the crop yields consistently follow the chief analytical figures, and especially the ammonia. Again, stable (horse) manure is said to be more liable to loss on keeping than cow manure. Recent experiments show that horse manure loses much less nitrogen than cow manure during storage for periods of three or four months. The chapter on garden remedies and insecticides is likely to be very useful this summer, when pests of all kinds are unusually active. E. H. R.

The World and its Discovery. By H. B. Wetherill. Part i., *Africa*, pp. 119. Part ii., *Asia*, pp. 99. Part iii., *America*, pp. 131. Part iv., *Australia*, pp. 62. (Oxford: At the Clarendon Press.) Price 1s. each.

MR. WETHERILL has a story of surpassing interest to tell, and he succeeds in conveying, by means of the accounts of the work of the chief explorers, a succinct summary of the main features of the geography of the four continents other than Europe. Told in this fashion, with the emphasis on the lands and their peoples, the geography of the remoter continents becomes vivid, and thus appeals to the pupils with a sense of reality; experience with this book leads to these conclusions. For example, the characteristics of the people and the lands near the Gambia and the Niger gain in precision and definiteness in relation to the travels of Mungo Park; and the gradual development of the story of the conquest of the Central Australian desert provides a useful account of the control exerted upon life on the earth by the absence of rain in a hot region.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Formation of Dust-ripples.

LAST evening when returning from a visit to the trenches I noticed an interesting illustration of the formation of dust-ripples. A battery of field-guns had been placed nearly parallel to a road some 2000 yards behind the lines. Owing to the continued fine weather the roadway was covered by a coating of fine dust. The guns were about 100 yards from the road, on lower ground, and pointing so that the shells just cleared. The battery had been in action all day. There was very little wind and no traffic over the road during day-time. The whole surface of the road in front of the guns was covered by a series of small ripples at right angles to the direction of the guns. The ripples were about 1/12 in. apart, from east to west. They were evidently caused by the explosive wave passing over the road. The same effect can be produced by discharging a Leyden jar across a spark-gap near a card on which some light powder has been sprinkled, or by tapping sharply a piece of parchment stretched tightly over the end of a lamp-glass containing fine powder. H. U. G. (C.F.).

France, August 10.

A Sunset Phenomenon on July 22.

REFERRING to the sunset phenomenon seen on July 22, and described in NATURE of July 27, it seems probable from information kindly sent by various correspondents that the clouds seen were somewhere in the neighbourhood of Plinlimmon. If this were the case, the height of the tops of the clouds would have been from 18,000 to 18,500 ft., and the two clouds would have been about eight miles apart. A correspondent who watched the sunset from Minchinhampton Common reports that no clouds were visible from there, but even from so far west the altitude of clouds at a height of 18,000 ft. over Plinlimmon would not have exceeded 1° 40′, and they would have only been visible if the horizon were a good one and the atmosphere very clear. In asking for information from Ireland I was casting my line too far; the top of a cloud the height of which is 24,000 ft. (which is probably high for a cumulo-nimbus in these latitudes) would not be visible more than 190 miles away. The distance of Plinlimmon from Farnborough is 154 miles; clouds at such distances can probably only be seen when the sun sets behind them in an otherwise clear sky. C. J. P. CAVE.

Meteorological Office, South Farnborough, August 14.

The Utilisation of Waste Heat for Agriculture.

WITH regard to Mr. Carus-Wilson's fear (NATURE, July 27) that the heating of the earth will multiply pests, one may point out that earth-warming is already greatly used. Large areas of land are covered by glass to maintain a high temperature, and land is also heated directly for forcing rhubarb. One may conclude that farmers would welcome further means for heating the land if the expense were not too great.

If the waste heat from electricity stations were used in the manner I have suggested, it would still be possible to remove the heat during winter months to destroy pests, if this were found desirable, or we could even cool the ground artificially.

I would like to mention here Prince Kropotkin's astonishing book, "Fields, Factories, and Workshops," in which he shows that agriculture may be speeded up in a way that would surprise most people who look on farming as an almost non-progressive industry. In it the author states that even in France, with its abundant sunshine, growers are experimenting with the direct heating of the soil, and if found an advantage there, surely it would be even more so in this country. C. TURNBULL.

Electricity Works, Tynemouth, August 4.

A Peculiar Thunderclap.

THE writer would suggest as an alternative explanation of the peculiar thunderclap described by Mr. Don (NATURE, August 17) at different places within the circumscribed area he mentions that probably the lightning discharges were not from cloud to earth, but in the reverse direction, from a large area of ground heavily charged relieving itself at several points simultaneously. H. O. F.

ENGINEERING EDUCATION AND RESEARCH IN RELATION TO THE ORGANISATION OF BRITISH ENGINEERING INDUSTRY.

THE Manchester Engineers' Club, which was established about three years ago, includes among its members most of the leading engineers in South-East Lancashire. During the first winter of the war a series of debates was held in

the club on problems connected with the future of British engineering. About Easter, 1915, a committee was appointed to bring together some of the suggestions which had most commended themselves to the club in the course of these debates. The committee met weekly during the summer of 1915, and in November last presented its report to the club. This report was unanimously adopted.

A number of members of the club then formed themselves into a "Council for Organising British Engineering Industry," and proceeded at once to secure the support of engineering firms in the neighbourhood of Manchester. At the present time, almost every important engineering concern in the Manchester district, and all but very few throughout South-East Lancashire, have promised their support to the movement. Moreover, the professional societies which have been approached by the Council have replied sympathetically, and have, for the most part, promised their active co-operation.

The time has come for the extension of the movement so as to make it of national dimensions. Steps have already been taken to extend its activities to the Midlands, where influential support is assured. Meanwhile, the British Engineers' Association has been moving in a similar direction. The fusion of the two movements appears to be imminent. When that fusion has taken place, the process of organising British engineering industry should proceed more rapidly still.

The report which led to the establishment of the Council for Organising British Engineering Industry began by pointing out that the development of British engineering export trade had been highly unsatisfactory for some years, while Germany had been making rapid progress. The report suggested that Germany's success had been due "to education, to co-operation, and to organisation in manufacturing and selling, backed up by adequate financial support; in Britain, on the other hand, education" had been "unsystematic, organisation weak, and co-operation between competing firms almost non-existent." The committee concluded that every British engineer ought now to realise that his British competitor in some markets must be his friend and ally in others; and that, in short, the time had come for the federation of British manufacturing engineers so as to organise the industry. The report proceeded to describe in outline the association of manufacturing engineers which the committee would like to see formed. The co-ordination and development of education and research were given prominent places among the functions of the proposed association.

Since the adoption of the report and the establishment of the Council, the question of engineering education and research has continued to receive attention. In evidence given on behalf of the Council to the Board of Trade Committee on the Iron, Steel, and Engineering Trades, special emphasis was laid upon the Council's view that, without the co-operation of engineering manufacturers in the education of engineers and without a great increase in the volume of engineering research, no amount of organisation could place the British engineering industry on a permanently satisfactory basis. The Board of Trade asked for further particulars of the Council's proposals in regard to education and research. The Council accordingly appointed a committee to report further upon this matter. The following is a summary of the committee's recommendations, which have been approved by the Council and forwarded to the Board of Trade:—

1. The organisation of British engineering industry, by the federation of British manufacturing engineers, for purposes which include education and research. Such a federation should co-operate with governing bodies of schools and colleges, as well as with education authorities, in providing a satisfactory system for educating engineers; with universities and colleges in testing and research; and with the Government in conducting a central research institution specially equipped for investigations with which existing research laboratories are unable to cope.

2. The co-ordination of the existing means for educating engineers and, in particular, the provision of an adequate and more uniform system of scholarships. To this end, the number of local education authorities for the highest education should be much reduced, correspondingly larger areas being assigned to each.

[This recommendation was supported by an appendix showing the number and value of the university scholarships at present offered by various local education authorities. It appeared from these figures that a candidate's chance of winning such a scholarship largely depends upon the particular town in which he happens to live.]

3. That a large number of "junior technical schools" be established for the education between twelve and fifteen of boys who intend to become apprenticed to engineering trades.

4. That all apprentices under eighteen years of age be required to attend part-time classes for, say, eight hours a week during works hours; but that this be subject to certain exceptions in the case of young people who continued in attendance at secondary or junior technical schools up to at least fifteen years of age.

5. That the instruction given to trade apprentices in these part-time classes be reformed so as to relate it more closely to the apprentices' everyday work and so as to include what are known as citizenship subjects—for example, economic history; and that, where a sufficient number of apprentices is employed by the same firm, such classes be conducted in that firm's own works and by the works staff.

6. That the specific education given to future members of the highly trained staff be provided in a university or college of university rank for the majority, who should be enabled to continue their studies up to twenty-one or twenty-two years of age; and in a "senior technical school" for the minority, who may have to enter engineering works at eighteen.

7. That boys who are to study engineering in a university should carry their study of mathematics and physical science to a higher stage before leaving school, and that, in general, the education of a boy at school, instead of being entrusted (as in some modern secondary schools) to six or seven specialist teachers whose business it is to advance his know-

ledge of an equal number of separate subjects to a uniform level of mediocrity, should be in the hands of a succession of form masters, who, knowing their boys well, may exercise a profound influence upon their characters and carry to a high level their studies in a more coherent curriculum.

8. That the conditions for admission to universities should be reconsidered and rendered more uniform as between different universities and less uniform as between different faculties and different honours schools in the same university; and that, in the interest of candidates of mature age and of other candidates approaching the university otherwise than through the normal avenue of the secondary school, university entrance tests should be distinguished from secondary school examinations.

9. The reform of university teaching in certain important respects, notably by a reduction in the number of lectures.

10. That the completion of a three years' university course in engineering should entitle students to no more than the B.A. degree; and that, until candidates have added works experience to academic training, they should not receive technical degrees (such as Bachelor of Engineering or Bachelor of Technical Science) which might then serve as professional qualifications.

11. That any time spent in works between school and college should not be unduly prolonged.

12. That university teachers be encouraged to undertake research on behalf of, and in co-operation with, manufacturing firms; and that additional Government grants be paid to universities and colleges with this end in view.

13. That, by the establishment of such an association of manufacturing engineers as we have advocated and by other means, the volume of research work carried out in connection with the British engineering industry be greatly increased; and that provision be made for this increase in the volume of research by fully utilising and extending the facilities already available in universities and colleges, as well as in the works of private firms, and also by establishing a central research laboratory for investigations that cannot be undertaken elsewhere.

The report was accompanied by a diagram illustrating the scholarship system recommended by the committee. This diagram differs but slightly from one reproduced in NATURE of October 21, 1915 (vol. xcvi., p. 214).

J. C. M. G.

THE OPTICAL INDUSTRY IN FRANCE.

A SERIES of articles by various authors has recently been appearing in the *Revue générale des Sciences* on the methods to be adopted for the development of French trade after the war. Amongst these have appeared two articles (May 30 and June 13) by M. A. Boutaric on the French optical industry and its future.

He points out that before the Napoleonic wars France had been dependent on England for its optical glass, and it was as a result of the British blockade that its manufacture was commenced in France.

At the present time the house of Parra-Mantois manufactures practically all the special optical glasses made by Schott and Co., and the French makers undoubtedly are more successful than their competitors in the manufacture of the glass discs required for very large astronomical mirrors and objectives. In every branch of optical science French physicists have invented instruments and methods for testing their qualities, but the French manufacturers have not done themselves justice by an efficient catalogue propaganda. M. Boutaric, when referring to the firm of Zeiss, mentions especially that it "has surrounded its products with a scientific propaganda." He shows how severe the German competition in microscopes was before the war, although there are two good French makers—Nachet and Stiassnie. The metallurgical microscope of Le Chatelier has been developed by Pellin with considerable success. The polarimeter in its present commercial form was developed by the French makers Soliel and Laurent, and is essentially a French instrument, yet the German houses have almost obtained a monopoly in the sale of the instrument outside France.

The manufacture of binoculars is the most successful of all the French optical industries, several large firms (Balbreck, Baille-Lemaire, Société française d'Optique, Société des Lunetiers, etc.) being employed in their manufacture. As showing the large quantity of optical glass used in these glasses, it is stated that the Société des Lunetiers alone use about 200,000 kilos of glass annually.

Although French makers showed several prism binoculars of the Porro type at the 1867 Exhibition, yet the manufacture of these glasses passed almost entirely to Germany. Now, however, glasses equal to the best German models are being made in France in large numbers for her Army and those of her Allies. The original supremacy of the French photographic lens has passed away, because, in the opinion of M. Boutaric, the French makers did not use the new glasses and modern grinding methods, nor sufficiently avail themselves of skilled technical knowledge. M. J. Richard has developed with great skill and success a stereoscopic camera, the "Verascope," and also a very rapid camera shutter, but the majority of the cameras used in France have been imported. The kinematograph, the invention of a Frenchman, Prof. Marey, has been carried to a high state of perfection by the firms of Lemaire, Pathé, and Gaumont. To a certain extent France is dependent on outside sources for kinematograph film, but, on the other hand, she exports finished printed film to the annual value of 600,000*l*. The lighthouse industry, built on the theoretical work of Fresnel, is a successful one, although it has had to face keen competition from English and German makers.

M. Boutaric points out that although in nearly all optical matters French savants are the pioneers, yet the French optical industry is very small as compared with the German. In an interesting paragraph he endeavours to analyse the reasons for this success. "Here, as in everything else, the Germans have been saved by their deep sense of business. The German industry demonstrates by