243 symbols, made up of 192 elements, 14 vowel diphthongs, 4 consonant diphthongs, 19 modifiers, and 11 other signs. It has been reduced to the smallest possible number suitable for giving a notion of the kind of symbolization required for universal alpha­bets. The list from which it was extracted contained double the number and was still incomplete, even so far as the writer’s in­vestigations had extended. A universal alphabet would probably require a thousand cases to be provided for. It would be difficult for even the inventors to use such an alphabet, and absurd to present it for practical use. Inventors have therefore had recourse to *radical* signs symbolizing what they consider the principal relations and modifiers of these radicals. Some, as Brücke, Merkel, Bell, and Sweet, use entirely new characters, of which Bell’s and Sweet’s are intended by their shape to recall the positions of the organs of speech in uttering the sounds represented. But these writers are not agreed either as to the shape or value of the radicals themselves. The modifiers are very various, and when more than one modifier is required the characters become too complicated for the eye and hand to deal with them rapidly. Universal writing is still a philosopher’s stone, though much has been learned in its pursuit. Palaeotype is of course a mere typographical makeshift.

Fortunately writing long preceded phonetic knowledge. The number of distinct sounds in any one language seldom exceeds fifty, and practically fewer still are needed, for a native needs only a broad hint of the sound to reproduce it. The signs for English in art. 1 are rather superabundant than deficient, and the small ad­ditions of foreign signs suffice for French, German, and Italian practically, though very deficient scientifically. In fact, the modes of combining sounds in those three languages and English are so different that the alphabet has to be differently conceived for each. This is the final breakdown of universal writing. An English, German, French, and Italian reader, each requires an alphabet founded on his own linguistic habits, and very insufficiently com­prehends any other. But even a rough appreciation for linguistic purposes is better than the thoroughly false appreciations now current. To obtain a scientific foundation for erecting an alphabet of any language which shall have scientific value, five stages are needed :—(1) the perfect acquisition of a series of words containing every sound used ; (2) variation of each word by involving its sounds in different combinations to appreciate the effects of gliding juxtaposition ; (3) the perfect acquisition of short sentences of different characters to understand the effects of construction and emotion ; (4) the study of unrestrained conversation between natives from the phonetic point of view ; (5) frequent writing from the dictation of natives and teaching others to read by the signs adopted after the first four stages are passed. How far the charac­ters should indicate the positions of the organs of speech is another point, which need not be considered at first, and can only be ac­complished with extreme roughness even at last. Thus Bell’s capi­tally conceived and executed “visible speech” requires much ex­planation to be intelligible and after all tells but little. Any signs easy to write and distinct to read without wearying the eye will suffice, provided each be furnished with a full explanation (much longer and more explicit than the greatly condensed explanations of art. 20) not only of its separate but its combined power, and the requisite knowledge for furnishing these cannot be obtained without much and long-continued labour. Mr Sweet’s studies of Danish, Swedish, Russian, Portuguese, and North Welsh pronuncia­tion are models in their way, especially the last, but suffer from extreme conciseness.

The use of such phonetic studies is principally philological, a much smaller amount of precision sufficing for all the purposes of ordinary life,—understanding speech and speaking intelligibly, writing speech from dictation and reading what is written. Our scientific knowledge of speech-sounds has really only just com­menced, and is therefore extremely incomplete and confined to very few people. But what has as yet been learned is of great practical value in the reduction of unwritten dialects and languages to writ­ing, in exhibiting the actual speaking habits of existent written tongues, in divining the intention of systems of writing employed in extinct languages, and hence in historically tracing the cogna­tion and filiation of one language to another and the successive forms assumed in the gradual development of a single form of speech. These great applications of the study of speech-sounds, as well as the practical introduction of systems of spelling easier to read and write than those now found in most of Europe (including European America) and Asia, lie beyond the scope of this article, which only aims at showing in extremely condensed terms the foundations of the theory of their combinations and some of their most important and best known forms.

*Bibliography.—-*Subjoined is a list of the principal works on the subject since 1S44 inclusive, in alphabetical order of the writers. E. Behnke, *Mechanism of the Human Voice,* 3d ed., 1882 ; Behnke and Brown, *Voice, Song, and Speech* (see Brown) ; A. Graham Bell, “ Vowel Theories,” in *Amer. Jour, of otology,* July 1879 ; A. Melville Bell, *Visible Speech,* 4to, 1867 ; Id., *Sounds and their Relations,* fls. 4to, 1881 ; Prince L. L. Bonaparte, “Vowels and Consonants,” in Ellis’s *Early English Pronunciation* ; Id., “Portuguese Simple Sounds,”in *Trans. Philol. Soc.,* 1880-81; Id., “Simple Sounds of ail living Sclavonic Languages,” *ibid.;*

Lennox Brown and Emil Behnke, *Voice, Song, and Speech,* 1883 (with photo­graphs of living vocal chords) ; Ernst Brücke, *Grundzüge der Physiologie und Systematik der Sprachlaute,* 1st ed. 1856, 2d ed. 1876 ; Id., *Neue Methode der phonetischen Transcription,* 1863 ; Johann Czermak, “ Physiologische Unter­suchungen mit Garcia’s Kehlkopfspiegel,” in *Vienna Acad. Math.-Phys.,* vol. xxix., 1858; Id., “Spiritus Asper und Lenis, Flüsterstimme, Kehlkopilaute,” *ibid.,* vol. lii., part v.; F. C. Donders, *De Physiologie der Spraakklanken,* 1870; Alexander J. Ellis, *Alphabet of Nature,* 1844-45 ; Id., *Essentials of Phonetics,* 1848 (printed in phonotypy) ; Id., *Teacher's Guide to the Reading Reform* (intro­ducing·“ glides”), 1853; Id., “ Palaeotype,” in *Trans. Philol. Soc.,* 1867; Id.,*Early English Pronunciation,* parts i. and ii. 1869, part iii. 1871, part iv. 1874 in progress ; Id., “Accent and Emphasis,” in *Trans. Philol. Soc.,* 1873 ; Id., *Pronun­ciation for Singers,* 1877 ; Id., *Speech in Song,* 1877 ; W. R. Evans, “Phonetic Outlines,” in *Spelling Experimenter,* 1S84, vol. ii. ; Ewing (see Jenkin) ; S. S. Haldeman, *Analytic orthography,* Trevelyan prize essay, 1860 ; H. Hale, “ Doubtful or Intermediate Articulations,” in *Jour. Anthropol. Inst.,* February 1885 ; H. Helmholtz, *Tonempfindungen,* 1st ed. 1862, 4th ed. 1877, 2d ed. of A. J. Ellis’s translation, “ Vowel Theory,” 1885 ; Fleeming Jenkin and J. A. Ewing, “ Harmonic Analysis of certain Vowel Sounds," in *Trans. R. Soc. Edin.,* 1879, vol. xxviii. ; Ch. Joret, *Du C dans les langues Romanes,* 1874 ; J. P. N. Land, *Uitsρraak en Spelling,* 1870 ; R. G. Latham, *English language,* 4th ed. 1855, vol. ii. part iii., “Phonesis”; James Lecky, “Irish Gaelic Sounds,” in *Proc. Philol. Soc.,* June 1884 and May 1885; R. Lepsius, “Chinesische und Tibetische Lautverhältnisse,” in *Trans. Berlin Acad. Sci.,* 1860; Id., “Die Arabischen Sprachlaute und Sclavisches *y," ibid.,* 1861 ; Id., *Standard Alphabet,* 1863 ; J. A. Lundell, “Det Svenska Landsmälsalfabet,” 1879, part of *Nyare Bidrag till Kännedom om de Svenska Landsm&len,* 1878, Stockholm ; C. L. Merkel, *Anthropophonik,* 1857 ; Id., *Functionen des menschlichen Schlund- und Kehl-Kopfes,* 1862; Id., *Physiologie der menschlichen Sprache* (Laletik), 1866; G. Michaelis, *S-Laute,* 1863 ; F. Max Müller, *Languages of Seat of War in East, and Missionary Alphabet,* 1855 ; James A. H. Murray, *Dialect of Southern Counties of Scotland,* 1S73 ; H. Nicol, “Diphthong *au,* in *Trans. Philol. Soc.,* 1877-79; Id., “Old French Labial Vowels,” *ibid.,* 1873-74; W. H. Preece and Augustus Stroh (studies on acoustics), “On the Synthetic Examination of Vowel Sounds,” in *Proc. R. Soc.,* 27th February 1879, vol. xxviii.; H. B. Rumpelt, *Das natürliche System der Sprachlaute,* 1869 ; Madame E. Seiler, *Altes und Neues über die Ausbildung des Gesangorganes,* 1861, translated in 1871 in America as *The Voice in Singing ;* Id., *The Voice in Speaking,* translated by Dr W. H. Furness, 1875 ; Edward Sievers, *Grundzüge der Lautphysiologie,* 1876; Id., *Grundzüge der Phonetik,* as 2d ed. of preceding, pp. xv. and 224, 3d ed. 1885 (in his biblio­graphy the author refers to 157 works of eighty-eight authors) ; Johann Storm, *Englische Philologie :* I. *Die lebende Sprache ;* Stroh (see Preece) ; Carl J. Sundevall, “Om Phonetika Bokstäfver,” in *Trans. Swedish Acad. Sci.,* 1856, vol. i.; Henry Sweet, “Danish Pronunciation,” in *Trans. Philol. Soc.,* 1873-74 ; Id., “History of English Sounds,” *ibid.* ; Id., *Handbook of Phonetics,* 1877; Id., “Sounds and Forms of Spoken Swedish,” in *Trans. Philol. Soc.,* 1877-79 ; Id., “Russian Pronunciation," *ibid.;* Id., “Sound Notation,” *ibid.,* 1880-81 (with corrections of the *Handbook);* Id., “Spoken Portuguese,” *ibid.,* 1882-84; Id., “Spoken North Welsh,” *ibid.;* F. Techmer, “Naturwissenschaftliche Analyse und Synthese der hörbaren Sprache,” in *Internat. Zeitsch. f. allg. Sprachwissen­schaft,* vol. i. ; W. D. Whitney, “On Lepsius’s Standard Alphabet,” in *Jour. Am. Orient. Soc.,* vol. viii.; Id., “On Bell’s visible Speech," in *Orient, and Linguis. Studies,* 1876 ; Id., “How shall we Spell?” *ibid.;* Id., “English Pro­nunciation,” ibid..; Id., “Relation of Vowel and Consonant,*"ibid.;* Id., “Accent in Sanscrit,” *ibid.; J.* Winteler, *Die Kerenzer Mundart;* O. Wolf, *Sprache und Ohr.* (A. J. E.)

SPEKE, John Canning (1827-1864), an eminent African explorer, who was the first European to cross Central Africa from north to south and to determine the existence and position of the great water basin from which the Nile proper issues full formed. He was born on 4th May 1827 at Jordans near Ilchester, in Somersetshire. Entering the Indian army in 1844, he served in Sir Colin Campbell’s division in the Punjab campaigns, and gradu­ally acquired no small repute both as a military officer and as a sportsman and naturalist. When on furlough Captain Speke often advanced into unexplored portions of the Himalayas, and even crossed the frontier into Tibet; but his attention was at an early date turned to the great problems not of Asiatic but of African geography, and in 1854 he commenced his brief and brilliant African career by an expedition along with Captain Burton into Somali land, the incidents of which are narrated in *What led to the Discovery of the Source of the Nile* (London, 1864). It was along with the same explorer that the expedition of 1857-59 was undertaken, in the course of which Captain Speke, leaving Captain Burton, unfortunately invalided, at Kazé, struck northwards and reached the shores of Lake Victoria Nyassa in the neighbourhood of a nullah, which he named Jordans after his birthplace. Convinced though he was that this lake belonged to the Nile system, he had no absolute proof to offer to the scepticism of his fellow-traveller and many stay-at-home geographers, until in 1863 he returned from another expedition along with Captain James Augustus Grant, in which he struck the Nile at its exit from the lake, and proved its identity with the river of Egypt by following it most of the way down. Captain Speke was expected to hold a public discussion with Captain Burton as to certain disputed points in the history of his discoveries at the British Association in Bath (1864); but on the very morning (15th September)