paratively brief report, and does not depreciate the efforts of the various contributors.

As outstanding features in the various reports, the following may be mentioned. Considerable space is devoted to the Bragg method of investigating crystals by means of X-rays, both by Dr. Dawson (general and physical chemistry) and by Mr. T. V. Barker (crystallography and mineralogy). An interesting discussion on phosphorescence is included in Prof. E. C. C. Baly's report (inorganic chemistry). Prof. J. C. Irvine contributes a very readable account of the year's researches on the aliphatic organic compounds, whilst homocyclic compounds are dealt with by Dr. F. L. Pyman, and heterocyclic compounds by Dr. A. W. Stewart. More than half of Prof. F. G. Hopkins's report (physiological chemistry) is devoted to the important subjects of "The Alkaline Reserve of the Body" and "Some Aspects of Nutrition." Dr. E. J. Russell writes on the year's agricultural chemistry in his customary lucid manner and emphasises the value of the present co-operation between farm and laboratory.

E. H.

## 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.*]

### A Proof that any Transfinite Aggregate can be Well-ordered.

THE following sketch of a proof which seems to me to be not wholly unimportant is given here for certain reasons of priority. I hope that this short account is not unintelligible.

Hartogs's (*Math. Ann.*, lxxvi., 1915, 438–43) considerations may be generalised without difficulty to an investigation of the consequences of the existence of a least ordinal number which is greater than the ordinal types of all possible well-ordered series that can be constructed out of a given aggregate M. This consideration throws no light on whether or not any one of these series actually exhausts M, unless we assume that of two different cardinal numbers one is greater than the other. Instead of using Hartogs's method, I consider all those parts of M which can be well-ordered, well-order them in all possible ways, so that they form what may be called for shortness "chains of M" (so that the same part in different orders gives different "chains"), and imagine as put on one side all chains which are "segments," in Cantor's sense, of other chains of M.

At this point we must introduce a definition: Given a chain (K) of M, let us say that a class K′ of chains of M is a "class of direct continuations of K" if each member of K′ has K as a segment, and also, if L is any member of K′ of type $\lambda$, those members of K′ which are of type less than $\lambda$ are segments of L. Such a class K′ evidently defines one chain and not a class of independent chains, such as Hartogs considers.

Now, in the above process of imagining, we do in fact have a remainder of chains which are not segments of others; for, if not, all chains of M would be segments of other chains of M, and then we could show indirectly that for any such chain K, any ordinal number $\gamma$, however great, and any class K′ of direct continuations of K, there is a segment of K′ of type $\gamma$. In fact, if there were not such a segment, there would be at least one definite example of each of $\gamma$, K, and K′, such that no segment of K′ is of type $\gamma$; and thence we can easily show that not every chain of M is a segment of others. But we can prove (*Phil. Mag.* (6), vii., 1904, 61–75) that there is no series which has segments of any ordinal number $\gamma$, however great. Thus there is at least one chain of M which is not a segment of some other. It is easy to prove that this chain exhausts M, and that there is a least type of those of chains that exhaust M. Thence, from the fact that the cardinal number of M is an Aleph, we can deduce Hartogs's theorem, determine the form of the limit that Hartogs was really trying to find, and prove Zermelo's (*Math. Ann.*, lix., 1904, 514–16; lxv., 1908, 107–28, 261–81) "principle of selection."

PHILIP E. B. JOURDAIN.

The Bourne, Basingbourne Road, Fleet, Hants, March 12.

### Future Supplies of Laboratory Apparatus and Materials.

I HAVE been looking at my list of apparatus and materials which the chemical dealer tells me must wait until the war is over before they can be obtained from Germany. I regret to say the list is a formidable one; I had to add to it this week. Few in our generation will ever knowingly purchase goods made in Germany if they can be obtained from other countries. We feel that German goods must appear to be smeared with the blood of our relatives and countrymen. I take it that my position is much the same as obtains with the heads of other laboratories in the country. Surely, therefore, it is time our British manufacturers realised that it is not much use tinkering with laboratory glass and porcelain ware, if the thousand-and-one other forms of laboratory apparatus have to be purchased in Germany after the war. It seems reasonable to suppose that the orders for laboratory glass and porcelain ware are bound ultimately to accompany the orders for the other requisites.

X. Y. Z.

### Long-range Guns.

BY a slip of the pen, double velocity was said, in my article in last week's NATURE (p. 65), to give double range, instead of fourfold.

At that rate, an increase of the velocity of our gun in 1887 would be required from 2400 to 6000 ft. per sec. to make the range grow from 12 miles to 75.

The rule is, of course, not exact except when air resistance is not taken into account. The 12-mile range would have been nearly trebled if it was not for the resistance of the air.

G. GREENHILL.

1 Staple Inn, W.C.1, March 30.

## LONG-RANGE GUNS.

THE appearance of a gun with a range of something like seventy or eighty miles has naturally aroused considerable interest, and the question is often asked as to how such long ranges are attained. The answer is that if the shot is to travel far it must get outside the atmo-