instance, the view taken in Herr Dedekind's book, "Was sind und was sollen die Zahlen." As regards the opening sentences of Chapter xv., the authors have apparently misunderstood the point of my objection. With the usually received definition of convergence of an infinite product, $\Pi(1 - a_n)$, if convergent, is different from zero. So far as the passage quoted goes, $\Pi(1 - a_n)$ might be zero; and it is therefore not shown to be convergent, if the usual definition of convergence be assumed. As to the passage quoted from p. 232, I must express to the authors my regret for having overlooked the fact that the particular rearrangement, there made use of, has been fully justified in Chapter viii. Whether $\log x$ is or is not, at the beginning of Chapter iv., defined by means of a string and a cone, will be obvious to any one who will read the whole passage (p. 46, line 16, to p. 47, line 9) leading up to the definition.

W. BURNSIDE.

The Tetravalency of Oxygen.

THE discovery of the new and easy method of preparing the pure oxygen phosphide OP_4 (or Le Verrier's phosphorus suboxide) by the acidification of the solution of phosphorus in "alcoholic potash," should draw attention to the remarkable fact that the oxygen atom can be therein symmetrically represented *only* as tetravalent and not divalent, and that it is probably an inorganic, non-carbon, closed-ring molecule:—

Without discussing the valency or "validity," as I have termed it, of phosphorus, my point is that oxygen is here tetravalent. The silver analogue (?) OAg_4 , or

is known. And doubtless others. There ought, therefore, to be no further hesitation in definitely accepting the oxygen atom in the CO molecule as tetravalent, and in proceeding with investigations which shall elucidate, in terms of physical chemistry, the remarkable fact of the "alternating valency" of the non-metallic atoms. Oxygen has as clearly two valence values as phosphorus and nitrogen.

The change in the valency of oxygen seems to be connected with "polymerisation." In 1888 I wrote in the *Philosophical Magazine*, vol. xxv. p. 232:—

"The stimulus—if I may so term it—to polymerisation in these cases seems to be due to the development, in ways that current research are seeking to explain, of the higher valency, or, as it may be preferably termed, the validity of oxygen, or the tervalidity, for instance, of chlorine in "hydrochloric acid solution" used as "a polymeriser," $H-Cl = \dots$. It is significant that there are few cases of polymerisation where oxygen is not concerned. . . . Probably more ring formulæ in inorganic bodies will come to light, and they will affect the maypole hypothesis—as it may be called—of the domination of the central polad atom."

This prediction has, I believe, since been verified, and the benzene-ring style of Kekulé is no longer viewed as exclusively characteristic of carbon. The remarkable volatile osmium compound is probably

where oxygen is tetravalent as it is in Friedel's $(H_3C)_2OCH$.

I would, therefore, venture to suggest that possibly my two papers in the *Phil. Mag.* may still be worth half an hour's attention from gentlemen who would find some curious compounds therein discussed—compounds whose physical chemistry may perhaps now be found worth examination in the light of the newer methods, and also in the light of the developing investigations concerning the ether and the intra-molecular equipoise of the atoms constituting the chemical molecule.

Banbury, March 25.

J. F. HEYES.

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THE PROGRESS OF WIRELESS TELEGRAPHY.

WE recently referred to the first messages transmitted over the English Channel between the South Foreland and Boulogne by Marconi's system of wireless telegraphy. During last week the English station was visited by Prof. Fleming, who has written his experiences to the *Times*.

An idea of the present state of the problem can be conveniently gathered from this communication. First as to the certainty of the results obtained, Prof. Fleming states:—

"Throughout the period of my visit messages, signals, congratulations, and jokes were freely exchanged between the operators sitting on either side of the Channel and automatically printed down in telegraphic code signals on the ordinary paper slip at the rate of twelve to eighteen words a minute. Not once was there the slightest difficulty or delay in obtaining an instant reply to a signal sent. No familiarity with the subject removes the feeling of vague wonder with which one sees a telegraphic instrument merely connected with a length of 150 feet of copper wire run up the side of a flagstaff begin to draw its message out of space, and print down in dot and dash on the paper tape the intelligence ferried across thirty miles of water by the mysterious ether."

Signor Marconi by much work has arrived at great simplicity.

"With the exception of the flagstaff and 150 feet of vertical wire at each end, he can place on a small kitchen table the appliances, costing not more than 100*l.* in all, for communicating across thirty or even one hundred miles of channel. . . . The distance to which effective signalling extends varies as the square of the height of the rod. A wire 20 feet high carries the effective signal one mile, 40 feet high four miles, 80 feet sixteen miles, and so on."

We are very glad to print the following extract from Prof. Fleming's letter:—

"The general public are not much concerned with questions of priority or with the claims or suggestions of rival experimentalists, but they are interested in ascertaining the serious possibilities of that which has been actually achieved. Signor Marconi has never hesitated to acknowledge that he has built upon the foundations laid by others, but a vast gulf separates laboratory experiments, however ingenious, from practical large scale demonstrations conducted with all that regularity and freedom from failure which is the absolute condition of their public utility."

"I cannot help thinking that the time has arrived for a little more generous appreciation by his scientific contemporaries of the fact that Signor Marconi has by minute attention to detail, and by the important addition of the long vertical air wire, translated one method of space telegraphy out of the region of uncertain delicate laboratory experiments and placed it on the same footing as regards certainty of action and ease of manipulation, so far as present results show, as any of the other methods of electric communication employing a continuous wire between the two places. This is no small achievement."

There can be no doubt that what this system will do in the future for those who live on coast-lines or go down to the sea in ships is destined to be of great importance. Already the usefulness of light-ships is increased tenfold. The fleet manœuvres of the future may be flagless. Sea routes by means of an international concert pitch may be turned into exchanges—but there is no end of the possibilities thus opened out by this new development of the results of the study of the "useless."

Prof. Fleming, in the course of his long and interesting letter, points out the importance of some new Board of Trade regulations "for the use of the ether"—the term is distinctly good—lest vagrant electric waves should interfere with the official ones. Even the ether, then, may yet be dismissed with costs.