of the earth, in short, into his infra-granite zone. He holds that the water which comes out in volcanoes cannot be original, because the temperature of the globe is constantly decreasing and that past conditions were still less favorable than the present ones for the maintenance of water in the interior. He thinks, therefore, that the water is of recent introduction.

"The solution of the question," states our author, "appears to result from some very simple experiments of M. Stanislas Meunier." Without describing the experiment which in no way duplicates the condition of the earth's crust at a depth, the author supposes that the water is brought into the infra-granitic zone as water of consolidation and crystallization embodied in fragments of rock which fall down along fault-planes and zones of crushing. The 'falling' of these hydrated rocks into the heated regions of the globe is supposed to give rise to volcanic explosions and as is stated in the next chapter to earthquakes also. The author very frankly states that he is obliged to note the profound astonishment which the first publication of his views elicited.

In the experiments on folds some interesting points are dwelt upon concerning the intersection of planes of fracture which arise, but these artificial faults are not compared with those of any particular region. Under the head of schistosity are described experiments which appear in reality to have induced a kind of cleavage as that term is understood in English. Fractures are produced by compression in some experiments which lead the author to reject Daubrée's famous radiating fractures produced by torsion, seemingly on the ground that such fractures have 'not anywhere been observed.'

The general distribution of mountains upon the globe last of all comes in for experimentation in the clever methods of the author. A small hemispherical shell has stretched over it a rubber layer coated with plaster, in such a manner that when the foundation, which represents the contracting nucleus of the globe, is allowed to retreat, the contraction of the rubber layer induces compression of the plaster. This stress is relieved by circumpolar lines of shearing and displacement, the overthrust being poleward in direction. The author points out the analogies which seem to exist between this model and the arrangement and orogenic movements of the mountain systems of Europe. The researches of Suess on the northwesterly movement of the Eurasian thrusts should be noted as favoring this hypothesis, but it is difficult to see in what way the view is exemplified on the North American continent.

The book is closed with a 'Postface' or statement, with which most geologists will probably agree, that this volume sets forth facts amply sufficing to justify the *raison d'être* of experimental geology. Whatever misgivings one may entertain concerning the decisive character of some of the experiments, there can be no doubt of the suggestiveness of the original and ingenious methods which the author has brought to bear upon some of the largest questions of dynamical geology. The book is illustrated with a few good cuts and is well printed. A list of contents takes the place of a good index. The publishers have taken the liberty of appending 35 pages of advertising matter which might have been omitted.

J. B. W.

Leçons sur la détermination des orbites professées à la Faculté des Sciences de Paris. Par F. Tisserand; redigées et développées pour les calculs numériques par J. Perchot; avec une préface de H. Poincaré. Paris, Gauthier-Villars. 1899. 4to. Pp. xiv + 124.

These lectures formed a part of the course in mathematical astronomy delivered at the Sorbonne by the late Professor Tisserand, but the important question of the determination of cometary and planetary orbits was not treated in his well-known treatise on celestial mechanics. The only work in the French language devoted to the numerical elements of orbits is the translation of Oppolzer's treatise, which is a most useful book to the computer, but neither easy nor attractive to the reader; on the contrary the lectures of Tisserand exhibit the clearness of exposition and the simplicity and elegance of method which uniformly characterize his writings, so that all devotees of mathematical science will be indebted to M. Perchot for this edition of the unedited lectures of his lamented master. Professor Poincaré's pre-

face, the most interesting chapter of the volume, is a graceful memorial to his predecessor at the Sorbonne; it discusses the methods of Laplace, Gauss and Olbers, together with other possibilities in the determination of orbits, and concludes with a concise *résumé* of the method followed in Tisserand's exposition.

In the first chapter Tisserand presents the method of Olbers for the determination of parabolic orbits. By this method the calculations fall into two parts: 1°. No hypothesis is made as to the nature of the orbit, and the six equations are combined in such a manner as to yield a unique equation; this combination can be made in an infinite number of ways and thus yield an infinite number of equations; Olbers effected it in such a happy manner that the unique equation assumes a remarkably simple form whose simplicity is conserved in the second approximation if the observations are equidistant. 2°. In the second part the condition for a parabolic orbit is introduced, thus reducing the number of unknowns to five: to the four equations given by the two extreme observations is joined the unique equation obtained in the first part. Four equations in four unknowns are to be solved; resort must be had to successive approximation. The chief advantage of Olber's method is that the only equations which present difficulties of computation contain only two unknowns; tables of single entry give one of these as functions of the other.

The second chapter presents the well-known method of Gauss for the determination of the orbit of a planet from three observations elaborated in his *Theoria motus*.

M. Perchot has increased the usefulness and convenience of the book by appending general *résumés* of the formulæ in definitive form for computing together with the numerical calculation of the orbit of the asteroid, 1897, DJ., in which no detail has been omitted; this model computation and reproductions of Oppolzer's tables VIII. and IX. conclude the work.

E. O. LOVETT.

Lexikon der Kohlenstoff-Verbindungen. Von M. M. RICHTER. Zweite Auflage der "Tabellen der Kohlenstoff-Verbindungen nach deren empirischer Zusammensetzung geordnet." Hamburg und Leipzig, Verlag von Leopold Voss. 1869.

The work bearing the above title is another product of the indefatigable energy and painstaking care of a German chemist. In 1883 Dr. Richter gave out his 'Tabellen der Kohlenstoff-Verbindungen' arranged in accordance with empirical formulas. While that edition contained 16,000 compounds, and the third edition of Beilstein now reaching completion has some 57,000 compounds described within its spacious pages, this dictionary says something about 67,000.

The work is conveniently divided into the following parts: Introduction, System and Nomenclature; List of about 67,000 compounds and their percentage composition; Register of Proper Names; Table of Numbers for finding the Percentage Composition.

The dictionary is to be issued in about thirty-five numbers, the first eleven of which are at present in hand. Each number contains sixty-five pages and is of the same size, style and print as the *Lieferungen* of Beilstein's 'Organische Chemie,' 3 Auflage.

In the Preface, which, with the Introduction to the system and nomenclature, is given in four languages (German, English, French and Italian), Dr. Richter states that the work was begun ten years ago. Three causes are ascribed for the length of time required to complete the work: viz., changes of nomenclature at the Geneva Convention, the immense number of new facts made known in the time and his own business engagements. Professor Beilstein's desire to exhibit the percentage composition of additional types CHO, CHN, and CHON, thereby adding some 20,000 formulas, has been complied with.

The alphabet of the system shown in the succession of the elements combined with carbon, as determined by the frequency of their occurrence is as follows:

(1) H, O, N; Cl, Br, I, F; S, P.

(2) All the other elements are placed in alphabetical order: A–Z.

The elements follow each other in horizontal and vertical rows according to the number of atoms.