

very name, *Volapük*, is taken from German and English. *Vol* represents the German *Volk*, *pük* the English speech, so that *vola-pük* means originally folk-speech. In the same manner *appetite* has been replaced by *potit*, *abundance* by *bundan*, *silver* by *silef*, *Jew* by *yudel*, *house* by *dom*. In many cases these borrowed words have been so much changed that it is difficult to recognize them. Here *Pasilingua* has a great advantage. All its words remind us of a Teutonic or Romanic prototype, or of English, which has amalgamated these two elements in its dictionary. *Volapük* often requires a commentary, where *Pasilingua* allows us to guess with a good chance of success. Thus—

What o'clock is it? is in *Volapük* *Düþ kimid binos?* in *Pasilingua* *Quota hora er al?*

Where do you live? is in *Volapük* *Kiplace lödens?* in *Pasilingua* *Ubi habitirs tiis?*

The sentence, Advertisements are to the man of business what steam is to industry, has been rendered in *Volapük* by *Lenunc binoms jafaman otos kelos stem plo dustor*; in *Pasilingua* by *Annöncius ers pro tos affüriros qua ta vapora pro ta industriu*.

After *Volapük* has once chosen what may be called its stems, which consist mostly of a consonant, a vowel, and a consonant only, everything else becomes easy enough. Thus if *fat* stands for father, we get a simple declension:—

Singular.	Plural.
N. <i>fat</i> , father	<i>fats</i>
G. <i>fata</i>	<i>fatas</i>
D. <i>fate</i>	<i>fates</i>
A. <i>fati</i>	<i>fatis</i>

*Pasilingua* declines:—

Singular.	Plural.
<i>rtu</i> , the death	<i>mortas</i>
<i>tude</i>	<i>mortasde</i>
<i>mortuby</i>	<i>mortasby</i>
A. <i>mortun</i>	<i>mortan</i>

*Spelin* declines:—

Singular.	Plural.
N. <i>mik</i> , a friend	<i>mikoes</i>
G. <i>doe mik</i>	<i>doe mikoes</i>
D. <i>tu mik</i>	<i>tu mikoes</i>
A. <i>mik</i>	<i>mikoes</i>

It is clear that there are ever so many ways by which the same result might be obtained, so long as the principle is strictly adhered to that each case shall have but one sign, and that the same sign is to be used in the plural and the singular, while the plural again is indicated by a sign of its own. In Bengali and many other languages the same principle is carried out with considerable consistency. What applies to declension applies to conjugation, to degrees of comparison, and to derivation. All becomes regular, simple, intelligible, whatever set of suffixes, prefixes, or infixes we adopt. Thus, to have is *lab* in *Volapük*. Hence:—

Singular.	Plural.
<i>labob</i> , I have	<i>labobs</i> , we have
<i>labol</i> , thou hast	<i>labols</i> , you have
<i>labom</i> , he has	<i>laboms</i> , they have
<i>labof</i> , she has	
<i>labos</i> , it has	
<i>labon</i> , one has	

By assigning to each suffix one peculiar power, *Pasilingua* distinguishes: *mortu*, death, *morto*, dead, *morte*, dead (fem.), *morta*, dead (neut.), *mortiro*, dying, *mortaro*,

murderer, *mortamenta*, instrument of murder, *mortana*, poison, *mortarea*, battle-field, *mortitarea*, churchyard, *mortiblo*, mortal, *mortablo*, fatal, *mortoblo*, easy to kill, *morter*, to be dead, *mortir*, to die, *mortar*, to kill, *mortor*, to be killed, &c.

These few extracts will give our readers an idea of what they have to expect from *Volapük*, *Pasilingua*, and *Spelin*. *Spelin* has nothing to do with spelling. It is derived from *lin*, the abbreviated stem of *lingua*. *Pe* (from Greek *pas*) means all, *s* on account of its continuous buzzing sound is used to form collective nouns; hence *s-pe-lin* means all-language, or *Pasilingua*.

The study of these systems is by no means without interest and advantage. It will help to clear people's ideas about the great complexity of language, and show how simple a process grammar really is. If more generally adopted, as *Volapük* seems likely to be, such a system of writing may become even practically useful, particularly for telegraphic communication. That it could ever supplant our spoken language is out of the question, and Dr. Schleyer, the inventor of *Volapük*, distinctly disclaims any such intention ("Hauptgedanken," p. 10, note). One protest only we have to enter before leaving the subject. Nothing could be a greater mistake than to imagine that these clever and amusing experiments have anything in common with Leibniz's conception of a philosophical language. What Leibniz had in his mind may be guessed from the "Essay towards a Real Character and a Philosophical Language," by Bishop Wilkins, London, 1668, of which an abstract is given in Max Müller's "Lectures on the Science of Language" (vol. ii. p. 50). This is as different from *Volapük* as the *Kriegspiel* is from real warfare. For spending a dreary afternoon pleasantly, an experimental study of *Volapük*, *Pasilingua*, or *Spelin*, may safely be recommended. *Lingualumina* is a more serious matter. It is built on an exhaustive analysis of the notions that have to be expressed, and thus approaches nearer to the ideal which Leibniz had conceived of a perfect and universal language.

#### BRIDGE CONSTRUCTION.

*A Practical Treatise on Bridge Construction: being a Text-book on the Design and Construction of Bridges in Iron and Steel.* For the Use of Students, Draughtsmen, and Engineers. By T. Claxton Fidler, M.Inst. C.E. (London: Charles Griffin and Co., 1887.)

THIS book is principally intended for practical use by engineers and draughtsmen, who are now being called upon to design and construct bridges of unprecedented magnitude, like the Forth Bridge, which the introduction of iron, and latterly more especially of steel, has rendered possible. The execution of these requirements has brought forward a number of new problems to be solved in Statics, and the Elasticity and Strength of Materials, and has invested old problems with an importance which they did not before possess. Evolution in this branch of creation has gone on so rapidly that the Darwinian student of the "survival of the fittest" might turn to this book for striking exemplifications of his theories, which he would find in the classification of

bridges, described and illustrated in the second section of the work. But while in the animate kingdom the mammoth animals have become extinct from insufficient mobility and relative strength to carry their own weight, the converse operation is observable in engineering construction. Bone and muscle are of the same strength as formerly, but the improved manufacture of steel has placed in the hands of the engineer a material with which he can safely attempt his mammoth creations; and should metallurgical science provide commercially for the engineer a new metal, as strong as, or stronger than, steel, but of less weight—say, aluminium—then we may expect to see still more marvellous developments in bridge building.

The bridge, on a large scale, resembles the mammoth or giant in requiring its whole strength to keep itself upright; and one of the most interesting theoretical questions discussed in the present treatise is the consideration of the maximum span possible with the material in hand—say, steel. When the span is large, the greatest economy in details must be practised, as the chief stress is due to the dead weight of the bridge, and not to the relatively insignificant weight of the moving load. Thus in the Forth Bridge a weight of 20,000 tons of steel is required in a single span to provide it with the necessary strength to hold itself up, so that the stresses due to a train of 200 tons running across may be left out of account.

The weight of metal worked into a bridge is at once a measure of the stresses in the material, and also of the quantity, and consequently the cost, of the material used. The author employs the customary units of engineers, the pound or ton as a measure of force and of weight, and measures stresses in pounds or tons per square inch. He does not find it necessary to express his stresses in poundals per square foot, nor does he measure quantity of material in units of mass, which are *g* pounds or tons, as we are taught in theoretical text-books.

The mathematical student, to whom the book is partially addressed, will find it, while valuable as a handbook for a practical engineer, at the same time stimulating to his imagination in the realms of pure Abstract Mechanics, which at present run the risk of wandering away from reality, because the writers of modern text-books of mathematics do not look to the wonderful creations of modern engineering science for illustrations of theory. Thus the methods of Graphic Statics, largely employed in this treatise, arose out of the requirements of an engineer's office: a draughtsman was found using the method, and Prof. Maxwell seized upon it and elevated it to the rank of a new method in Mechanics.

Scientific treatises on Practical Mechanics are more common in America, where the requirements of opening up a vast continent have given great employment to the engineer and the bridge-builder; and it must be owned that these treatises are far superior to our own. But we hope the present treatise will do something to take away this reproach.

We may flatter ourselves that the Forth Bridge now in progress is the greatest thing of the kind in the world, but a rival in the Poughkeepsie Bridge is projected. These two bridges will exemplify the difference of practice of the Old World and the New. In our practice the whole bridge is riveted up into a rigid structure as much as possible; while in America the

articulated system of triangular cells, with pin joints permitting rotation, is adopted, the stress in individual members being thus a simple pull or thrust. So far the American system has scored one in securing the contract for the Hawkesbury Bridge in Australia. This system affords the best theoretical illustrations of elementary Statics—the subject of Part I. of the present treatise—until the question of the bending moment (it is gratifying to find the term “tendency to break” of the abstract treatises discarded) comes into consideration, when the Old World bridge affords the requisite illustrations.

In Part III., on the “Strength of Materials,” the author begins with the resistance of columns and struts to flexure, and here theory and practice have long worked together almost in harmony. The expression “breaking load” of a column—to mean the load which just starts flexure of the column—is apparently usual, but like the expression “tendency to break” should now be discarded for something more suitable. The theoretical strength of a column, according to Euler, which requires the assumption that the column is initially *perfectly* straight, and the actual strength against flexure, are represented in a diagram (p. 160); and the author has shown very ingeniously how the actual state of things encountered in practice can be imitated theoretically by a strut composed of two flanges of unequal elasticity (p. 163). Such a strut will begin to curve immediately as the load is gradually applied, and will thus represent very closely the actual behaviour of a continuous column, as great variations are found experimentally in the elasticity of iron or steel in specimens cut from one piece of metal (p. 167). When crushing or tearing takes place from continually applied pressure or tension, only empirical formulæ are suitable; but, as in actual structures the stress is kept by Board of Trade rules much below the elastic limit, the theoretical equations depending essentially on Hooke's law, that Tension and Extension are in the ratio of the Elasticity of the material, may be employed. Even with the low stresses permissible by law, Wöhler's researches on the fatigue of metals show that permanent deformation may keep on accumulating, and, in consequence, modern engineering practice is in some respects not so daring as formerly. Gordon's empirical rules (§ 124) (originally due to Tredgold) have been shown by Prof. J. H. Cotterill to rest on a theoretical basis, if the compression of the material due to the thrust previous to flexure is taken into account.

For very long spans, the only two rival methods of construction are the cantilever and the suspension principles, of which the Forth Bridge and the Brooklyn Bridge are the great respective examples. In the Cantilever method we build out equally on each side of a pier, so as always to preserve stable equilibrium, while in the suspension method the roadway is suspended from the chains or steel ropes. The chief drawbacks of the suspension principle, its defect of stiffness and great sensibility to changes of temperature, are shown by the author to be avoidable by the system of bracing in his “rigid suspension bridge” (Fig. 22).

The disastrous fall of the Tay Bridge Viaduct in a hurricane has forcibly redirected the attention of engineers to the importance of the theory of wind-pressure and wind-bracing (Chapter XXIV.), and now we may

feel secure that in the new Tay Bridge of Mr. Barlow, as well as in all recent structures, ample allowance of strength is provided for against the effect of wind.

The book is copiously illustrated with excellent diagrams of real practice in the construction of bridges, based on the theories of the text, and should prove not only an indispensable hand-book of the practical engineer, but also a stimulating treatise to the student of mathematical mechanics and elasticity.

A. G. GREENHILL.

### TWO FRENCH BOOKS.

*Les Pygmées.* Par A. de Quatrefages.

*Les Ancêtres de nos Animaux, dans les Temps Géologiques.*

Par Albert Gaudry. (Paris: J. B. Baillière et Fils, 1887-88.)

THESE two works form two volumes of Baillière et Fils' "Bibliothèque Scientifique Contemporaine." The first, by the eminent Professor of Anthropology at the Jardin des Plantes at Paris, treats of the Pygmies, a diminutive race of mankind known to the ancients, alluded to by Homer, insisted upon as really existing by Aristotle, next believed to be but myths, and now established as a veritable race of the human kind. The author accepts for them the terms, suggested by Hamy, of Negritos and Negrilles, the latter being confined to the African Pygmies, and the former to those of the Asiatic Isles.

Avowedly a compilation, this little volume has all the peculiar charm that distinguishes Prof. Quatrefages' writings, and abounds with much curious and interesting details. The first chapter treats of the Pygmies from an historic point of view; the second, third, and fourth, of the Negritos, they being exclusively insular. The Negritos are to be found in New Guinea, and all over the Melanesian Archipelago, as far as Fiji; but, while the typical Negrito is confined to this area, conquest, emigration, and slavery have spread the race to Timor, Ceram, Bouru, Gilolo, to the western shores of Borneo, and so to other islands of the Pacific Ocean. Northwards they can be traced to the Carolines, and southwards to New Zealand where they preceded the Maoris. Mr. Ten Kate reports a Melanesian skull found in the little Isle of Santo Spiritu, off the coast of California. To the northwards they can be traced to the Loochoo Isles, Formosa, &c., while their western limits seem to be the Nicobar and Andaman Isles.

The question of the mixing of races on the borders of their distribution is discussed, and a good deal of recent information on this subject is given. The various modifications dependent on the wide range of distribution are also investigated, and the manners and habits of the several groups are described at some length. Good copies of photographs of native heads and figures are appended.

Chapter VI. treats of the Negrilles, or African Pygmies, the details of the Akkas, Tobbo and Chairallah, reared in Italy by Count Miniscalchi Erizzo being full of interest. The last chapter is devoted to the Bushmen of the Cape, and in connection with them there is an account of the Hottentots. The volume has thirty-one figures intercalated with the text.

The second work is by an equally well-known writer, —though of a very different school from that of Prof. Quatrefages—Prof. Albert Gaudry, also a Member of the Institute, and the Professor of Palæontology at the Museum. Well known for his able writings, and for his liberal and modern views on science, he has in this little volume given us a most delightful account of his ideas on the origin and development of the Mammalia during geological time. The volume begins with a chapter on the history of the progress of palæontology, followed by one on evolution and Darwinism. Though a disciple of D'Archiac, who was a strong opponent of Darwin's views, Prof. Gaudry read "The Origin of Species" with the most passionate admiration, and his labours since then have very materially helped to complete the palæontological record. The third chapter is devoted to the subject of the evolution of the Mammalia in geologic time; the fourth introduces us to the author's researches at Pikermi, where, as he tells us, he spent some of the most pleasurable moments of his life, engaged in excavating the remains of the quadrupeds which in times long ago roamed at liberty over the plains of Greece. Here were found an assemblage of animals of large size, such as has never been found before within so limited an area. Beautiful figures of many of these are given, and their relations to existing forms are explained. In another chapter we find an account of similar researches carried on at Léberon, near Cucuron (Vaucluse), where the remains were chiefly those of Herbivores, and an interesting table is added of the succession of the terrestrial Mammalia in France during the Tertiary period. In a concluding chapter there are some short sketches of the well-known palæontologists of the Museum: Alcide D'Orbigny, D'Archiac, Edouard Lartet, followed by a description of the fine new gallery for fossil forms at the Museum.

### OUR BOOK SHELF.

*The Elements of Graphical Arithmetic and Graphical Statics.* By John Y. Gray and George Lowson, M.A. (London and Glasgow: W. Collins, Sons, and Co., 1888.)

In the year 1871, Prof. Crofton, F.R.S., explained before the London Mathematical Society his diagrams illustrative of the stresses in Warren and lattice girders, and in the course of his remarks said that he had not found anything to help him in English text-books, and referred to papers by Profs. Rankine and Clerk-Maxwell. It was at this meeting (April 13) that Prof. Henrici drew attention to a work then little known in this country, viz. Culmann's "Graphische Statik"—"l'excellente 'Graphische Statik' de M. Culmann" (Prof. Cremona)—and showed that Prof. Crofton's constructions had been anticipated and the methods applied to a very wide range of subjects. On this occasion also Prof. Henrici illustrated the subject by a simple and ingenious notation. He subsequently drew up an abstract of Culmann's work (1866), which was printed in the Appendix to vol. iii. of the above-named Society's Proceedings (pp. 320-22). The work is now well known, and its methods are very generally employed by engineers, and are the subject of lectures in more than one of our Colleges.

The object of the book before us is to give an elementary account of the fundamental principles of the subject