superior to that obtainable elsewhere. The two older universities are also to be the chief centres for research.

The Commissioners further approve of loans to local authorities for afforestation of suitable land, *e.g.* water catchment areas.

Some advance has been made in matters comprised under the remaining headings of the report, namely :—

III. *Land Drainage and Reclamation.*—One Irish scheme (Owenmore) approved.

IV. *Rural Transport.*—Considering the vital importance to small holders and others of this matter it is astonishing to find that only a very few applications, all Irish, have been received. No grants were recommended.

V. *Harbours.*—The Commissioners make a number of important recommendations, on the lines indicated in an earlier part of this review.

VI. *Inland Navigations.*—Technical difficulties retard this direction of advance, but loans are recommended for improvement of the Stort and Upper Medway.

VII. *Fisheries.*—Substantial grants to various authorities are recommended, partly for scientific research, and partly for improvement of harbours, and other purposes. Concessions to Irish fishermen by way of loans are also recommended.

VIII. *Miscellaneous.*—An application by the Meteorological Office was not entertained.

IX. *Compulsory Orders for the Acquisition of Land.*—Only one small and unimportant order has been made.

Within the limits of our space it is impossible to deal with the last part of the report, which is devoted to finance, but it is stated that in all cases the Commissioners "have tried to follow sound principles of finance and administration, to take a broad view of the questions involved, and to avoid any haphazard and spasmodic distribution of public money."

The Commissioners may be congratulated on having made very considerable progress during the year, and the principles of their action appear to be fairly sound, though they are somewhat handicapped by the unusually small proportion of scientific experts to be found among them. It is, however, very gratifying to know that the whole time of Mr. A. D. Hall is in future to be given to development work. Now and then we find that a sound principle advocated is not worked out satisfactorily in practice by the responsible authority. For example, on p. 11 of the report we read that the grants available from various resources "will provide for utilising to the full the energies of the Agricultural Colleges in teaching, in research, and in giving technical advice to farmers on practical difficulties involving problems which are beyond the scope of either an experienced agriculturist or even a member of the County Staff." Yet a grant of 1000*l.* per annum for advisory work in horticulture and agriculture has been made to the University of Bristol, none of which has been allocated to the associated Royal Agricultural College at Cirencester, the pioneer institution, accustomed to give the kind of advice contemplated for nearly seventy years. The progress made as regards cooperation and rural transport is disappointingly slow, considering the great importance of these for enabling farmers to cope with foreign competition, but the Commissioners can scarcely be blamed for the delay. Ultimately, we may hope to see a substantial reduction in the enormous sums paid to foreign countries for agricultural products.

RECENT PUBLICATIONS ON THE FERTILITY OF THE SOIL.

RECENT inquiries have shown that the fertility of agricultural land in Europe has very materially increased owing to the use of commercial fertilisers and green manuring, but it has often been stated that this increase is effected at the expense of virgin lands. Mr. Coventry therefore instituted an inquiry in India to see if there is any evidence of a progressive decline in fertility there. The results are published in vol. vii. of *The Agricultural Journal of India*, and show that the average of productivity may have become lower, but this can be entirely explained by the fact that inferior lands have been taken into cultivation on account of the great agricultural prosperity and expansion brought about under British rule When allowance is made for this it is seen that the fertility is not declining, but rather tends to increase.

It is, however, undeniable that phosphoric acid and potash are removed from the soil in the crop and transferred to the centres of population. Impoverishment of the virgin soils necessarily takes place, although the productiveness is not affected until lack of these particular nutrients becomes the limiting factor in crop production. This position has been reached in parts of the United States, and has induced Prof. Whitson and his colleagues at the Wisconsin Experiment Station to undertake a valuable set of investigations on the effect on the soil of rock phosphate, which fortunately is readily obtainable. In the admirable surveys of Wisconsin now being made by Dr. Weidman it is shown that continued cropping has caused phosphate exhaustion, which can be remedied by dressings of rock phosphate.

The other side of the question, the increased phosphorus supply to land near cities, is very well seen in many parts of England, and has recently been strikingly illustrated by Messrs. Hughes and Aladjem in a paper in *The Agricultural Journal of Egypt* (vol. i., part ii.). Analysis of soils taken from various places in the Delta showed that certain spots were much richer in phosphates than usual, although in other respects the soils were fairly uniform. Detailed examination of one of these cases showed that the authors were working on the site of an ancient city where a considerable population had existed for a period of at least four thousand years before the Arab domination. To supply such a population and the animals belonging to it with food must have required the produce of a large area, while the refuse of the city would be used as manure only on the nearer land. The city and its population have long since vanished, but the concentration of phosphoric acid in the soil remains an indelible record of the past :—

Distance from the centre of Kom, kilometres ...	0–1	1–2	2–3	3–4	4–5
Total phosphoric acid, per cent.	0·34	0·29	0·26	0·22	0·22
Easily soluble phosphoric acid, per cent.	0·086	0·069	0·065	0·051	0·036

Nitrogen compounds are also transferred, like phosphorus compounds, but they take part in a perpetual cycle in which the nitrogen of the air plays a part, so that the accumulation and depletion processes are both limited. Much work is being done on this cycle; in particular, investigators in all countries are finding that addition to the soil of easily oxidisable organic substances, such as sugar,

conditions a notable fixation of atmospheric nitrogen. Indeed, in tropical countries where sugar-cane is cultivated, molasses are sometimes actually added to the soil for this purpose. The action of the sugar is not entirely simple, however, and Peck has shown that in Hawaii it may actually do harm by bringing about a marked decomposition of the nitrates (Bull. No. 39, Hawaiian Sugar Planters' Association).

It is, however, now realised that soil fertility is not wholly a matter of plant food, but may be limited by the presence of harmful substances in the soil. This phase of the problem is being investigated by Schreiner and Skinner, who have recently published (Bull. No. 77, Bureau of Soils, U.S. Dept. of Agriculture) a detailed account of the action of coumarin, vanillin, and quinone on plant growth. The general research of which this forms part consists in isolating from the soil such organic compounds as can be identified, and then trying their effect on plant growth.

It would be a mistake to suppose that the medium on which the soil organisms live and which is in contact with the plant roots is the inert mineral matter that constitutes the bulk of the soil. Recent investigations have brought into prominence the colloidal constituents that occur in notable quantity and appear to be distributed over the surfaces of the particles, and apparently impart to the soil many of its characteristic properties. On general grounds, it might be expected that these colloids would be much altered by the addition of small quantities of soluble salts, and the experiments of R. O. E. Davis (Bull. No. 82, Bureau of Soils) have justified this view, and have shown in what way the changes affect the physical properties.

The re-establishment of vegetation on devastated areas presents many important problems, and much interest attaches to a paper by W. N. Sands on the return of vegetation and the revival of agriculture in the area devastated by the Soufrière eruption in St. Vincent, 1902–3. The paper is published in the West Indian Bulletin, vol. xii., No. 1, and is well illustrated. Vegetation now flourishes wherever the old soil remains, even when a considerable admixture of ash has taken place. The ash itself, however, is unsuited to vegetation, and where no soil is present vegetation is very scanty. Once, however, plants begin to get a footing improvement speedily takes place, as the substances formed on their decay furnish supplies of plant food. In dealing with the agriculture, it is noted that yields are now in some cases higher than formerly; this result is attributed to the heating of the soil by the lava, and is discussed in the light of recent work at Rothamsted.

E. J. R.

UPPER AIR INVESTIGATIONS.

WITH the beginning of this year the Meteorological Service of Belgium completed its hundredth international balloon ascent, and the director, M. Vincent, considered this to be a suitable occasion for communicating to the Royal Academy (*Bulletin de la Classe des Sciences*, 1912, No. 6) some of the data deduced therefrom. The complete results are included with those obtained in other countries in a special publication compiled by the president of the International Commission for Scientific Aëronautics and elsewhere.

The recording apparatus used is the Bosch-Hergesell baro-thermo-hygrograph, and this is suspended to the smaller of two rubber balloons, coupled in tandem and inflated with hydrogen gas. The larger balloon bursts at a variable height, and the rapidity of the fall of the apparatus is slackened by the smaller balloon. This remains floating as soon as the apparatus reaches the ground, and serves as a signal to its whereabouts. After making allowance for accidents, ninety-two of the records obtained remained available for examination. The highest altitude reached was 32,430 metres (determined from the pressure and temperature curves by means of Laplace's formula) on June 9, 1911. The lowest level of the principal inversion was recorded at 6890 m. on November 3, 1910, and the highest at 13,760 m. on August 2, 1906. The lowest temperature, −73·5° C., was registered on February 2, 1911, at 10,390 m., at the level of the inversion.

M. Vincent distinguishes three regions in the atmosphere accessible to instrumental observation:—(1) An upper one, which has been called the stratosphere, where the decrease of temperature is nil, or replaced by an increase; (2) an intermediate zone, where the decrease is at the rate of 0·7° C. per 100 metres, whether the conditions be cyclonic or anticyclonic; (3) a lower stratum of variable depth, where the decrease is less than 0·7°, and is frequently negative; some remarkable inversions are quoted in this portion of the atmosphere. These two lower zones are known as the troposphere. The conditions obtaining in the stratosphere are essentially different from those in the lower regions; the strata are nearly in statical equilibrium, the wind velocity usually weakens, and the direction is uncertain, but the author shows that there are important exceptions to this rule. The trajectories of some of the highest ascents determined by means of a special theodolite designed by M. de Quervain have been discussed.

The Royal Observatory of Batavia has recently published an important contribution to our knowledge of the upper air, including observations made (1) with kites and captive balloon at Batavia between November, 1909, and September, 1910; (2) with kites in the Java and South China seas in January, 1910; and (3) with manned balloon in the years 1910 and 1911. It was during the descent of a balloon on August 5, 1911, that the leader, Lieut. A. E. Rambaldo, unfortunately lost his life. A preliminary report upon these investigations was published in the Proc. Amsterdam Acad., June 25, 1910, and referred to in NATURE of November 3 of that year. Among the results of the kite observations we note that the amount of aqueous vapour per cubic metre over Batavia decreases with height, even in the lowest strata. The decrease of temperature with height, up to 1000 metres, is less in the west than in the east monsoon; between 1000 and 2000 metres it is about equal. Over the ocean the decrease is considerable between 0 and 200 metres and exceeds 1° C. in the first 100 metres; above 500 metres it is less than at Batavia. Above 1400 m. the temperature is higher than at Batavia, and the difference probably increases at heights beyond 3000 m. The diurnal change of the vertical temperature gradient differs over land and sea.

THE Supplement to the Monthly Weather Review of the Canadian Meteorological Service for 1911 contains a preliminary account of the results of the investigation of the upper air over Ontario by means of balloons and kites commenced during that year; a full description of the apparatus and methods employed, together with a more complete discussion, is reserved until a longer series of observations has been obtained. Registering balloons were liberated on the evenings preceding the "international" days, and the results are given for each 0·5 km. of height, with intermediate points if there were any noteworthy