sion of Health and Sanitation of the Institute of Inter-American Affairs and now assistant secretary of the American Medical Association. We find that our activities can often be coordinated with that of other organizations, to our mutual benefit. It is quite possible that the medical work for Peru can be extended to other Latin American countries. Progress is being made toward setting up other collaborative groups in Latin America which should promote not only interchange with our committee, but also useful interchanges among the scientists of the different Latin American countries.

There will probably be opportunities for important cooperation with Unesco's operations in the United States. Mrs. Buechner has worked with the Pan American Union in forming a guide and description of the various universities, colleges, and scientific institutions of the American Republics. The Inter-American Committee has also been closely associated with the large translation project managed by *Science Service,* and is thus in close contact with the scientific publishing houses of Latin America.

Finally, I should mention that the existence of the Inter-American Committee has become so well known in Latin American scientific circles that the office in Boston has the opportunity of undertaking a multitude of miscellaneous services. They include bibliographic work, guiding Latin American students and scholars in their travels through the United States, entertaining scientific visitors, and some assistance to the many science students in the Boston area (including the annual "Evening with the Stars" at the Harvard Observatory). To handle these miscellaneous operations competently, we shall soon require a larger budget and a larger staff.

The gratifying cooperation given our committee has led us to propose that the Committee on Inter-American Scientific Publication should become an International Committee on Scientific Information. From 34 countries of Europe and Asia we have received requests for the special articles by experts, for the summaries prepared by the scientific societies, and for other services of the sort we now give in the interests of our Latin American assignment. The cultural attachés connected with our embassies and legations in a number of countries in the Eastern Hemisphere have already distributed copies of our material. So far as it goes, this distribution from government offices in Europe and Asia is useful; but we feel that it would be better to deal directly with the scientists, and with their scientific journals and institutions.

Robert Ridgway's Color Standards

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PRIOR TO THE APPEARANCE of Ridgway's *Color standards and color nomenclature* in 1912 (*22*) English-speaking biologists had neither a standardized set of colors nor a generally recognized set of color names. Scientists had long been striving for accurate description but had not felt the specific need for precise color terminology until about 200 years ago, when the many naturalists interested in the mass of new material brought in by world explorers had to introduce order into their descriptions if the information they recorded was to be of any value to others. In two of the first important systematic works written in English, especial care was taken in respect to color records, both in the written descriptions and in the coloring of the copper plate engravings. Mark Catesby, writing in 1743 (*1*), says: "In Designing the Plants I did them fresh and just gathered; and the Animals, particularly the birds, I painted them alive (except a very few . . .)." He concludes by referring to possible color variability of two kinds: pigment changes in his illustrations and actual color differences in specimens arising from seasonal variations. George Edwards reported his methods of drawing, engraving, and coloring in the preface to *A natural history of birds* (*4*). He states: "A copy carefully and exactly coloured from the original drawings will be deposited in the Library of the College of Physicians, of London, which may serve as a Standard to refer to and to compare with, to try the Truth of the Colouring, in case the Plates should outlive me, and any should question the Authority of the Colouring." He adds, in Part II in 1747, "This book hath the Advantage to be Original in its Figures, as well as its Descriptions; not one of the former being copied from others, or the latter being translated or transcribed."

Many of the color records made since the develop-

ment of modern systematics by Linnaeus, both in the early period and today, are very similar to those made by an early Canadian naturalist, Charles Fothergill (*7*), who in 1820 described the back of a sandpiper as "a light olivaceous yellow brown, or dead flesh color." Workers in color have been irritated by such terms, even though admitting that they are superior to imaginative descriptions such as "Elephant's breath" and "Isabella-colored," and have preferred to use descriptions such as olive, scarlet, and turquoise, or color words such as red, pink, and brown, modified in various ways as recommended by Judd and Kelly (*12*).

Color terms of any sort, however, cannot be used satisfactorily without reference standards, and standards cannot be used over any extended period of time unless they are reproducible. While standards of sorts have existed for many years, the three most widely used in the English-speaking world today are those that satisfy, in part at least, the color theories advanced within the last 100 years by Clerk Maxwell, Hermann von Helmholtz, and others. These three systems have much in common, but they differ considerably in some respects, and each possesses some unique attribute. The one devised by Albert H. Munsell (*16, 17*), a professor of normal school art, has qualities that give it fundamental importance when judged by modern physical and psychological standards. One introduced by Wilhelm Ostwald (*5, 20*), a great physical chemist, finds many applications in the field of decoration. The standards developed by Robert Ridgway are preferred by biologists. There are two apparent reasons for this preference: most of the colors needed by biologists are included, and most of the names assigned to the colors are satisfactorily descriptive according to everyday usage. Besides the frequent references to these standards in biological writings, there are also many uses in other fields which indicate their status. Dade (*3*) standardizes Saccardo's Latin Color Names (*24*) on a Ridgway basis; Maerz and Paul (*14*) make many references to Ridgway names and give their color equivalents; and Wilson (*26*), in his color charts for horticultural use, gives Ridgway names for his chips when possible, as does Villalobos (*25*) in a recently published set of standards.

Robert Ridgway (1850–1929) was curator of birds at the United States National Museum for over fifty years, and "was known and honored throughout the ornithological world," to quote an obituary (*27*). While he was an active student of bird life for some seventy years, and writing on the subject much of that time, as the dates of his 540 papers indicate (*9*), his contributions to the science of color are noteworthy also, because of his paintings and two books on color standards. Very early in his life he started painting portraits of birds, and they had become so good by the time he was ten years old that his schoolmates are said to have paid as much as fifteen cents each for them (*2*). Besides being interested in good illustrations, he became involved in the problems of color description in the taxonomy of birds and he saw the need for reference standards not only in ornithology, but also in the whole field of biology.

He attempted to satisfy this need by publishing in 1886 *A nomenclature of colors for naturalists* (*21*), illustrated with 200 hand-stenciled chips, and supplied with a glossary of parallel color name equivalents in seven languages. He justified the publishing of the book by writing: "The want of a nomenclature of colors adapted particularly to the use of naturalists has been more or less of an obstacle to the study of Nature," and he also elaborated on the fact that "popular and even technical natural history demands a nomenclature which shall fix a standard for the numerous hues, tints, and shades which are currently adopted, and form part of the language of descriptive natural history" (*21*).

This book was welcomed by contemporary naturalists and its standards are still occasionally used, but Ridgway himself apparently realized its limitations, for he continued to work on color standards and devoted all his spare time for twenty-five years (*9*) to their development and publication. He was encouraged and helped toward this objective by others, two in particular: professionally and financially by his great friend, Don José Zeladón, the famous Costa Rican ornithologist (*23*); and in the handling of details of publication and checking by his wife, Julia Evelyn Perkins Ridgway. *Color standards and color nomenclature,* with its 1,115 named colors, was finally published early in 1913 under the date of 1912, and is still the color system most generally used by biologists.

Ridgway set up his standards with the expectation that they would be exactly reproducible in the future, using methods and materials specified by P. G. Nutting of the National Bureau of Standards, but these are not adequate according to present conceptions of color accuracy. In 1912, standards and methods for the physical specification of visual colors were not yet available. Since then, exact methods have become available, have been accepted on the international level (*12*), and now are coming into general use. It is unfortunate that Ridgway chose some pigments which fluoresce (*8*) and are affected by humidity, by abrasion, by offsetting, and by hue shift (*10*). In addition, his arrangement of colors is such that it is impossible to specify exactly the colors falling between the 1,115 illustrated. This limitation is important,

for it is currently accepted that over ten million shades of color are discernible to the normal observer (*12, 19*). Despite these serious handicaps, the Ridgway standards are still the favorite of biologists, and it is proposed to consider critically the advantages possessed by these standards and not by others.

Ridgway, like Munsell and Ostwald, developed his system of color description after extended study of color phenomena and ideas. It would appear that there were three stages in its development: first, a period of observation and record, in which he considered colors occurring in nature, pigments suitable for recording these colors, and names useful in describing them; second, organizing the colors within the color solid so that the final colors of his system were systematically spaced, with much use of the Maxwell color wheel; and third, reproducing the colors for publication.

The colors are disposed within a color solid on a series of concentric cones that are spread out on the chart as if they were cylinders. Around the mid-periphery of the outer cylinder are distributed the 36 highly saturated colors of his "pure spectrum scale." Above each color are the three "tints," obtained by systematic dilution with white, and below are the "shades" obtained by dilution with black. Thus there are seven colors for each hue in the series. The first cylinder of colors lying within the outermost is known as the "prime one" (′) series. The full colors on the mid-periphery of this cylinder are derived from the full colors of the outer spectrum series by dilution with a definite percentage of neutral gray, the tints by dilution with the same percentage of white as employed in diluting the first series, and the shades in a similar manner by dilution with black. Four additional series of colors, designated as prime two (″), three (‴), four (⁗), and five (⁗′), are derived like the prime one series by addition of increasing amounts of neutral gray. For the central axis of his solid, Ridgway provided two series of grays, called Neutral Gray and Carbon Gray, to be used according to varying conditions.

As the system was planned, there should have been 1,512 colors ($36 \times 7 \times 6$), but Ridgway reduced the number of hues in the series of low saturation, (the reduction being from 36 to 7 in the prime five series, for example) so that the total is only 1,115, consisting of 1,057 regular colors, 42 extra colors, 14 grays, black, and white.

These 1,115 colors were primarily found by using the Maxwell color wheel, and were duplicated by painting. In making up the color chips for publication, enough sheets of paper were painted of each color to provide for an edition of 5,000 copies (*8*). The work was done by A. Hoen and Company of Baltimore, initially under the immediate direction of Ridgway and his wife. While troubles and accidents hampered them from the beginning (*9, 18*), the original painted sheets were sufficient for most of the required chips. Though further editions were contemplated, only one was issued. Some confusion on this point has been caused by a letter written in 1937 which has been interpreted as meaning that a second edition had been published (*13*). It had reference only to the completion of the edition.

It has already been noted that Ridgway was very early interested in satisfactory names for colors. From 1885 until 1912 he devoted considerable time to choosing suitable names for his colors from those currently used, and to modifying color names in simple ways to describe related colors. While "Isabella-colored" and "Invisible Green" occur in his nomenclature, there are remarkably few names not suggestively descriptive. In general, the Ridgway names are so good that they have been adopted widely, and it is likely that these names will be applied for a long time to colors similar in appearance to those that he named. He provided, in addition to the names, a system of notation. This is not very generally used, but it is the only method for identifying the 4,559 in-between colors, recognized in the system but not provided with names or chips.

Biologists are sometimes asked by color workers why they prefer the Ridgway standards. This question has been answered by a mycologist: "I can find the colors I want there, other mycologists use the same standards, and the literature for years has employed Ridgway names." Mass use by biologists is indicated by similar statements from other specialists, and also by the replies to the Canadian Questionnaire (*15*). It would thus seem probable that Ridgway standards would continue to be used for many years to come if they were permanent, and if new copies could be obtained, regardless of the scientific advantages of other methods of color description.

Answers to the Canadian Questionnaire and many personal discussions have clearly indicated that other color systems have been considered and used. Many biologists have tried and have flatly rejected the *Munsell book of color* as unsuitable for biological work. In developing his key to Ridgway in terms of Munsell notations (*8*) the author became interested in this point of view, which seems to be caused primarily by the lack of matchable colors. After work on the key was finished the notations of the Ridgway colors were examined to see if there was a foundation for this opinion. It was found that of the 1,057 regular Ridgway colors, 454 are outside the range of the 40-hue *Munsell book of color*: 221 are higher in value and/or chroma; 136 found in 18 hues possess a lower chroma;

and 97 are marginal. The number of low chroma colors is noteworthy, for they are especially useful in ornithology, mammalogy, and mycology. The need for low chroma Munsell colors has now been recognized by publication of special colors for soil work.

The future of the Ridgway standards and the Ridgway appraisal of color needs. In summarizing the present status of the Ridgway standards and their place in future color description there are two main considerations. The first is that there is no means of reproducing the original colors exactly and it is possible to give only approximate equivalents, as has been done in other systems and in the author's key now being published. The second is that experience has shown biologists generally are satisfied by the selection of colors that Ridgway worked so long and successfully to fit to their needs.

In view of these facts biologists might well consider the adoption of a comparably inclusive but permanent system of color description. While such a system might be entirely new, it could be much more readily developed, and would make available a very large body of information and past experience, if it were standardized primarily on the international basis provided by I.C.I. agreements of 1931 (*11*). It could be fitted into the Munsell color solid, so that there would be no need for an entirely new set of standards, but only a series of specialized sets of color corresponding to those parts of the Ridgway colors that have been most widely used in the various special fields. If this were done at an early date, aid could be obtained from active users of Ridgway and it would not be necessary to depend upon records in the literature and a key, both of which have distinct limitations, chiefly because of actual physical changes in the various copies of Ridgway standards.

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