planning the work, and the Montana Association, the Billings Commercial Club and the research committee specially appointed by Red Lodge are aiding in arranging for future work. Through Dr. Francis A. Thomson, director of the Montana Bureau of Mines and Geology, the cooperation of the U. S. Geological Survey and the U. S. Army has been secured, respectively, for the topographic mapping and airplane photography of the region to be studied, and the U. S. Coast and Geodetic Survey has promised to extend its chain of gravity stations eastward from Yellowstone Park across this newly mapped area in order to ascertain how the geological and geophysical evidence indicative of the origin of mountain uplift may be harmonized.

Inquiries have been received from Wyoming sources as to the possibility of the work being extended southward into the Cody territory, and this possibility is under consideration at the present time.

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SCIENTIFIC BOOKS

A History of Science and its Relations with Philosophy and Religion. By WILLIAM CECIL DAMPIER DAMPIER-WHETHAM. Cambridge, at the University Press. xxii + 514 pp., 14 figs. in text. 1929. Price 18*s*.

To survey the universe from the electron and the cosmic ray to the gene and conditioned reflexes is an intellectual labor truly Herculean in its order of magnitude. But to trace, coordinate and place in their most significant relations man's ever-changing and his so recently greatly enlarged concepts of nature and the discoveries from which they have sprung is a task for which no ancient galaxy of gods has an appropriate prototype. It is Einsteinian in its proportions. The author of this "History of Science" has attempted this survey and analysis, chiefly, he tells us, for his own satisfaction and amusement, but certainly for the intellectual orientation of all who seek in the past an interpretation of this our own era of achievement and of change.

This is more than a history of the sciences or of science. Its central theme seems to be man's continuing efforts to understand and interpret nature and the interaction of his concepts thus derived with philosophy and religion

> Till out of chaos comes in sight
> Clear fragments of a Whole;
> Man learning Nature's ways aright,
> Obeying, can control.

To our historian science is more than natural science. It is the ordered knowledge of natural phenomena and also the rational study of the relations between the concepts in which those phenomena are expressed. Philosophy may protest the encroachment.

The work falls into ten chapters. The first four proceed chronologically through the science of the ancient world, the Middle Ages, the Renaissance and the Newtonian Epoch. Thenceforward the treatment separates the physical from the biological sciences, and segregates the interrelation of science and philosophy. Chapters V and IX treat of nineteenth century physics and the new era in physics, respectively. Chapters VI and VIII are concerned with nineteenth century biology and recent development in biology and anthropology. Chapters VII and X give the syntheses of nineteenth century science and philosophy and scientific philosophy and its outlook.

This is no place to construe the argument, much less to criticize the selection or the treatment of the material; both have the horizon and the *élan* to be expected from a scion of the illustrious explorer. The style is lucid, forceful and vigorous. The treatment is comprehensive, judicious and eminently free from bias. The aim is clearly synthetic throughout, and to this end the presentation of the separate scientific fields and of biographical aspects is quite subordinated.

Priority in formulation of an idea or in discovery does not seriously embarrass our historian. "In science 'being right is no excuse whatever for holding an opinion which has not been based on an adequate consideration of the facts involved in it.'"

Noteworthy in this survey is the selection and treatment of significant figures in the onward march of ideas: to alphabetize a few, Aquinas, Aristotle, Francis and Roger Bacon, Bateson, Bergson, Bishop Berkeley, Bernard, Berzelius, Bohr, Boltzmann, Boyle, Burt, Copernicus, Crookes, Darwin, Democritus, Eddington, Einstein, Foster, Galen, Galileo, Gauss, Haeckel, Helmholtz, Van't Hoff, Hume, Huxley, Huygens, Jeans, Kant, Kelvin, Kepler, Laplace, Lavoisier, Leibnitz, Leonardo da Vinci, Liebig, Lucretius, Lyell, Maxwell, Mendel, Mill, Millikan, Newton, Pasteur, Plato, Russell, B., Rutherford, Sarton, Singer, Thomson, J. J., Thomson, W., Voltaire, de Vries and Whitehead.

In a treatise of the scope of this work some deflections of emphasis and preference in selection result inevitably from propinquity and limitations in con-

tact. One has a feeling that the group is a little firmer in the physical than in the biological sciences. In the latter the outlook is quite Batesonian. The historical perspective might well have included L. Agassiz, and more emphasis given to the work of Franklin and Willard Gibbs. One looks in vain for Kircher, the reputed discoverer of bacteria. But one volume can not be an encyclopedia.

This "History of Science" is in sharp contrast with the work of professional historians who weave their interpretations out of the impermanent threads of war, politics or economics. It is an intellectual challenge, though by no means written as such, to all other interpretations of the past, and a most convincing and stimulating revelation of the foundations of this age of material and intellectual achievement.

It should be read and reread by those responsible for the formulation and conduct of all forward-looking educational policies in our universities. It may be illuminating to those advocates of culture who have regarded science as mere technique, and to pietists who fear its materialistic devastations.

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Comets. By CHARLES P. OLIVIER. The Williams and Wilkins Company, Baltimore, 1930, pp. 246, illustrated. Price $3.50.

PROFESSOR OLIVIER wrote this book as a sequel to his "Meteors" with the purpose of supplying "a book of moderate size . . . useful to the astronomer who does not specialize in the subject, as well as to the average intelligent reader."

There is no doubt that the author succeeded in this. The book is well written and well printed. It fills a gap in modern astronomical literature, especially so as Chambers' "The Story of the Comets" is now somewhat obsolete.

The author selected several topics for his book. After chapters on the history of comets and general facts about comets follows a discussion of cometary groups, families, tails and spectra, chapters on several individual comets, connection of comets and meteors, collision of comets with the Earth and the origin of comets. In the last chapter the author gives his views on the origin of comets, and the appendix contains elementary notions from the theory of orbits.

The desire to avoid mathematics is probably responsible for the absence of a discussion of such important questions as the motion of matter in the heads and in the tails of comets, radiation pressure of the Sun and the luminosity of comets. However, no serious study of comets can avoid these topics, and the author frequently uses the terminology of the theory of comets without explaining it. The result is that in some few places the book will be hardly understandable even to an "intelligent reader." In the chapter on the "Spectra of Comets," for instance, such arbitrary notation as CNIV (cyanogen band λ3883), or the "third negative group of carbon" is mentioned without an explanation. Fluorescence and resonance phenomena are referred to, but the exact meaning of both is left for the reader to find out.

Some inaccuracies are unfortunately present in this book. On page 80 the wave-lengths of the Swan bands are given λλ5630, 5166, 4719 instead of the correct values λλ5635, 5165, 4737 for the brightest heads. The author does not explain that the angstrom is used here as the unit. On page 184 the wave-lengths of a band are given "from λ620 to λ700," again without mentioning that μμ is the unit. Indeed, no effort was apparently made to reduce all data to the same units. On many pages miles and kilometers are side by side. Some comets are denoted by Roman numerals according to the time of their perihelion passage; others by letters, according to the order of their discovery.

A misstatement occurs on page 184. The author says about Comet 1910a, "The several preliminary orbits published differed widely from one another. As an example the first three gave the inclination 62°, 85° and 57°, respectively. A correct orbit finally gave it as 139°, entirely reversing even the direction of motion! . . . No decided deviation from a parabola could be found." The reader might possibly infer that something went wrong with the computations, or that the comet was not observed accurately enough. However, this was the classical case of a triple solution, and the definitive orbit by Simas gave an indication of ellipticity.

On page 42, referring apparently to one of the famous "Schmidt's Clouds" in Comet 1882 II, the author says, "Its orbit proved to be quite similar to that of the main comet." On the contrary, Bredichin and others showed that the clouds moved under appreciable repulsive force of the Sun. The comet itself is denoted by the author as 1882 III, instead of 1882 II.

In the appendix the author gives *seven* elements for an ellipse, the semi-major axis and period are listed separately. The latter is denoted for no apparent reason as *Pe*.

From a statement on page 192 the author appears to be unaware that the question of the common origin of comets and asteroids was seriously discussed as early as 1851 by Stephen Alexander.

The typographic work is good, although a few misprints have been noticed. It is unfortunate that