustive knowledge of the tangled problems which have exercised medical educationists during the last twenty-five years. He was the representative of the Royal College of Physicians on the Senate of the University of London from 1902 to 1910, and probably his last appearance in public was as a witness before the Royal Commission on University Education in London in July, 1911, when he gave expression to his own views based on forty-five years' experience, during which he had been actively concerned in medical education and examinations.

At various times he examined at the Universities of London, Durham, and Glasgow, at the Conjoint Board of the Royal Colleges of Physicians and Surgeons, for the Naval, the Army, and the Indian Medical Services, and was also a member of the Advisory Medical Board of the Admiralty. He had a considerable knowledge of old medical books, and did much in arranging the library of the Medical Society of London, of which he was honorary librarian for eighteen years. He was also a high authority on precedence. He was not an original thinker or investigator, but his judicial mind, high standards, and conscientious devotion to the somewhat tedious work of committees have been of great value to the cause of medical education. H. D. R.

NOTES.

WE notice with the deepest regret the announcement of the death of Lord Lister, on February 10, in his eighty-fifth year. An account of his work appeared in our series of "Scientific Worthies" on May 7, 1896, and we hope to supplement this next week with a further appreciative statement of his services to science and humanity. The King has sent a message of sympathy to Lord Lister's family. Queen Alexandra and other members of the Royal Family have sent telegrams also, Queen Alexandra's message being in the following terms:—"Pray accept my most sincere sympathy in the great loss which the whole nation shares at the death of Lord Lister, whose name will ever be honoured and gratefully remembered as that of