

ments, was found to be practically independent of the voltage between 0 and 8 volts. When once a magnetic field had been applied, of sufficient strength to stop all the slow-moving electrons, a large increase in its value had no effect on the magnitude of the positive charge. I think these experiments undoubtedly show that the α particles do carry a positive charge, and that the previous failures to detect this charge were due to the masking action of the large number of slow-moving electrons emitted from the plates.

Observations were made under different experimental conditions, and with very concordant results. In one set of experiments a weight of 0.19 mg. of radium bromide was used, spread on a glass plate, which was covered with a thin sheet of aluminium foil; in the other 0.48 mg., spread on an aluminium plate. The saturation current due to the latter plate, measured between parallel plates 3.5 cm. apart by means of a galvanometer, was found to be 7.8×10^{-8} amperes. It is possible that the failure of Prof. Thomson to detect the positive charge carried by the α rays from radio-tellurium was due to the smallness of the effect to be measured; for with the plate of radio-tellurium in my possession, the current was only about 1/40 of the above value.

Since the film of radium bromide is so thin that all the α particles escape from its surface, it is easy to deduce from the observed charge from a known weight of radium the total number of α particles expelled per second from one gram of radium bromide. Taking into consideration that half of the α particles were projected into the radium plate, and assuming that the α particle carries the same charge as a gaseous ion, it was deduced that one gram of radium bromide emits 3.5×10^{10} particles per second. Now the activity of radium bromide in radio-active equilibrium is four times this minimum, and contains four products which emit α particles at the same rate. It is thus probable that one gram of radium bromide in radio-active equilibrium emits 1.4×10^{11} particles per second. I had previously deduced (*loc. cit.*), from indirect data, the value about 1.1×10^{11} , so that the theoretical and experimental numbers are in very good agreement.

I have also made experiments, by a special method, to determine the total number of β particles emitted from one gram of radium bromide in radio-active equilibrium, and have found a value about the same as the number of α particles emitted at its minimum activity. It is thus seen that four α particles are expelled from radium for each β particle. The number of β particles obtained by Wien was much smaller than this, but, in his experiments, a large proportion of the more slowly moving β particles was absorbed in the radium itself and in the envelope enclosing it.

The number of α particles expelled per second from one gram of radium is a most important constant, for on it depends all calculations to determine the volume of the emanation, and of helium, the heat emission of radium, and also the probable life of radium and the other radio-elements.

E. RUTHERFORD.

McGill University, Montreal, February 10.

Compulsory Greek at Cambridge.

THE conclusion to be drawn from Mr. Bateson's letter seems to be that it is useless to compel candidates to get up subjects for which they have no aptitude, or in which they take no interest. The glories of "another world," whether in science or art, are reserved for those that can see them, and a bright boy, not to say a dull one, is unlikely to discover the beauties of compulsory Greek, if he happens to have a distaste for dead languages. But is it not rather a narrow view which recognises only one new world and the entrance to it through compulsory Greek? It is said of a great creative mathematician that surveying his subject from a high pinnacle of abstract thought, he exclaimed, "And we too are poets"; but the most enthusiastic would scarcely expect this feeling to be aroused by compulsory mathematics in a dull boy; it does not seem to have occurred even to an exceptionally bright one.

Sullied, as Mr. Bateson seems to consider mathematics, by a degrading usefulness to "trade and professions," it nevertheless remains of essential importance to nine-tenths of our scientific work, and most of those of us who have but little of it sigh that we have not more. Mr. Bateson himself has

not disdained its assistance in his work on breeding and heredity.

The point of previous letters is not that the writers had no aptitude for Greek, but that they found it useless to them in the studies to which they devoted their life. German is indispensable; soon we shall have to read Russian too, and if a man is to keep abreast of his subject he must not only read German, but read it with ease, so great is the bulk of literature to be got through. Arbitrarily to compel a boy to learn Greek, which, if he does not appreciate it, will be perfectly useless to him, when he might be learning German, which, whether he likes it or not, is indispensable for the full pursuit of his scientific studies, seems to be one of the cruellest conceivable tyrannies of pedantic folly. Could there be greater intellectual waste, and could any means be designed more likely to defeat the end for which it is designed? Compulsion and education are terms as opposed philosophically as they are etymologically; let the student be encouraged to work at the subjects he has really at heart and he will proceed from one success to another, and may even find his training in natural science leading him to the higher things in Greek literature.

But since the most natural classification of candidates would seem to be into those having a tendency to exact thought—who will naturally gravitate towards mathematics, and those with a love of art—who will naturally aspire to literature, and those with a little of both—who will be given over to natural science, why not allow a first class in any two of the three to count as a pass? such a measure would prove a great relief both to congenital non-mathematicians and non-linguists.

Finally, why should a want of sympathy with Greek, the noblest language of the noblest literature the world has known, be imputed to those who think that it is too good a thing to be wrested to injurious purposes? X.

If Mr. Bateson's case is that of hundreds, I make bold to say the case of the boy who wastes hundreds of hours on Greek grammar is that of thousands.

We do not want to abolish compulsory Greek because it has no value in the market, but because, stopped where the boy who takes it no further than the Little-Go stops it, the study of Greek has no value, ninety-nine times out of a hundred, in the forming of an active, living intelligence.

Mathematics may have contributed nothing to the formation of Mr. Bateson's mind; it is not unlikely, though it is deplorable. But if Mr. Bateson seriously thinks that elementary mathematics contributes no more than elementary Greek to the sound training of an average mind, surely he is curiously destitute in experience of the run of faculties in a young human being. This explanation of Mr. Bateson's astonishing argument suggests itself the more readily, because his idea that Greek is one of the things that put "one touch of art in the life of a dull boy, and open his eyes to another world," appears absolutely grotesque.

The narrow (and conspicuously *unintelligent*) utilitarian idea of education represented by Mr. Bateson's "intelligent lady" must be fought with all our strength, but it cannot be fought successfully with the rusty sword of Mr. Bateson's reactionary classicism. That is a weapon which will break in our hands and leave us defenceless to the spoiler.

A. G. TANSLEY.

New University Club, London, S.W., February 23.

MAY I be permitted to suggest, with all deference, that Mr. Bateson's statement that his knowledge of mathematics is "*nil*" must be taken *cum grano*! He is now, I believe, largely engaged in the business of counting chickens before they are hatched. How could he do this without some mathematics? As a matter of fact, the research in which he is engaged involves mathematical conceptions of no mean order, yet I presume he knows something about his subject.

Mr. Bateson's letter might be a good argument in favour of lowering the mathematical standard in the previous examination. But, as he uses it, it is merely an unusually frank example of the reasoning which is the real support of compulsory Greek, *viz.*, "When I was a little boy the big boys bullied me; now that I am a big boy myself I mean to take it out of the little ones!"

EDWARD T. DIXON.

Racketts, Hythe, Hants, February 24.