iron sandwiched with ternary eutectic and then forging down to a ¼-in. sheet. This treatment squeezed out the excess of eutectic and left the juxtaposed faces perfectly united with a thin layer rich in phosphorus. After very slow cooling, sections were cut, polished, and etched. The structure was found to consist of "strings of disconnected patches of pearlite and straight lines of ferrite," very similar to those found in ship and boiler plates. All the carbon originally present in the eutectic was found to have diffused into the iron beyond the phosphoretic junctions Heating to 1350° C., however, followed by a three days' cooling period to 700° C., caused a uniform distribution of the carbon and phosphorus in the steel.

Dr. Stead's general conclusion is: "After careful study I am inclined to believe that if they"—*i.e.* ghost lines—"are not associated with a material amount of slag inclusions, they are not dangerous or liable to lead to the failure of engineering structures. I am led to that conclusion by submitting cross-sections to violent shock test, so that the stress applied is greater across the lines; for when this is done fracture does not start where they are located unless there are sulphide or slag inclusions in material quantity. The subject should have more consideration, and be thoroughly investigated by making suitable mechanical tests."

Only two aspects of Dr. Stead's publication have been touched upon in this article. The complete paper, however, should be studied by those who are interested in the presentation of the subject in a series of masterly and informing sub-papers which no one but he could have written.

H. C. H. CARPENTER.

THE SEISMOLOGICAL SOCIETY OF AMERICA.

FOUR volumes of the Bulletin of this society were completed with the last year. They contain many papers of interest and value, most of which have been noticed in these columns, and several —evidently the work of novices—which the Publication Committee might with advantage have suppressed.

The first part of the fifth volume, which has been issued recently, contains six papers, three of which are of general interest. Of the others, one on the seasonal periodicity of earthquakes is inconclusive. Mr. Carl H. Beal describes an earthquake which originated near the town of Los Alamos, in south-western California, on January 11 last. This is probably the first earthquake in which the long-distance telephone has been used in the collection of records. Prof. J. C. Branner insists on the untrustworthiness of personal impressions on the direction of an earthquake-shock, and he urges that, in investigations of an earthquake, the question dealing with such impressions should be omitted. It has long been known that single observations on the apparent direction of the shock or on the fall of a column, etc., are valueless, the apparent direction being almost invariably perpendicular to the principal walls of the house in which it is observed. But the average of a large number of personal observations within a limited area has been found in several cases to coincide with the direction of the area from the epicentre. Moreover, after the Tokyo earthquake of June 20, 1894, Prof. Omori measured the direction of fall of 140 stone lanterns with circular bases in Tokyo, and the average of these measurements coincides exactly with the direction of the single great oscillation registered in that city.

The first place in the number is given to Mr. Carl H. Beal's account of the Avezzano earthquake of January 13. The material of this paper is derived chiefly from newspaper reports and from a short article which appeared in NATURE (vol. xciv., p. 565), but the author adds an interesting note with regard to the origin of the earthquake. "The higher mountain ranges near Avezzano," he says, "rise to an altitude of from 6000 to 7000 ft. and trend generally north-west and south-east, the direction apparently being determined by a series of nearly parallel fractures which extends from a region south-east of Avezzano north-west to the vicinity of Cittaducale. . . A fault is known to pass through Luco, Cappelle, Sourcola, and very close to Avezzano, and as these cities were completely demolished, it is quite probable that movement along this fracture caused the shock."

On November 8, 1914, a fairly strong earthquake was felt in central California. From the duration of the preliminary tremors at Berkeley, and from the initial times at Santa Clara and the Lick Observatory, and taking the velocity for the tremors at Zeissig's value of 6·3 km. per sec., Mr. E. F. Davis finds that the epicentre was situated on the San Andreas Rift close to the town of Laurel. From a study of the distribution of intensity, Mr. Carl H. Beal had previously assigned approximately the same position for the epicentre. The San Andreas Rift is the great fault along which for 270 miles the movements took place which gave rise to the Californian earthquake of 1906.

Since 1832, there have, according to Mr. H. O. Wood, been twenty-five eruptions of Mauna Loa, in the south of Hawaii. With the majority of these no earthquakes are recorded, and this might also have been said of the last eruption which began on November 25, 1914, had it not been for the instrumental record of a large number of feeble shocks. Mr. Wood concludes that "nothing appears in the sequence of events which would have justified confident, or definite, *prediction* of outbreak," though the numbers of shocks recorded during the five preceding weeks were one, five, sixteen, thirteen, and thirty-eight.

C. DAVISON

INDIAN GEODESY.[1]

THE two volumes referred to below supplement one another, for while the general report gives an abbreviated account of the year's work, more detailed descriptions and the discussions of the results obtained find their place in the Records.

Pendulum observations were made at fourteen stations between lat. 20° N. and lat. 30° N., all in the immediate neighbourhood of the 78th meridian, thus filling in the gap which existed between Lieut.-Colonel Lenox-Conyngham's work from Mussoorie to Meerut, and that of Captain Cowie in the Central Provinces. The stations include that of Kalianpur, the station of origin of the Indian triangulation, and here the pendulums were swung in the same room where Captain Basevi swung his pendulums in 1867. At Dehra Dun the new pendulum room was used. Some changes have been introduced in presentation of the results; Helmert's formula of 1901 is employed instead of that of 1884, which had been used previously; also the formula for the mass correction has been modified by taking somewhat smaller values for the mean surface density of the

[1] "General Report on the Operations of the Survey of India during the Year 1912–13." By Colonel S. G. Burrard, C.S.I., R.E., F.R.S. (Calcutta, 1914.)
"Records of the Survey of India." Vol. v., Reports of Survey Parties, 1912–13. (Calcutta, 1914.)

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earth and the mean density of the earth as a whole, viz.: 2·67 and 5·576, in place of 2·8 and 56·6.

In August, 1913, two members of Dr. de Filippi's Karakoram Expedition swung their pendulums at Dehra Dun, and thus a new independent value for gravity at Dehra Dun will be obtained when the expedition has returned to Genoa.

No officer being available, the determination of astronomical latitudes was not undertaken during this season.

Work was carried on in the principal triangulation, and twenty-two triangles of the Sambalpur series were observed, the standard of precision being well maintained in spite of the difficult and inhospitable character of the country traversed. A network was also observed as the control for a large-scale survey of Bombay island, and as a further stage a traverse network of considerable precision was utilised. Permanent marks were placed on brass plugs which were built into masonry a foot below ground, and a special device was introduced for accurately centring the theodolite over the mark. Linear measurements were made with a 100-ft. steel tape, which was strained by means of weights suspended over pulleys. The precision of the lines of the traverse network when adjusted to triangulated points is given as 1 in 12,000.

Some 180 miles of the Indo-Russian triangulation connection, which had been reconnoitred in the previous year, were observed, and the work satisfactorily concluded.

In levelling details are given of carrying lines, of levelling across rivers, both by the "target" and by the "vertical angles" methods, and their respective advantages are discussed.

In the winter of 1912–13 a delimitation of the boundary between Nepal State and Naini Tal district was carried out. The boundary consisting of three straight lines joining four predetermined points in forested country, it was found most convenient to run an accurate traverse near and approximately parallel to the boundary line, so that from the traverse points could be located on the boundary line, and be determined. The result was quite satisfactory, and boundary pillars were erected along the line.

Dehra Dun having been dispensed with as a meteorological station, the forenoon and afternoon observations have been discontinued, and others at 2 p.m. (standard time) have been substituted. With similar simultaneous observations taken at Mussoorie, it is hoped to gain information bearing on terrestrial refraction which will be useful in the work of the survey.

Besides the points which have been mentioned there is much detailed information of value and importance to surveyors and geodesists in these volumes, which represent a large amount of work of a high standard carried out during the period under review.

H. G. L.

THE FLY PROBLEM.

IN a pamphlet published by the Zoological Society, entitled, "The Fly Campaign," and in a public lecture delivered at the Zoological Society's offices, Prof. Lefroy has dealt with the problem of the house-fly and its allies, less from the purely scientific point of view than from the practical and economical aspect.

The pamphlet discusses flies generally, their importance and occurrence; the life-history of the house-fly is dealt with in detail; the eggs and where they are laid, the maggot, its habits, appearance, and its migration; the pupæ, the adult, its appearance, food, reproduction and the total period of its life.

A separate section describes the feeding habits of the fly, to show why and how it is such a carrier of disease, and what a repulsive intruder it is to houses; the hibernation and flight of flies is separately discussed, and a section deals with other flies than the house-fly which are found in houses.

Dr. C. J. Martin has written a section on flies as carriers of disease, which need not be summarised in view of the article on this subject in NATURE of May 13.

The pamphlet then deals with "Methods of Destruction," including the treatment of "tips" and manure, the protection of hospitals and houses, and the use of fly-traps. It concludes with a bibliography.

In his lecture at the Zoological Society's offices on June 2 Prof. Lefroy illustrated his remarks with lantern slides, largely made from the posters and illustrations used in the Fly Exhibition at the Zoological Society's gardens; these bring home vividly what flies do, how they actually feed, what the connection is between the fly feeding on human excreta and the spread of typhoid or summer diarrhœa.

In the lecture Prof. Lefroy expressed his personal opinion on many points, and especially on the question of the treatment of manure. Elaborate experiments are in progress, and already a method has been obtained which is one-third the cost of borax and water, and of far more general application. Naturally this has to be elaborately tested, but the lecturer was extremely hopeful of a solution of this problem, by far the most important in regard to the prevention of flies.

Equally elaborate experiments are in hand with regard to baits, with great promise of success; and success means a good bait that may be obtained and used in the campaign this summer.

Prof. Lefroy's lecture was illustrated by more than sixty lantern slides, many made from large wall pictures prepared for the Fly Exhibition by Miss Bertha Reid. Arrangements have been made to reproduce the lecture with the slides at any town in England that wishes it. The exhibition at the Zoological Society's gardens is popular, and will bring home to many the importance of flies and the simple ways of dealing with them.

JAMAICA AS A CENTRE FOR BOTANICAL RESEARCH IN THE TROPICS.

NO botanist should be content until he has visited some tropical area, and studied its flora on the spot. The tropical region most readily accessible from Great Britain lies in the West Indies; and as Jamaica now offers special facilities at the Cinchona station, recently leased by the Jamaican Government to a committee of the British Association, the time is opportune for explaining the advantages it can provide.

The public gardens controlled by the Jamaican Department of Agriculture are seven in number. Of these only three are botanic gardens in the strict sense, viz., the Hope Gardens near Kingston, the Castleton Garden, and the Cinchona Plantation, or Hill Gardens, in the Blue Mountains.

The first of these lies on the Liguana Plain, just beneath the foothills of the Port Royal range, at an elevation of 650 ft., and about six miles from Kingston. It comprises an area of 200 acres, with a mean annual temperature of 76° F., and average rainfall of 54·5 in. The gardens contain a large and varied collection of typical plants of the tropics, together with economic and ornamental plants, and many species of academic interest. The office, which constitutes the headquarters of the Agricultural Department, contains a good working library, and an in-

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