

joyment and contented agreement from lecture to lecture, for, otherwise, one is more inclined to be continually stopping and arguing by the way, but at the same time it is felt that one is being thoroughly instructed upon the present state of knowledge of the subject by a master worker who has himself been engaged upon the problems involved.

The book is a record of a course of lectures given in recognition of a generous gift by the Mercers' Company in aid of the work of the physiological department at University College, London; a similar course is to be delivered each year, and it is to be hoped they will also be published.

This first course treats of the foodstuffs and their changes during digestion, the mode of action of ferments, secretion of saliva, digestion in the stomach, pancreatic secretion, changes in the pancreas during secretion, the properties of the pancreatic juice, the bile, the intestinal juice, and the movements of the alimentary tract. It is the "growing border," as the author himself styles it, of these important subjects which is mainly treated of, and to take up and criticise all the new work and theories involved would occupy more space than the little volume itself.

There is, however, one view of general interest with regard to the action of ferments or catalysts which here, as elsewhere, scarcely receives the consideration it deserves, and appears to be accepted without criticism. This is the law of Ostwald, that in order that an intermediate compound may be regarded as a sufficient explanation of a catalytic process, it must be first demonstrated that the rapidity of formation of the intermediate compound, and the rapidity of its decomposition into the end-products, are *in sum* greater than the velocity of the reaction without the formation of the intermediate body.

The error in this statement is the implied supposition that these three velocities are constants, in which case the law would follow—but a reaction is not constant throughout its range, beginning with high velocity and decreasing as the equilibrium point is approached. Further, for the reaction to run, all that is necessary is a potential quantity of the intermediate body, which would tend to be formed with very high velocity, so that the necessary and sufficient condition is that the intermediate body should decompose to form the end-products with greater velocity than does the initial substance when present alone. The greater velocity is obtained because the intermediate body formed with the catalyst gives a path of less resistance, so that the same chemical potential difference leads to equilibrium in a shorter time.

BENJAMIN MOORE.

SCIENCE AND ROAD-METAL.

Attrition Tests of Road-making Stones. By E. J. Lovegrove. With Petrological Descriptions by Dr. John S. Flett and J. Allen Howe. Pp. xx+80. (London: The St. Bride's Press, Ltd., n.d.) Price 5s.

MR. LOVEGROVE'S attrition-tests have been carried out systematically for some years past in the modest but unique museum of the Hornsey

Town Council, an institution devoted to the useful arts of building-construction, sanitation, and public works in general. Here the compact machine figured on p. vii makes itself heard from time to time, when the stones undergoing the tests are lifted by the internal flanges of the three revolving cylinders, and fall a distance of eleven inches in their cast-iron prisons with painful iteration. After 8000 revolutions, what is left of them is taken out, and the chips and dust broken from them are separately estimated. The production of chips, as Mr. Lovegrove points out (p. vi), is an indication of brittleness, but may not be injurious to a road. The dust, which is determined in a dry experiment and also by one in water, is so much pure waste when formed on a road-surface or in the layer of macadam itself. The melancholy and pebble-like appearance of certain stones after they have suffered from Mr. Lovegrove's inquisition can be well seen in the Hornsey Museum, or in Figs. 77 and 78 of the present volume.

The director of the Geological Survey of Great Britain has encouraged this excellent series of experiments by forming a collection of tested stones in the Museum of Practical Geology in Jermyn Street; while Dr. Flett and Mr. Howe have supplied Mr. Lovegrove's volume with petrological descriptions and photographs from microscopic sections. Indeed, these valuable additions form the greater part of the book, though the eye is unpleasantly attracted from them to the large-type advertisements which are distributed throughout its pages. Mr. Howe's "general conclusions" will be read with special interest, and we cannot help quoting the following from them:—(P. 67) "The hardest and toughest stones combine *abundance of a hard mineral—e.g. quartz—with a dense fine-grained texture.* (P. 69) "The very best rocks in these tests are altered rocks, and as a general rule a certain amount of alteration of the feldspars seems to be an advantage. The reason for this is that the alteration produces a *number* of mineral units where formerly only *one* existed; in other words, the texture is made finer, and often the interlocking of the grains is made more complete." (P. 70) "*Fineness of grain* makes for toughness in all classes of stone."

The alteration of basic feldspars of course often results in the crystallisation of granular minerals of hardness superior to that of the original material. Mr. Howe notes, moreover (p. 60), that uraltised augite is an advantage in dolerites, while augite altered to chlorite and calcite is naturally defective. Microscopic examination probably assists more in the case of rocks of the diorite, dolerite, and diabase type than in any other series; and this alone makes the practical field of the petrologist a wide one. The engineer and the experienced user of roads will, of course, recognise other grounds for the selection of this or that stone than the results of the attrition-test alone. Flints, for instance, which stand out well in the tests, are unsuited for countries with dry summers. Well-rolled limestone, on the other hand, where dry days are liable to follow dewy nights, as in the Apennines, may provide an admirable and cement-

like surface. For ordinary moist climates, however, these tests serve as a clear condemnation of all limestones. Even the gritty Kentish Rag (p. 45) comes out badly, though, in combination with the ferruginous sandstones of our Lower Greensand, it has been known to make a road that held well together in dry seasons.

The question of composite roads would be an interesting study in itself. Materials showing great differences under the attrition-test should, of course, not be used in association; but roads made of mixed gravel taken out of streams show good results in many parts of Europe. Similar material is usefully supplied by the glacial gravels nearer home. Teachers of practical geology, as well as all county and borough surveyors, will be grateful to the three authors for providing a remarkably cheap, clear and thoughtful treatise on a subject that the whirligig of time has again made of national importance. G. A. J. C.

DYNAMO DESIGN.

Elementary Principles of Continuous Current Dynamo Design. By H. M. Hobart. Pp. x+220. (London: Whittaker and Co.) Price 7s. 6d. net.

IT is scarcely necessary at this date to recommend a book by Mr. Hobart on the design of direct current dynamo machines; it is safe to say that any production by this author will repay the study of practical men, and the present book forms no exception.

The contrast presented between a volume setting forth the results of the practical experience of a man engaged in actual work and a book evolved out of the inner consciousness of a man who has access only to the theory of the subject is very striking. Books of the former class are comparatively rare, and are correspondingly valuable.

Dealing in a general way with Mr. Hobart's work, the first point that strikes one favourably is the emphasis laid on the necessity of a large amount of application on the part of the student of the principles and methods set forth. These principles and methods must be regarded as the framework on which a designer is to build; and it is folly for him to assume that he is acquainted with the subject unless and until he has gone a long way in completing the structure by his own labour. The value of the book lies in the essential soundness of this framework, more particularly of the fundamental ideas on which it is itself based than on the framework itself. The commercial point of view is not instinctive with designers, and it is of the greatest importance that it should be acquired as soon as possible. For this reason Mr. Hobart has done well to lay stress on the necessity of judging every design by taking into account its first cost as well as its technical merits.

Regarded in this way, the book consists of a series of statements explaining the way in which a dynamo should be considered as a successful machine or the reverse, and of a short account of several methods whereby the designer may himself estimate the first cost.

After preliminary chapters on what may be called the practical theory of the continuous current dynamo, Mr. Hobart deals at length with those considerations which form the limits in the design, namely, heating, sparking, and efficiency. Numerous constants and formulæ are given, and miscellaneous information from which efficiencies can be calculated. The sparking data are, naturally, based on the method of reactance voltage, introduced some years ago by the author and Mr. Parshall, although a long list of references is given to those who have contributed to the theory in recent years. This method, or some modification thereof, is so widely used that there is no necessity to describe it here. The constants for dealing with the heating and the efficiency are, perhaps, the least praiseworthy part of the book, or rather not so much the constants as the general method. The treatment in both cases seems somewhat arbitrary; for instance, it is not absolutely certain that the rise in temperature of the armature is proportional to the total watts lost—copper plus iron loss—divided by the area of the cylindrical surface. Again, the method of estimating the iron loss in the armature is distinctly rough. This point has been debated at considerable length in the columns of the technical Press; but in the present writer's opinion there are other methods which certainly give better results. The calculation of the bearing friction and windage is referred to a single curve giving the relation between this loss and the value of D^2L at the speed of 1000 revolutions per minute; but there seems to be no indication as to how the loss varies with the speed, whether in direct proportion or as the 1.5th power of the speed.

These slight discrepancies somewhat diminish the value of the book as a work of reference; but the essential feature of the book consists, as already stated, in the enforcement of a general grasp of the whole problem, commercial as well as technical.

The book contains a large number of tables in which the various calculations are set out; some are filled in and others are left blank for the convenience of the student. It will thus be seen that this is a work which can be thoroughly recommended to the student and the designing engineer alike.

OUR BOOK SHELF.

Irrigation with Surface and Subterranean Water; and Land Drainage. By W. Gibbons Cox. Pp. viii+297; illustrated. (Sydney: Angus and Robertson, 1906.)

THE author of this book has been engaged for many years in Australia in water supply and irrigation works. There are vast areas of land in that country the soil of which is of the highest fertility, but is barren and comparatively useless because of periodical aridity. The problem of irrigation of the land from the rivers and creeks that flow at times through these districts, and form inexhaustible accumulations of underground water, is treated fully and practically according to the latest and most approved methods.

With all its natural wealth and resources Australia is subject to the great drawback of occasional droughts of greater or less severity. The consequences of one of these droughts is thus graphically described:—"The natural water supply of the dis-