living, (ii) in populating the rather vulnerable North Queensland, and (iii) in supplying the country with home-grown sugar.

The profits of the industry appeared to be better distributed than in most other countries and one marked feature was the fair number of factories owned by the growers themselves on a co-operative basis.

DIFFERENT STRAINS OF THE SAME DISEASE.

On the scientific side, discussions at the Congress brought out many points of interest. The papers presented indicated almost unmistakably the possible presence of different biological strains or pathogenic types of one and the same disease. This has an important bearing on the transport of new canes from one place to another and on the methods of disease-resistance trials.

USE OF *Saccharum Robustum* AS PARENT.

Saccharum officinarum when crossed with *Saccharum spontaneum* (male parent) doubles its chromosome on the mother side. No such doubling takes place when *S. officinarum* is crossed with *S. robustum.* This opens up a new line of work in Sugarcane Breeding so far at least as the tropical sugar world is concerned. Sugarcane breeding has gained greatly by the use of *S. spontaneum* as one of the parents. The use of *S. robustum* has not yet been exploited and there are indications from Hawaii that for Hawaii, at any rate, the use of *S. robustum* is likely to be useful. The delegates—including Dr. Brandes, the discoverer of *S. robustum*—saw in one of the Breeding Stations in Australia certain promising seedlings obtained from the mating with *S. robustum.*

MANY DISEASES KEPT UNDER FULL CONTROL

Similar interesting facts emerged from the discussions in the other Sections as well. But one fact which impressed the Congress as a whole was the very successful manner in which the various cane diseases had been controlled in Australia by suitable organization of control measures and growing resistant types. So efficiently has this been done that, though in the first circular it was mentioned that pathologists would have an opportunity to see many diseases, in the actual visits to the plantations it was difficult to get good specimens of the same.

The Congress was fortunate in having the presence of such a distinguished sugar-man as Dr. C. A. Browne, who was specially honoured by the Congress at its full session. The next Congress is to be in Louisiana in 1938 under the General Chairmanship of Dr. E. W. Brandes, the well-known head of the Bureau of Plant Introductions, United States of America.

The Shape and Size of the Earth.*

THE fundamental problem of geodesy is the accurate determination of the form of the Earth or the deviations of the actual geoid from the international ellipsoid and also study the dynamic causes that bring about a change in this form, the guiding principle being the principle of isostasy.

The problem of the determination of the form of the earth resolves into the following :—

(1) Observation of the mean levels of the sea ; therefore a study of the tides in the oceans at different places.

(2) Observation of the surface inequalities. This involves levellings to determine the height, etc., by means of spirit levels and telescopes.

(3) Determination of distances on the earth in different directions. This is done by a system of triangulations by means of chains of standard lengths made of invar to determine the distance of two stations along what is called a straight *base line.* A precision theodolite enables the position of a third station to be observed from the first two by noting from each the angular separation of the two other stations. This is extended through a large number of stations to those hundreds and thousands of miles distant. By assuming a mean form of the geoid the longitude and latitude (geophysical) could be measured with respect to a standard station, chosen centrally.

(4) Determination of the astronomical latitude by observation of the azimuths of two stars one on either side of the zenith, or vertical or plumb line, at the place of observation by means of telescopes.

(5) Determination of the astronomical longitude by observing the local time by the transit of stars over the meridian and simultaneously getting by means of accurately adjusted chronometers or time signals times

* The Survey of India, Geodetic Department, 1934.

from some place of reference whose longitude is assumed.

(6) Comparison of 4 and 5 with 3 gives an expression of the deviation of the plumb line, or of the direction of gravity from the vertical (the perpendicular to the international spheroid or whatever general geoid that fits best). This gives gravity level surfaces.

(7) The curvature of the plumb line measured by the torsion balance of Baron Ötvos. One type of this balance in which two equal weights are attached to the ends of a beam suspended at the middle with a quartz fibre gives the gradient of the gravity deflection along two directions. A second type in which one weight is above and the other equally below the beam enables the gradient to be measured in magnitude as well.

(8) Determination of the absolute intensity of gravitation at different places by means of pendulums.

(9) Determination of the intensity of gravity on sea, by means of a barometer to be read correct to 0·01 mm. and determination of boiling point of pure water to an accuracy of 0·001° C., in that with change of gravitational intensity alone the pressure read off remains the same, the boiling point however indicates the change.

(10) Purely astronomical measurements of the precession of the equinoxes. They enable the form of the earth to be calculated. If the earth were perfectly round, there would be no precession.

The determination of the accurate form is of utmost importance in the location of mineral resources such as ore. coal. oil, etc., even when hidden deep in the crust, because these minerals are pretty sharply distinguished from the rest of the crust by their density so that measurement of plumb line deflection gives the wanted clue. Almost every government has established departments of its own for such measurements. The Geodetic Branch of the Survey of India, Head Office Dehra Dun, is in charge of these measurements in India. The Survey of India is an old institution. The Great Trigonometrical Survey was started in 1800. From 1922 the annual reports are published in three separate volumes of octave size, *viz.*, (1) General Report which is confined to reporting the Survey operations of the ordinary field parties and detachments with only brief abstracts of Geodetic operations, and Map Publication and Office Work. Published annually. (2) The Map Publication and Office Work Report which contains all the Index Maps showing the progress of Map Publications on all scales, with reports on publications and issue. Published annually beginning with year 1924, price Rs. 3. (3) Geodetic Report which includes full details of all scientific work of the Geodetic Branch, Survey of India. From 1933 inclusive, the General and Map Publication and Office Work Reports have been confined into one report under the title of General Reports at Rs. 1–8–0.

Triangulation, levelling, gravity, deviation of the vertical and predictions of tides have been the main features of the Geodetic Reports of every year. Preparation for the international longitude project began in 1925–26 and was receiving the attention of the Department in years 1926–27 and 1934, magnetic measurements were made in 1925-26. In 1930–31, a Magnetic Survey was included. In the 1934 report (the latest) Chapter I, devoted to Triangulation and Base measurements, are given results of measurements of three base lines, one in Baluchistan, second in Poona and the third in Assam and the order of accuracy discussed (1 in about 600,000), the best hours for observation of the horizontal angles found to be either morning or evening. Levelling parties worked mostly in Burma and Northern Shan States. Late in the year three double detachments and eight single detachments were formed for levelling the Bihar Earthquake (Jan. 15, 1934) area. Bench marks showed shrinkages up to 4½ feet and only four cases of elevations were observed of which the largest is 0·029 feet. The largest sinkages occurred in structures which had presumably sunk into the ground, and the embedded bench marks generally show smaller change although one case of 2·7 feet was observed.

Chapter III gives the results of pendulum experiments for the intensity of gravitational attraction in Ceylon, and in the Maldive and Laccadive islands. Gravity results of Ceylon show a satisfactory agreement with the geology. They suggest that the tilted syncline (folding in ellipsoidal, paraboloidal surfaces with same sign for the principal curvatures) of the island is unsymmetrical as it is distorted in the region of the Adam's Peak. In the Maldives evidence supports the theory that those coral islands are formed by gradual subsidence of the ocean bed due to isostatic adjustment. Work at Minicoy leads to the interesting conclusion that the Laccadive islands are tectonically different from the Maldive islands.

Two detachments were employed on tracing sections of the geoid by means of stations at close intervals by observing both components of the deviation of the plumb line. One worked from Assam–Burma frontier through Bengal to Bihar. In 1934–35 it is expected to push this up to Agra and to observe in Sindh and Baluchistan. It is expected that by 1935–36 the whole section from Persia to Indo-China would be completed. The second detachment observed latitude only between Cape Comorin and Hyderabad (Deccan). The observations of the Siamese Survey have been made use of along with those of the Indian and the geoid calculated. The radius of curvature of the east-to-west section 2,500 miles long is 700 feet greater than that of the international spheroid, while the curvature of a 2,000 miles north-to-south section 1,500 feet less than that of the international spheroid. It is suggested that the geoid of South Siam is 100 feet higher than any geoid that fits in with those two arcs and that therefore South Siam shows some departure from isostatic equilibrium. This might lead to some earthquake in the near future.

In Chapter VIII on research notes, conversion maps are given showing the heights of the International Spheroid over the Everest Spheroid used by the Geodetic Survey, as well as over that of its spheroid II used since 1928. The short Chapter VI gives the value of longitude observed at Dehra Dun for the International project arranged by the Burma International de l' heure at Paris, working with four different instruments. Standardisation measurements are given in Chapter VII. Tide predictions from observations at 14 ports are given and the accuracy discussed.

B. DASANNACHARYA.

The Geology of Ceylon.*

THE island of Ceylon constitutes largely a continuation of the main geological formations of Southern India. Like the adjacent mainland it consists of large masses of ancient crystalline schists and narrow fringes of some of the later sediments deposited along the coastal strips.

Mr. J. S. Coates has recently published an account of the geology of the island, based on the results of his traverses over the greater part of the country, supplemented by numerous scattered observations which he had been able to make while engaged as Government Mineralogist. According to him nine-tenths of the island is occupied by the Archean crystalline schists with only a few narrow belts of sediments along the coast. The sequence of rock formations as given by the author is as noted below :—

Post Tertiary,
Miocene,
Jurassic,
Archean.

The *Jurassic* rocks are described as forming an insignificant series occupying a small area of less than a square mile in extent. They are found exposed near Tabbawa, at a distance of about 80 miles N.N.F. of Colombo, and form a series comprising of conglomerate, grits and sandstones, shales and nodular limestones attaining an estimated thickness of about 2,000 feet. The sandstones and shales are unfossiliferous, but impressions of a number of plant relics have been found in a clay bed. Amongst them, many of the identified species seem to be of lower Oolite and Upper Liassic horizons and correspond to the plant fossils recorded from the Madras Coast.

The *Miocene* rocks form the entire peninsula of Jaffna and they are also seen as narrow fringes in the north-west coast, extending to a width of about 10 to 12 miles inland. This formation consists mainly of fossiliferous limestone succeeded by a series of sandy argillaceous beds and mottled sandstones. The fossils from the Jaffna limestone include several identifiable species of molluscs and foraminifers. The palæontological evidence leads to the conclusion that this series of rocks of the north-west Ceylon are identical with similar rocks at Quilon in Travancore, and are of an older age than those of Karikal on the Coromandel Coast of India.

Pleistocene and Recent.—These post-tertiary formations consist of various types of coastal deposits, including sandstones, coral

* "The Geology of Ceylon," J. S. Coates. *Ceylon Journal of Science*, 1935, **19**, Sec. B, Part 2.