

of English inventive genius. The over-shadowing influence of the recent sensational inventions of the telephone and phonograph have led even practical men to believe that inventive power had crossed the Atlantic, but no one who reads Mr. Culley's book can fail to learn how much has been done in England. Though duplex working was revived by Hearn, and quadruplex made practical by Edison, neither was invented in America. On the other hand, Hughes's beautiful type-printer was born in America, but it was developed in Europe, and its birthplace knows it not. Thomson's syphon recorder, Varley's double-current translator and condenser working, Bain and Wheatstone's automatic systems, fast-speed translators, and all the valuable systems and apparatus in use for testing have sprung from here, and are well described in this work. The Post Office telegraph system, in its technical department, is a credit to this country and a pattern to the world, and it possesses on its staff some of the most practical electricians of the day. Messrs. Preece, Lumsden, Marson, Gavey, and Kempe are well known everywhere, and though their labours are not acknowledged by Mr. Culley, it is well known that they have contributed materially to establishing the telegraphic system of the Post Office. It is especially in developing the automatic system and in establishing fast-speed translators that the Post Office officials have been so successful. A relay station in Anglesey has increased the rate of working [between London and Dublin from 70 to 120 words per minute. Translating relays working at the rate of 120 words per minute are quite new in telegraphy. Mr. Culley has given scant justice to Mr. John Fuller for his new form of bichromate battery, a battery that is coming into very extensive employment for all purposes. It is a zinc-carbon couple, the exciting fluid being Poggendorff's mixture. Its peculiarity consists in the shape of the zinc, which is permanently inserted in a bath of mercury. Its electromotive force is double that of a Daniell's cell, its constancy wonderful, its economy great, and its cleanliness and freedom from smell all that can be desired.

This work is deservedly popular, not from its literary merit, but from the position of the author and from the great mass of very valuable practical information it possesses.

OUR BOOK SHELF

Manual of the Vertebrates of the Northern United States, Including the District East of the Mississippi River and North of North Carolina and Tennessee, Exclusive of Marine Species. By Prof. D. S. Jordan, M.D. Second edition, Revised and Enlarged. (Chicago: M^cClurg, 1878.)

THE object of this volume is to give collectors and students a ready means of identifying the families, genera, and species of the vertebrate animals of North America. Following the usage of botanists, the author has adopted the system of artificial keys to the classes, orders, families, genera, and species, while use has been freely made of every available source of information. The account of the mammals has been chiefly compiled from Prof. Baird's work, and Dr. Coues has given great assistance in the part relating to the birds; while in this edition the account of the fishes has been entirely re-

written in order to include the results of recent investigations in that department. The fact that a work of this nature should in two years' time call for a second edition, is, indeed, a proof of the interest taken in natural science by the American people. This edition seems to fairly represent the present state of knowledge.

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. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The Phonograph and Vowel Theories

SEVERAL letters have appeared in NATURE bearing on the subject of the phonograph, and referring to our first communications upon the subject. We are glad to see that our statement as to the reversibility of consonants (NATURE, vol. xvii, p. 423) is generally accepted. We feel that as yet the phonograph does not speak with sufficient clearness to determine how perfect this reversibility is, and that the effect of many minute parts of articulate utterance cannot be heard with any certainty. Mr. Ellis, in his first communication, ranked the phonograph somewhat too low, but we are more than satisfied with the acknowledgment in his second letter (vol. xviii, p. 38). Mr. A. M. Mayer and Prof. Sylvanus Thompson both speak of the marks on the tinfoil as differing according to the distance of the mouth from the diaphragm. We do not observe any effect of this kind and see no theoretical reason for any alteration in the relative phases of the simple tones with a change of distance from the mouth. Mr. Mayer seems here to have fallen into an error. We find ample confirmation of Helmholtz's statement that the phase relation between two constituents is not appreciated by the ear. Each person usually, but not invariably, adheres to the same phase relation on one pitch, but different people pronouncing the same vowel with approximately the same constituents, combine these differently, which, as Mr. Mayer says, would make reading the marks on the tinfoil a very difficult matter.

With reference to the letter by Mr. C. R. Cross which appears in NATURE, vol. xviii, p. 93, we adhere with much confidence to the opinion that the five vowels, *a e i o u* (Italian), pronounced in succession, are by contrast at least thoroughly distinguishable when the instrument is run at various speeds, such as to reproduce the sounds at all the pitches within the compass of the average human voice. That no marked change is produced in the relative values of the vowels is confirmed by the fact that neither in public nor private exhibitions do the hearers of sentences alternately run slow and fast suggest that the vowels have changed with a change of speed. This alone would be a sufficient proof that *oh* does not change into *ae*, as we understand Mr. Cross to say, and there is no ground, according to Helmholtz's theory, for expecting that it would. To us the relative sounds of the vowels at various speeds seem at least as perfect as those obtained from Willis's well-known experiment, where a succession of vowels is suggested by contrast when the length of a resonating tube is altered.

We do not, however, think that our instrument speaks with sufficient distinctness to warrant our expressing an opinion as to the constancy of quality of any single vowel when the instrument is run at various speeds.

Some *ohs* remain apparently very constant, and at times we thought that other *ohs* became brighter or more like "awe."

Sometimes we thought *awe* became very like "ah." We should be glad to learn the impressions of any of your readers as to this point.

We venture, however, to remind any one trying the experiment that a low note followed by a high one suggests a change from *u* (Italian) to *i*. Thus if we whistle a low note and then the octave to it or a note near this, the ear is easily persuaded that the whistle resembles *u i*, but if now, beginning again on the note we just thought was *i*, we go up another octave, the new sequence again suggests *u i*, although the very note which was last taken to represent *i* now stands for *u*. If, therefore, we wish to judge what a sound really is we should not trust much to contrast, especially when a change of pitch is involved in the comparison.