binite are safe up to a certain point while nitroglycerine and blasting gelatine are not. The French Commission decided that an explosive whose temperature of explosion, as calculated by certain thermochemical data, was below 1,500° C., could be licensed for use in fiery mines, yet carbonite, which is one of the safest of all, and several others in use, have a temperature of explosion considerably above 1,500° C. Bichel and Mettegang, whose investigations in this field are highly praised, require slow detonation as one of the characteristics of a safe explosive, yet "the velocity of detonation can not, however, be considered to be a determining factor under all circumstances. Certain nitroglycerine explosives, amongst which we may also include carbonite, explode much more rapidly than, say bobbinite, and yet show themselves to be much safer when tested." Even in making firing tests in galleries, as is now being done by several governments and organizations, the author finds that the results differ with the shape and dimensions of the galleries, so that each gallery may have its own ignition temperature which would affect the results obtained.

In discussing this topic the author says: "It has been known for a long time that coal dust as well as pit gas is highly explosive," while he knows perfectly well that neither coal dust nor pit gas is explosive by itself, though they may form explosive mixtures with the air. Also in discussing "smokeless," "flameless" and "safety" explosives he fails to point out that these terms are used in the art in a purely relative sense and that an explosive possessing these purely negative qualities absolutely does not exist. Justice requires us to state, however, that when discussing catastrophes in explosive works he says: "The author has always warned manufacturers and users alike that the function of an explosive is to explode, and that although certain compositions are almost insensitive to ordinary impulses, such as blows, friction, etc., yet he never believed that any explosive existed which under favorable conditions and by proper means could not be made to explode," but this point is emphasized because in a publication such as this, which may be cited as authority in litigation in which important interests are involved, care should be taken that no loose terms or unqualified phrases regarding the properties of matter are used.

Surprise is expressed at the extent to which black powder is still being used, it being stated that 7,000 tons of it were used in the mines and quarries of Great Britain, and 3,597 tons exported in 1907, making 10,597 tons in all. This is markedly less than the output of the United States, where the production of black powder at the census of 1900 was 62,412 short tons and at that of 1905 was 107,910 short tons. In fact, since the statistics of this industry in the United States were first separately taken, at the census of 1840 there has been a constant increase at each decade, and this failure of "smokeless" powder to supplant black powder was commented on with fullness in the Census Bulletin for 1900.

The book is filled with information, much of which is quite up to date, and it bristles with references, a large part of which are to British patents. A defect is in its limited use of American sources, patent or other readily accessible literature, for a country which produced 363,748,097 pounds of explosives of all kinds in the census year 1905 can not have failed to have made useful contributions to the progress of the art. Nevertheless, the book is a good one. It is more than a compilation, for it is thoughtful, critical and sometimes controversial. Every one of the many who possess the parent volumes must also acquire this and they will be pleased to have done so.

CHARLES E. MUNROE

Birds of the World. By FRANK H. KNOWLTON, Ph.D., with a Chapter on the Anatomy of Birds by FREDERIC A. LUCAS. The whole edited by ROBERT RIDGWAY. With 16 colored plates and 236 other illustrations. American Nature Series, Group 1, Natural History, pp. i–xiv, 1–874. New York, Henry Holt & Co. 1909.

In the elaborate and excellent American Nature Series, now in course of publication, Knowlton's "Birds of the World" forms the third issue under the head of "Natural History," having been preceded by Jordan's "Fishes" and Kellogg's "American Insects."

Writers of bird-books sometimes hear the remark in tones of disparagement: "But you describe so few birds! The robin and the chipping sparrow are very well in their way, but we should like to read about the bird-of-paradise, and the toucan as well." Such critics will have no case when they handle Mr. Knowlton's weighty volume, for in this treatise he reviews the entire class; there are over eight hundred large pages, and these are embellished with nearly two hundred and fifty illustrations.

When we reflect that the birds of the world comprise upwards of twelve thousand species, and that the major and minor celebrities form a great company, with an already vast and ever-growing literature, the labor and difficulty of preparing a well-balanced hand-book for the entire field, which shall be both useful and interesting, is a task of no holiday order. In our opinion the author has succeeded admirably in nearly every respect. His work, from necessity a compilation, is certain to prove very useful; it is published in attractive form, and possesses a large fund of interesting facts concerning the structure, classification and general habits of the better known and more important members of the entire avian group.

The body of the work is preceded by several sections of an introductory nature, dealing with the general characteristics of birds, with their distribution, migration and zoological relations. This part further includes a very compact and valuable chapter on the Anatomy of Birds by Mr. Frederic A. Lucas. The fact that the entire work has passed under the "editorial censorship" of Mr. Robert Ridgway should tend to discourage those critics whose appetite is whetted by their ability to find mistakes. Twenty-one chapters follow on the "orders" in the classification adopted by the author, beginning with the sole occupant of a subclass, the famous *Archæopteryx,* which has been pronounced three fourths "bird" and one fourth "reptile," and ending with the great order of Passeriformes, said to embrace over seven thousand species, or more than one half of all known birds. This is followed by a full, and therefore useful index.

Dr. Knowlton's book is presumably not one of the kind intended to be read from cover to cover, but like Newton's "Dictionary of Birds" and other extended treatises, is to be used as a compendium for reference. The author has surveyed the most pertinent literature so well, and has preserved so sane a judgment in dealing with it, that he is a guide to be trusted on all matters of which he treats. His errors will be found to be chiefly those of omission.

Some criticism could be made of the author's style, but this is certainly even and clear, and probably well adapted for a reference-work of this kind. The reviewer has found no errors of consequence, those noted being of a rather trivial order, as when in speaking of the night-hawk, Mr. Knowlton says (p. 43): "Some individuals" spend "the summer in Alaska and the winter in Patagonia," which may be true, but is an assumption, to be tested only by the marking of individual birds. The "banding" or "ringing" of individuals to obtain exact data on migration, first tried with a measure of success on the *Phœbe* by Audubon, has been taken up rather recently, and with the promise of yielding very valuable results.

We miss from the introductory matter any summary of the modern work on the instincts, intelligence or general behavior of birds, a subject no longer of interest to psychologists only. In speaking of the absence of "hook-like processes of the ribs" in *Archæopteryx* as a "decidedly reptilian character" it should perhaps be noted that the New Zealand lizard-like *Hatteria* possesses them, as well as the crocodile and alligator, and the latter, moreover, builds a nest which is guarded by the male.

We can not subscribe to the view that "we are without an adequate theory of birds'

nests," for we regard the nesting instinct as no more inexplicable than the other instinctive actions which recur with almost clock-like regularity in the reproductive cycle of most birds. The entire round of activities which leads to the production of a certain type of nest, as in the robin, vireo, or oriole, is without doubt remarkably uniform and stable. But it is far less stable or uniform than the conditions which determine the form and color of the egg. If this is true it is not altogether surprising to find some open nests with snow-white eggs, and some closed ones, like the magpies', in which the eggs are spotted. Yet no one could maintain that the behavior of the wild bird is to be explained by any simple formulæ, at any point.

The abundant illustrations which have been drawn from a variety of sources, are naturally uneven in proportion and quality, half-tones of photographs from life having been excluded to keep down the weight, but the plan thus followed has certainly led to variety in abundant measure. FRANCIS H. HERRICK

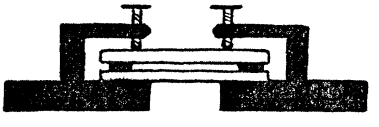
SPECIAL ARTICLES

A SIMPLE FABRY AND PEROT INTERFEROMETER

DURING a course of experiments with interferometers it was found that a very simple and inexpensive Fabry and Perot instrument could be constructed of plate glass which gives results almost as good as the costly interferometer. The construction of this apparatus for demonstration purposes will well repay the teacher and student. The sharp-colored interference rings obtained by using luminous gases in vacuum tubes as sources are extremely beautiful. The D lines from a sodium burner are easily separable. If the interference pattern using a copper or iron arc is focused on a wide slit of a single prism spectrometer, a section of the interference rings is seen in the various spectrum lines, illustrating the method of Fabry and Buisson for the determination of the new standard table of wave-lengths. The Zeeman effect can also be easily shown with this apparatus.

Take two pieces of plate glass about an inch square (I have used the so-called German plate) and silver[1] them till one surface of each plate cuts down the intensity of the transmitted light to about a quarter of the incident light. Separate these silvered surfaces by two strips of cardboard. A useful thickness to begin with is the cover of the 24 two-cent postage-stamp book, as this will clearly separate the D lines. Mount these plates over a half-inch hole in a metal plate by means of three pressure screws, two of which are shown in the following diagram, being a section through the center. The third screw is midway between the other two and at the end of the plates.

Looking normally through the plates at the glowing filament of an incandescent lamp, a number of images of it will probably at first be seen. Adjust the pressure screws until these images are in juxtaposition in the line of sight; the silvered surfaces are then approximately parallel. Place the instrument in a clamp stand, and focus the light from a sodium flame or a vacuum tube upon the plates and look at the interference bands with a small laboratory telescope focused for infinity. Usually the eyepiece has too large a magnification for the above retardation and it is better to use in place of it a single lens



of focal length about two inches. At first only a small section of the interference pattern is seen, but with a little careful adjustment of the pressure screws the whole ring system is obtained in sharp focus. Removing the telescope and with the above lens used as eyepiece, focus the interference system from the above sources or an arc, upon the slit of a spectroscope. The bands in the different spectrum lines are then observed with the telescope on the spectrometer.

For further suggestions regarding the adjustments and other experiments for which this apparatus can be used, refer to an article

[1] For silvering solutions see the appendix to Baly's "Spectroscopy."