tion of the boreal mollusca. For this reason the till of the lower St. Lawrence valley seems to have been deposited under marine conditions, covering up all the marks made by the earlier ice sheets. Hence it is not strange that the Canadian geologists have so generally given the largest place to icebergs in their conceptions of the work done in the ice age.

The perusal of this volume clearly shows the great efficiency of the Director and his assistants in carrying on the work so ably commenced by Logan and Selwyn. The field work has been carried on economically and successfully. While theories of divers kinds are advocated, there seems to be no attempt to distort the facts to square with preconceived notions, and all will hope that abundant means will be continuously supplied to the survey organization to carry on its explorations in a manner honorable to the Dominion government.

C. H. Hitchcock.

Tables for the Determination of Minerals by Physical Properties ascertainable with the aid of a few field Instruments based on the system of Prof. Dr. Albin Weisbach. By Persifor Frazer. Lippincott. 1897. 4th edition enlarged, 163 pp.

The first edition of this book appeared in 1874 and has been followed by the succeeding editions at varying intervals (1877, 1891, 1896).

This is really an authorized translation of the German work of Weisbach, to which Professor Frazer added the empirical formulæ best representing the data at hand. Few changes were made till the publication of the third edition which appeared rewritten and considerably changed in detail, though following the lines laid down in the first edition. The chemical formulæ previously used were replaced by those given by Groth in his 'Tabellarische Uebersicht der Mineralien,' and to the tables were added the characteristic habit, structure, fracture, specific gravity and association of the minerals.

The present edition is an enlarged and corrected reprint of the preceding. To the seven hundred and sixty odd species and subspecies previously included, there have been added a hundred and thirty-five others, which embrace several old and well known species, like microcline, and many minerals which recently have been described or rendered of economic importance, like monazite.

As in the earlier editions, the only instruments necessary are a knife, streak table, file and pocket lens. The classification is based on the lustre, streak and hardness, thus dividing the minerals into sixteen different classes upon criteria which are easily determined by the practical manipulator. The book is intended to be of service to the student, as an artificial aid to memory; to the field geologist, as a reminder and handy book of reference for properties of unusual minerals; and to the amateur, as an incentive to more accurate observations.

The author, for the sake of economy, in using the old electrotype plates, has, in a measure, decreased the value of the book, as their use has caused the retention of features which to-day savor of an earlier period in mineralogy. At the present time there is a tendency to discard even the well known crystallographic symbols of Naumann in favor of the Miller system. The present book, however, retains the abbreviated Naumann symbols suggested by the elder Dana, without incorporating the modifications introduced in the last edition of E. S. Dana's Manual of Mineralogy. A still more pronounced archaism is the introduction of such 'mineral species' as *pitchstone* and *perlite* which belong to rocks and not to minerals. Similar criticism might be passed on the ambiguous use of the term 'andesite,' which on page 92 is used to designate a mineral, while on page 99 it designates a rock; or the term *pegmatite*, which is given as a varietal name for orthoclase.

Turning to the tables themselves, there seems to be looseness in the choice of values given for hardness and specific gravity; the habitat or association of the minerals, and the symbols used as abbreviations.

In turning over the pages, the eye catches such deviations from the hardness, as on page 90, where the opal is ranked as '5' (Dana 5.5.–6.5), or the separation of 'andesite' on page 92 from laboradorite on page 100 (both 5–6). The choice of values for density may be illustrated by those given in the mica group, where the higher limits seem to be preferred,

though micas generally give lower values than the true on account of their crystal habit. For example, Lepidolite 2.9 (2.8–2.9), biotite 2.9 (2.7–3.1), muscovite 3. (2. 76–3.), phlogopite 2.9 (2.78–2.85).

In spite of these slight deviations, which undermine one's faith in the accuracy of the book, there is little doubt that the tables will prove serviceable to the practical worker who wishes to gain at a glance the approximate values of the substance under investigation.

The typography of the book is good, the type is clear, and the matter is well spaced. An especially attractive feature is the size, which is adapted to the collecting bag or pocket. The few instruments required, the use of the external and physical properties only, the notes on the paragenesis, and the great number of rarer minerals, will make it serviceable alike to the field geologist, the mining engineer and the teacher.

E. B. MATHEWS.

Traité élémentaire de mécanique chimique, fondée sur la thermodynamique. P. DUHEM. Paris, A. Hermann. 1897. Vol. I. Large octavo. Pp. viii+299. Price, 10 francs.

The object of this book is to give a consistent, coherent account of the mathematical theory of the changes in physical state and chemical constitution, as obtained by an application of thermodynamics. This would be valuable even if badly done, since the mathematical treatment of physical chemistry in book form is painfully deficient in comparison with the exhaustive handling of the experimental side of the subject by Ostwald. This particular book is doubly valuable because it not only gives us the mathematical development of the subject, but presents it in a masterly way.

Duhem begins with a short sketch of the analytical methods to be used, and then develops the fundamental principles of thermodynamics, taking up in order the conservation of energy, the first law of thermochemistry, the theorem of Carnot-Clausius and the absolute temperature, the entropy and the thermodynamic potential, the general equations of thermodynamics, the application of the thermodynamic potential to systems at constant pressure or constant volume, perfect gases, isothermal displacement of equilibrium, heat effects, adiabatic displacement of equilibrium and the change of the equilibrium with the temperature. The remarks on the accuracy of Hess's law, page 49, are especially worth reading because the points raised are usually overlooked in the statement of the theorem.

The second part of the volume—devoted to false equilibria and explosions—is even more interesting than the first part because the point of view is less familiar. Duhem has been troubled like many others by the fact that in certain cases there was a state of equilibrium when the theory, as formulated, said that this was impossible. Gibbs showed that many of the difficulties could be removed by the assumption that the surface of a phase was in a different state from the interior—in other words, by the theory of capillarity. Duhem attempts to carry this farther by introducing the notion of viscosity or of false equilibrium. His idea can best be understood by an analogy from mechanics. Suppose we have a body on an inclined plane. In an ideal state of things where there is no friction the body is not in equilibrium and will slide down the inclined plane. In the world as it is we can not get rid of friction entirely and the body will remain stationary on the plane, provided the pitch is not too great. Similarly, if there were no passive resistance to change, water vapor and a mixture of hydrogen and oxygen in the proportions in which they combine to form water should yield the same system under the same conditions. At low temperatures this is not the case experimentally, so far as we now know; so that it is natural to follow out the analogy and to say that in the actual chemical world there is a chemical friction or chemical viscosity and that states of equilibrium are thus possible which could not occur in a system where there were no passive resistances to change.

Duhem now attributes to capillary phenomena the behavior of supercooled vapors and superheated liquids, and he is inclined to group under this head supercooled solutions, supersaturated solutions and some theoretically unstable solid allotropic forms, classifying under false equilibria hydrogen and oxygen, liquid