

geological times are doubtful. But Prof. Zittel considers that the climate must have been damper, the rainfall heavier, and freshwater denudation more active in Pleistocene days than now, to account for the erosion that has taken place, the abundance of fulgurites, and the present distribution of the fauna and flora, especially in such cases as the occurrence of Central African crocodiles in the marshes and streams of the completely isolated Ahaggar Mountains. Reasons are also given for believing that the Nile was formerly a larger river than it now is. It is probable that Prof. Zittel's views on some of these points will be contested, but it is impossible to deny that his arguments are admirably expressed and clearly reasoned out.

Some very interesting details are given about the desert sand, and a careful description of its arrangement in the form of sandhills. The sand of the Sahara is considered to have been largely derived from the decomposition of the so-called Nubian sandstone, the original matrix of the well-known silicified wood. In the Libyan desert there are some remarkable anomalies in the arrangement of the sandhills, and it is clear that they cannot have been entirely formed by accumulation through the agency of the prevailing wind as it exists at the present day. It may here be remarked that very similar observations were made, a few years since, upon the sand ridges of the Indian desert east of the Indus. Some of the sand ridges, both in Africa and India, attain an elevation of about 500 feet, and in both areas the largest appear to have undergone no change within the memory of man, although in places, in both continents, moving tracts of sand occasionally overwhelm cultivated land and buildings.

One mistake in the book deserves notice. In the comparative table of Upper Cretaceous and Eocene beds in Europe, Asia, North Africa, and North America the position assigned to some of the Tertiary stages of the Indian rocks requires correction. The lower Nari beds in especial were never supposed to be so old as Middle Eocene (Parisian), and they are now known to be in all probability true Oligocene. But trifling mistakes of this kind are to be expected: it is surprising that more should not have been observed.

W. T. B.

#### APPLIED MECHANICS

*Applied Mechanics.* By H. T. Bovey, M.A., Professor of Civil Engineering and Applied Mechanics, McGill University, Montreal, Fellow of Queen's College, Cambridge. Part I., pp. 190. Part II., pp. 150. (Montreal: J. Lovell and Son, 1883.)

THIS work appears to be designed as a college text-book for somewhat advanced students, who have already received good training in mathematics (as far as the elementary parts of the integral calculus) and theoretical mechanics.

Part I. treats of the strength of materials, dealing with longitudinal stress, the strength of beams and pillars, torsion, and the strength of hollow cylinders and spheres.

In Part II. we have chapters on frames, roofs, bridge-

trusses, suspension bridges, arched ribs, and in conclusion one on "details of construction," which includes a discussion of the strength of rivets and other fastenings.

In his exposition of these subjects the author manifests a power of clear and precise statement; and the treatment of the more difficult problems of the first part is perhaps as profound as could be attained without a knowledge of the general theory of elasticity. The numerous illustrations serve sufficiently well in Part I., where they consist chiefly of diagrams; but in Part II. they are on too small a scale for the complicated structures illustrated; and in clearness of detail are far below the standard reached in recent English books on the same subjects. Analytical methods are preferred throughout; and generally speaking geometry is used merely to illustrate results previously obtained in a symbolical form. Thus graphical statics is quite subordinate in Part II.; stress diagrams are introduced, but there are not sufficient instructions in the text to enable a student, who has not studied the subject independently, to construct them for himself.

In the extended treatment of a parabolic rib of uniform stiffness (pp. 101-120) the author follows very closely the lines in Rankine's "Civil Engineering," with some further consideration of the additional terms depending on change of temperature.

There is no acknowledgment in regard to this and other parts of the work where Rankine's influence is clearly apparent. But as no preface is given to the present volume, perhaps other portions of the great subject of applied mechanics are in course of preparation by our author; and till the completion of his work he is postponing the statement of his obligations to those who have gone over the ground before.

We have referred to the apparent excess of symbolical reasoning: but none of this is due to the introduction of investigations better left to treatises on pure mathematics and theoretical mechanics.

Difficulties special to the subject of the work, such as the equations of the "neutral axis" (so-called) for all the different modes of loading and supporting a beam, the theorem of three moments, the moments of inertia of complicated forms of section, the deflection of struts, are however treated with the fullness of detail required by ordinary students.

Such investigations constitute the best feature of the book. The detailed application to problems such as occur in actual practice is but slightly touched on; perhaps for this we are to look to the "Examples," of which some few are worked out in the text; appended to the several chapters, moreover, are close upon 400 proposed for the exercise of the student.

These form a very important collection. A great number involve numerical results, and unfortunately the answers are not given; this greatly lessens their value for private students at any rate. Several examples are taken from existing structures, and are liberally furnished with diagrams in illustration of the data.

Many are new to text-books, and the author has evidently taken great pains in collecting and arranging them.

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