

ject that the discovery of this phenomenon of pre-determination has shattered almost all accepted beliefs about the fibre of cotton, and has at the same time coordinated the old data afresh into a straightforward story. The practical applicability of the results is slight, since every boll passes through a different life-history, on account of the continuous fruiting of the plant.

In 1913 a series of daily pickings was made from a group of pure-strain plants growing in field-crop conditions, over a period of ninety days, with parallel records of flowering, etc. The examination of these having been delayed by unavoidable circumstances, the present note has been prepared. It should be noted that this last material is unique in the history of long-staple cotton.

These results were obtained incidentally during my tenure of the post of botanist to the Khedivial Agricultural Society, and to the Egyptian Government at the Giza Cotton Experiment Station, 1904-13.

W. LAWRENCE BALLS.

NEW ZEALAND SURVEY.¹

THE report before us gives a full account of the work of the Department of Lands and Survey, New Zealand, for the year ending March 31, 1913. As in previous years, not only surveying, but also the direction of the magnetic observatory falls within its purview. Most of the work dealt with in the report has been undertaken in connection with cadastral requirements, and the higher grade work, which is termed "standard" survey, is in great request in town and suburban holdings, where land that could probably have been purchased sixty or seventy years ago for a mere trifle is now reported as having a value of 1200*l.* a foot. Under such conditions work of the highest precision is essential, but the new secondary triangulation is as yet available for a small part of the country only. This triangulation is the equivalent of second order triangulation, since the triangular error is kept below 6", and is usually considerably less. This is as much as can be expected from the instrument used, a 10-in. vernier theodolite, and the Conference of Surveyors-General supported the New Zealand Survey in the opinion that a modern instrument of higher class was indispensable. A standard bar of nickel-steel 10 links long has been obtained from the Société Genevoise, Geneva, as well as a comparator from the Cambridge Instrument Company for use with it. Both of these have been examined and verified at the National Physical Laboratory. Four bases, from 5.2 to 11.5 miles in length, have been measured since 1909, but only two are as yet part of the finally accepted triangulation.

In the magnetic observatory a new set of Eschenhagen-Toepler magnetographs were received at the end of 1912, and were installed at Amberley, thirty-four miles north of Christchurch.

Considerable assistance was given to the officers and scientific staff of the British Antarctic (*Terra Nova*) expedition, who took magnetic observations and determinations of gravity as controls to the work carried out in the Antarctic. The report also publishes ten seismograms of those recorded during the year by the Milne seismograph. Maps showing the progress of the work and extracts from Conference of the Surveyors-General of the Commonwealth of Australia, which was held at Melbourne in May, 1912, complete a report which is of much interest, and contains a record of much valuable work.

H. G. L.

¹ Report on the Survey Operations for the Year 1912-13. Department of Lands and Survey, New Zealand. By James Mackenzie, Surveyor General. Pp. 77+6 maps+5 diagrams. (Wellington, 1913.)

THE ENCOURAGEMENT OF RESEARCH BY THE CARNEGIE INSTITUTION OF WASHINGTON.

THE Year Book for 1913 of the Carnegie Institution of Washington is now available. The information provided in its 336 pages shows convincingly that there has been no relaxation of effort on the part of the trustees of the institution to administer wisely the funds placed at their disposal for the encouragement of scientific research, and that the results arrived at by the men of science who have received assistance are as promising and as full of interest as in previous years.

The following list shows the amounts of the grants made for the present year and the purposes to which they are being devoted:—

	£
Administration	10,000
Publication	12,000
Division of Publications	2,000
Departments of Research	137,929
Anthropology	4,000
Embryology	5,380
Minor Grants	18,980
Index Medicus	2,500
Insurance Fund	5,000
Reserve Fund	50,000
Exhibit at Panama-Pacific International Exposition	2,000
	<hr/>
	£249,789

The next table shows the departments of scientific investigation to which the larger grants were made by the trustees for the financial year 1912-13, and the amounts allotted from these grants by the executive committee during the year:—

	£
Department of Botanical Research ...	7,601
Department of Experimental Evolution ...	19,028
Geophysical Laboratory	15,600
Department of Historical Research ...	5,920
Department of Marine Biology ...	6,378
Department of Meridian Astronomy... ..	5,036
Nutrition Laboratory	9,310
Division of Publications (office expenses)	1,800
Solar Observatory	33,126
Department of Terrestrial Magnetism ...	42,053
Researches in Anthropology	1,400
Researches in Embryology	3,000

£150,252

The following extracts from the *résumé* of the investigations of the year included in the report of the president of the institution, Dr. R. S. Woodward, will give some indication of the work which has been initiated and encouraged:—

All the departments of research of the institution are now well-defined organisations, each of them independent of and more or less isolated from the others, and each of them devoted to a field which, while in some cases related to, does not encroach upon, the fields of others. Each of them possesses a degree of autonomy which calls for a corresponding degree of freedom in the character of their annual reports and accounts of progress.

Studies of the Salton Sea, carried on during the past seven years by the department of botanical research in collaboration with a number of contributing specialists, have been brought together during the year in a volume now in the press under the title "The Salton Sea: A Study of the Geography, the Geology, the Floristics, and the Ecology of a Desert Basin."

Among many researches carried on by the director, mention may be made of his cultivation of second and third generations of mutants arising from ovarial treatments of plants and resulting in further noteworthy morphological and physiological departures from the original parent stocks.

The work of the year in the department of experimental evolution records, among many other advances, additional contributions to the laws of human inheritance; the results of further and more conclusive studies of the transmission of traits in plants of the genera *Bursa* and *Oenothera*; and some preliminary indications of specially instructive investigations in the field of biochemistry. The director has divided his time between researches based on breeding experiments carried on at his station and studies of data bearing on human heredity collected under the auspices of the Eugenics Record Office, of which he is also the directing head.

In his annual report the director of the geophysical laboratory gives instructive accounts of the effects of pressure in the formation of minerals, of progress in the perfection of adequate appliances for calorimetric measures of minerals, of the factor of temperature in optical studies of crystals, of the results thus far obtained in volcano studies, and of the important economic investigations of the secondary enrichment of copper sulphide ores. It had been hoped that the signal success attending the studies of Kilauea a year ago might be followed up during the past year, but in this the staff has met disappointment, for the volcano has been inactive and gives no warning of renewed opportunities.

When the laboratory of the department of marine biology was established on Loggerhead Key, Dry Tortugas, Florida, now nearly ten years ago, Fort Jefferson, on an adjacent island, was an important base station of the United States Navy, and transportation to and from points on the Gulf coast was a matter of daily occurrence. In the meantime, however, this station has steadily diminished in importance, and is now virtually abandoned as a naval base. This change of conditions shifts the burden of transportation between the laboratory and the nearest port, Key West, about thirty miles distant, wholly upon the department; and the resulting increased cost and inconvenience have led the director to recommend a gradual transfer of his laboratory and activities to a more favourable site. Preliminary investigations indicate that such a site may be had in Jamaica, where health conditions and transportation facilities have been much improved in recent years, where the cost of labour and subsistence is low, and where such an international scope as best befits marine biology could be readily developed. It may be anticipated that definite plans for an advantageous change of site will be matured during the present year, and ready for submission to the board of trustees in December, 1914.

The extensive computations essential in the derivation of the great number of stellar positions observed at the temporary observatory at San Luis, Argentina, are going forward in the department of meridian astrometry at a favourable rate, so that the inclusive catalogue of precise positions for stars in both hemispheres may be expected in due time. Some instructive results of these computations, showing the stability of the San Luis meridian mark (mire), the diurnal variation of the clock corrections, and the changes of personal equation for day and night observations are given in the report. As in most lines of fruitful research, the work of this department is noteworthy for its by-products, or for contributions it is making to allied lines of inquiry. Obviously, a first requisite to a knowledge of stellar motions lies in

precise determinations of stellar positions at different epochs. The so-called proper motions of stars are thus brought to light, and from these it is possible to determine also the motion of our solar system. But now comes the surprising discovery that these proper motions, hitherto supposed to be of a random character, are of a systematic nature dependent in large degree, apparently, on the stage in evolution any individual star has reached and on the group to which it belongs. A new and peculiarly fascinating field is thus opened to astronomers of all kinds, and the by-products referred to seem destined to prove not less important than its primary object in positional astronomy. The world of astronomy, however, is anxiously awaiting the attainment of this object, as is well shown by the fact that the preliminary catalogue issued by the department three years ago is already out of print.

One of the noteworthy events of the year for the department of terrestrial magnetism is the completion of the second cruise of the non-magnetic ship *Carnegie*. She arrived in New York in February last, having been continually in service since June 20, 1910. The aggregate distance traversed in her two cruises is in round numbers 100,000 miles. The corresponding distance covered by the chartered ship *Galilee*, in the Pacific Ocean during 1905-8 is 60,000 miles. Thus the total distance traversed up to date in the magnetic survey of the oceans is 160,000 miles, or about six times the circumference of the earth. Accurate magnetic data have been obtained thereby in all of the oceans between the parallels of 50° north and 50° south latitude, or near the courses usually followed by vessels. By reason of the expedition attained in deriving from these surveys the results of chief interest to mariners, it has been practicable for chart-publishing establishments to make prompt revision of defective sailing charts or to issue corrections thereto; and a distinct improvement in these aids to navigation is already noticeable in the charts issued by the leading maritime nations. In the near future it is considered that the *Carnegie* should make surveys in areas not yet covered and along some stretches already traversed where cloudy or stormy conditions have prevented the securing of adequate observations. She will at the same time cross her previous tracks as often as practicable in order to determine for such intersections the information now most needed by chart-makers, namely, the annual changes in the magnetic elements.

In the near future it is anticipated that the department will have sufficient data to permit the construction of a new set of magnetic charts, including all three magnetic elements (declination, dip, and intensity), especially for that part of the globe included between the parallels of 50° north and 50° south of the equator. It will then be practicable to study the general problem of the earth's magnetism by aid of a large mass of homogeneous data surpassing in definiteness any mass hitherto available for this purpose. In anticipation of the need of experimental facilities for studies of this problem and others closely related thereto the office and laboratory building of the department was authorised a year ago and has recently been completed.

From the date of its establishment nine years ago the solar observatory has been one of the most important of the enterprises fostered by the institution. It has called for heavy annual appropriations; it has grown with extraordinary rapidity and with equally extraordinary productivity; and it is now an organisation of which the staff of investigators, research associates and collaborators, constructors, computers, designers, mechanicians, and operators includes upwards of sixty individuals. The report of the director

of the observatory has been described already (April 23, p. 201) so it need not be summarised here.

The complexity of the relations which research associates and collaborators sustain to the institution is so great as to preclude any comprehensive explanation within the limits allotted to an annual administrative report. Their work embraces a wide range of subjects, and varies in its conduct from individual independence to intimate collaboration with the departments of research and with the division of publications. During the past year more than twenty distinct fields of research have been cultivated, and a total of more than one hundred investigators have contributed to the output. Summaries of the work of associates proceeding independently are given by them in the Year Book.

THE TOTAL ECLIPSE OF 1914 IN TURKEY AND PERSIA.

ON account of the unfavourable weather prognostications for the approaching total eclipse of the sun throughout the European countries traversed by the track of totality, it seems particularly desirable that stations should be occupied beyond the Black Sea, nearer the sunset limit of eclipse, in eastern Turkey and western Persia.

The central line of the eclipse passes very nearly through Baiburt and Bitlis, just a few miles to the west of Lake Van, in the former country. In Persia it passes through Kermanshah and Khorremabad, to the south-west of Teheran, and through a point about midway between Persepolis and Dehbid, and slightly to the north-east of Shiraz, only a few miles distant from Bushire, a port in the north-east of the Persian gulf.

The desert character of a large part of this region would indicate that the probability of a cloudless afternoon sky in August is very good. Most of this region traversed by the shadow is quite elevated, some of it being as much as five or six thousand feet above sea-level; and this would, in large measure, if not entirely, compensate for the lesser altitude of the afternoon sun at local totality. Throughout the Turkish region the approximate local time of totality is 3h. 50m. p.m., the duration of total eclipse being about 120s. Throughout the Persian region the time is about 4h. 50m., with totality shortened to about 105s. As very little of the European track has a likelihood of less than 50 per cent. of cloud, it seems highly desirable that some of the observers now contemplating European location should undertake the extra journey into Turkey, at least in order to diminish, if possible, the chances of entire failure of the eclipse, such as befell astronomers in 1887, and was nearly repeated in 1896.

The region of western Persia is not especially difficult to reach by way of Batum, at the east end of the Black Sea, thence through Tiflis to Baku on the Caspian, thence to Resht on the south-west coast of the Caspian, whence Kermanshah is easy by caravan through Kazbin; or, better, first to Teheran to receive Government authority and facilities. Most of the roads of Persia would permit the use of wheeled vehicles only with difficulty. Allow four weeks from London or Paris to Teheran, and two weeks thence to Kermanshah. Camping outfit and subsistence for the most part should be taken along, as only chicken, fruits, and similar edibles can be depended on for the last stage of this journey. Roads are in part built, in part old roads and trails. From Teheran the best route is to Kum, and thence to Sultanabad and Kermanshah; also Bourodjird, quite a large town with a telegraph station, and the chief city of Luristan.

Summer clouds are said to be highly improbable. From Bushire to Shiraz and Persepolis is rather more than 100 miles by caravan, the particular drawback at this season being the intense heat, which renders travel exceedingly uncomfortable, except at night. There are telegraph lines traversing this region which would make it feasible for the eclipse observer arriving early in the field to check up his longitude as well as latitude, so as to make sure of being within a few miles of the line of central eclipse. Bushire is very accessible; the steamers of the British India Company are scheduled to sail from Bombay every Thursday; from Karachi every Saturday, and are due in Bushire on Wednesday. The Bombay steamers of the P. and O. are due to arrive at Bombay on Friday, and there is direct rail connection for Karachi, and while the British India steamers are scheduled to sail from Karachi on Thursday, if the English mails are late, the steamers will be held pending their arrival. Transportation from Karachi to Bushire is approximately 15h.

The Turkish region is very accessible from Trebizond. The eclipse is total at Trebizond itself, the line of exact centrality intersecting the coast a few miles west of Trebizond, about midway between that port and Tereboli. While at the coast towns themselves, including Plattana, Eskiefe, and Jaeboli, the chances of clear weather are not at all good, one can, by ascending the cliffs and entering the elevated tableland of the interior, select observing stations which apparently decrease in probable cloudiness, the farther inland one goes. Of course, there are no railways; but travelling so far as Erzerum, about 150 miles south-east of Trebizond, is not particularly arduous, because it is the first section of the early caravan route through Tabriz to Teheran. Wheeled vehicles are now possible so far as Erzerum, and packages of any size and weight required by the eclipse astronomer are not prohibited.

Probably the most detailed map of this region is Richard Kiepert's "Karte von Kleinasien," on a scale of 1:400,000, published in 1902 by Dietrich Reimer, Berlin. The sheets which should be consulted are AVI, Tirabzon, and BVI, Erzurum. Another good map is the "Map of Eastern Turkey-in-Asia, Syria, and West Persia," published by the Royal Geographical Society, 1910, and is accompanied by notes. Consult also "Zug des Zenophon bis zum Schwarzen Meere" (Karte ii.), Entworfen von E. v. Hoffmeister, accompanying "Durch Armenien und der Zug Zenophons" (1911) and "Wandkarte des Osmanischen Reiches," von W. v. Diest and Dr. M. Groll (Geogr.-Verlag, Berlin W. 35, 1911); scale 1:1,250,000.

Erzerum itself is within the belt of totality, though not far from the north-eastern edge of it, so that totality would not last more than a very few seconds there. Besides this, Erzerum is quite likely to be cloudy; and the same might be said of Bitlis itself, which is located in a sheltered valley. But about fifteen miles west of Bitlis begins the elevated tableland of Moush, which, according to the best information I have been able to secure from those resident in Bitlis, would probably be cloudless. At the time of the eclipse, this whole region rarely experiences any rain from the latter part of June until the middle of September. The atmosphere is very clear, being only a trifle cloudy during that season, and clear skies can be depended upon, although it is extremely hot.

Officers of the Turkish customs are not inclined to cause trouble over the baggage of travellers, and it is probable that the English and American Consuls would be able to get instruments passed without examination, especially if the observer brought a letter viséd by the Turkish Consul nearest his home.

It would be highly desirable, before leaving home,