made by Dr. Walter B. Jones, state geologist in charge of excavations in the Moundville area. Plans for the structure call for a central building 130 feet by 43 feet, surrounded on all sides by terraces. The building itself is to consist of a central exhibition hall 40 feet by 60 feet in size, with a wing on each end of the exhibition hall to house burial pits already excavated. No change will be made in these burial pits, which were excavated and put in their present condition by Dr. Jones and his assistants. Remains of the Mound Culture and Mound Indians are preserved in these burial pits, which have been exposed and laid open to view. Construction of the museum is the joint project of the Civilian Conservation Corps and the National Park Service.

REORGANIZATION of the Biological Board of Canada under the name of "The Fisheries Research Board" is provided in a bill introduced in the House of Commons, Ottawa, by Hon. J. E. Michaud, Minister of Fisheries. Mr. Michaud said that the old name was misleading to the public, as the work of the organization was confined to fisheries, and did not extend to biology generally. Some universities did little or no work on fishery research and they would not be represented on the new board. It will consist of fifteen members appointed by the Minister, two from the Department of Fisheries, two representing the Atlantic Coast and two the Pacific Coast fishing industry, and nine scientific men selected from a list which will include nominations by any Canadian university whose staff includes investigators engaged in research bearing on fishery problems.

THE Association of American Medical Colleges has completed the study of the accomplishment of all freshmen in medical schools during the session 1935–1936. Any arts college or university which would like to have a report on those of their students whose records form a part of this study may obtain it by writing to the secretary of the association, 5 South Wabash Avenue, Chicago, Illinois. This study has been made each year since 1928. The records of students in the second, third and fourth year of the medical course may also be obtained if the names of such students are given. The full four-years report applies only to the class which entered medical school in 1932; the first three years for the entrants of 1933; first and second year for the entrants of 1934; freshmen for 1935.

THE *Journal* of the American Medical Association reports that it is hoped to finish the building of the Paris Eastman Dental Clinic in time to hold the dedication ceremonies on July 4, 1937. The president of the French Republic, M. Lebrun, Ambassador William C. Bullitt and a number of other leading French and American personalities will be invited to take part in the ceremonies. The clinic is designed to provide free dental service for children less than sixteen years of age who are unable to pay. It occupies a large area, and the land surrounding the clinic will be converted into parks and playgrounds. The work of the Paris Eastman Dental Clinic will be based on that carried out at Rochester, N. Y., and it should serve as a center for dentists and dental surgeons to carry on research and postgraduate work. It will also aim to teach children and parents the need and value of regular dental work.

THE transfer of the *Discovery* to the Boy Scouts' Association is reported in the London *Times* to have considerably disorganized the arrangements of the British Antarctic Expedition Committee and has made it impossible for them to carry out their original program. E. W. Walker, commander of the proposed Antarctic expedition, states that a certain proportion of financial support was conditional on acquiring the *Discovery* and will no doubt be withdrawn. It is the intention to readjust the organization and draw up a new program.

DISCUSSION

MIMICRY, AS VIEWED BY PROFESSOR SHULL

THE book on "Evolution," by Professor A. Franklin Shull, is, according to the preface, an "attempt to review the field of evolution as it appears to modern biologists, with the genetic bearings indicated wherever these may reasonably be assumed." It is stated that "general books on evolution have . . . lacked any adequate application of knowledge of genetics to the problems of evolution."

One of these problems is natural selection, and the author discusses it with special reference to the theories of mimicry and other forms of protective coloration. Now the field of genetics is scarcely the standpoint from which to survey problems of the coloration of insects as a whole, for genetics are primarily concerned with the basic changes which result in *production* of a certain appearance, whereas the problem for the mimetist is not "how or why" a habit or pattern is produced, but how or why it *survives*. There is thus from the beginning a discrepancy which is constantly apparent between Professor Shull's point of view and

the phenomena which he discusses. The question whether various types of coloration really are of use is treated from a philosophical point of view rather than from that of a naturalist in the field who sees events happening.

The study of mimicry suffers much because it is so often discussed by critics as an isolated, rather peculiar, rare phenomenon exemplified by a few butterflies and moths and made of too much importance by a band of imaginative enthusiasts. Few critics seem to be aware of the great extent of the phenomenon, and Professor Shull is no exception. Thus, page 181 seems either to expose his unfamiliarity with the subject or to be an unworthy attempt to pour scorn upon it. What is to be thought of the statement that the bulk of instances of mimicry are among the butterflies and moths or of allusions to "the alleged mimicking of the lady beetle by other beetles, of a beetle by a grasshopper, of a wasp by a beetle . . ." and so on? "Most instances of mimicry in butterflies occur in a certain small group of subfamilies." This is most misleading in seeming to suggest affinity as the cause of mimicry—a suggestion which can not be sustained for the phenomena as a whole.

Mimicry is of the same order as the procryptic resemblance of a Membracid to a thorn: an insect escapes being eaten because it reminds the enemy of an object which he is not accustomed to eat, either because it is unpleasant or because it is of no food value. Affinity does not account for the resemblance of a caterpillar to a twig or a bird-dropping, neither does it explain the superficial resemblance of a fly to a wasp.

Mimicry is embraced by the sentence (p. 167), "the animals are presumably seen but are regarded as of no interest by prospective predators," which the professor applies to procryptic species. Carrick[1] showed that a bird taking food to its young did not perceive stick-caterpillars at rest on twigs at the entrance to its nest, but if these were placed where they were obvious they were picked up and given to the young.

The fundamental principle of *relative* edibility is ignored in such a phrase as "unfit to eat" in an argument on page 177, though the author invokes it for his own purpose on page 172. Edibility depends upon the presence together of a number of articles of food having different qualities of taste. Under pressure of starvation men have been known to devour boots; the present writer has seen a wren in a wood in winter extract from dead leaves and devour a large cock-tail beetle, black and stinking, possessed of all the attributes of a defensively colored species. On the other hand, in his experiments with two young monkeys[2] the writer found that the soft-bodied, brightly colored Lycid beetles were placed by them as near to absolute inedibility as could be expected without real starvation. These beetles, wherever they occur, are mimicked by species of other orders; according to Morton Jones[3] a species was found to be equally unattractive to birds.

Referring to ants, Professor Shull enlarges on the danger of mimicking insects so much devoured by predators. But not by *all* predators! The monkeys mentioned certainly objected to ants running near them and pawed them away vigorously. The writer watched, in an African verandah, a ragtail picking up disabled flies which had been hit by a fly-flapper and, lying on the ground, attracted ants. The bird did not want to eat ants and shook vigorously the corpse of a fly, endeavoring to dislodge the ants which clung to it. If mere number were the chief factor in providing prey the bird could have obtained a greater weight of food had it attended to the ants instead of the less numerous fly corpses.

Another point made by Professor Shull is that protective coloration would not deceive insect enemies (p. 169). The force of this argument is weakened by the fact that nowadays no one supposes that it does: mimicry or procrypsis are not generally supposed to protect against predatory insects. It is true that in the days of teleological theology the resemblance of the fly *Volucella* to the bumble-bee in whose nest it breeds was claimed as a provision of Providence, whereby the fly can enter the nest unharmed, but such views are not in accord with the present day.

The subject of warning colors is lightly treated, and finally (p. 212) contemptuously dismissed, but students of living insects in their natural environment will not agree with this. It is difficult to believe that Professor Shull has any acquaintance with the working of this principle; it is a phenomenon of life and not of museum specimens or logical arguments. What meaning can there be in the following occurrence, unless warning colors *are* accepted as such by predators?

The writer experimented on two young monkeys with miscellaneous insects.[4] A large grasshopper, shiny blue-green and red, which freely exposes itself in the open, was put down for a monkey to see. "It at once erected its wings vertically, showing their purplish-red and black colour, but made no attempt to escape." The monkey "looked very hard at it, took hold of one wing, let go, and again looked very hard at it, but made no attempt to eat it." But he immediately devoured a large procryptic grasshopper put down in the same way, and then another. More con-

[1] R. Carrick, *Trans. Royal Ent. Soc. Lond.*, 85: 131–139, pls. 1–3, 1936.

[2] G. D. Hale Carpenter, *Trans. Ent. Soc. Lond.*, 1921: 1–105, 1921.

[3] F. Morton Jones, *Trans. Ent. Soc. Lond.*, 80: 345–386, pls. 18–28, 1932.

[4] *Loc. cit.*

vincing still was his behavior in the bush under close observation, but free to do as he liked. He found a pair of these warningly colored grasshopper *in copula,* freely exposed on short grass, a fact in itself highly suggestive. He "went up to them and pawed the male. Without attempting to get away, the grasshopper merely erected its wings perpendicularly so as to display their purplish and black colors. The monkey took no more notice and ate some grass. Afterwards he ate other insects, including a large *Cyrtacanthacris* grasshopper." The same maneuver was utilized by another member of this species when threatened by a fowl which ran up to it, halted, gazed at it and walked away. The specimen was then killed, and laid on the ground with its purple wings hidden under the covers; fowls were seen to peck at it but obviously found it very tough and, though they pulled it about, ate none of it. Professor Shull comments on the danger of drawing conclusions from experiments on animal behavior (p. 183), but quotes experiments to show that birds may not see colors as we see them, for "some experiments by Hess on domestic fowls indicate that the middle to red portions of the spectrum are more easily seen than the blue and extreme red."

The inner significance of this is, however, not noted by the critic: it is that, broadly speaking, red, orange and yellow are the very colors utilized for warning, while blue and green are rare in comparison.

"Logical Objections" to natural selection take no account of the facts that the possession of stings, poison spines or irritating hairs, emission of acrid juices or foul odors, toughness and powers of resistance, even to chemical injury, are associated with characteristics of the living animal such as instincts leading it freely and fearlessly to expose itself, often herded in masses whereby conspicuousness is increased, together with slow and heavy gait or flight, the latter sometimes accompanied by a loud rattling noise. Why is such an association not found among insects that resemble their surroundings when it is characteristic of those that have warning colors? And why almost entirely among insects of *diurnal* activity if the colors are not meant to be seen; and if they *are* meant to be seen what other explanation than natural selection fits all the facts?

Professor Shull does not seem to have grasped the principle of common warning colors, for he finds it difficult to imagine how a species can derive advantage by changing from one warning color to another (p. 189). If two species, A and B, each have a pattern which has to be learned by enemies, the loss resulting to each species, *and each pattern,* will be a certain percentage, let us say 10 per cent. But if two species combine to show a single pattern, the loss to the pattern remaining as before at 10 per cent., the loss to the two species bearing that pattern will be 10 per cent. *divided between them,* or between as many more as, through the processes of variation, have been able to enter into that pattern.

The fundamental principle of mimicry, that it is the artist and not the anatomist who is deceived, has a bearing on one of the most important attributes of natural selection, the production of a result by different means. Professor Shull treats this very lightly and reduces it to genetics (p. 184). But an argument based on corresponding mutations fails to explain cases such as that of two Longicorn beetles in Australia which resemble a wasp. The latter bears the characteristic Australian aposeme of red-brown and black in transverse bands. One beetle reproduces the effect on its elytra, the other has the elytra so aborted that such a display is impossible: the colors, however, are shown to the same extent as in the other species, but across the exposed dorsal surface of the abdomen, concealed in the first beetle. The effect is the same to the eye at a little distance.

Two especially striking illustrations of the principle are given by Poulton,[5] but lack of space forbids further treatment of it here. The argument based on corresponding mutations can not stand for mimicry as a whole, nor for its analogue, procryptic resemblance. Would Professor Shull apply it to the resemblance of a moth to a bird-dropping? Even for mimicry between butterflies it has been shown to be invalid.[6]

Professor Shull adduces among his "logical objections" the extremely feeble one, "those few instances in which model and mimic do not occupy the same area" (p. 188). Has he any idea at all of the disparity between the great numbers of cases in which the correspondence in distribution is close and the comparatively few cases in which there is little or no correspondence and for which it may be said, there is a possible explanation which demands further knowledge of the movements of migrating predators? Cases which must be ascribed to pure coincidence do exist, and Dixey[7] carefully examined the question. His paper reveals the weakness of the argument based on coincidence. The fact that Handlirsch is quoted in favor of this argument (p. 192) only suggests that that expert morphologist knew no more than Professor Shull of the correlation in distribution which has been worked out for such African species as *Papilio dardanus, Pseudacraea eurytus, Acraea johnstoni,* for the American *Limenitis* or the Euplocas of Fiji.

Finally, space allows no further criticism than to

[5] E. B. Poulton, *Trans. Ent. Soc. Lond.,* 79: 395–398, pls. 14–15, 1931.

[6] E. B. Ford, "Mimicry" (Methuen's Monographs) by Carpenter and Ford. Pp. 106–7, 1933.

[7] F. A. Dixey, *Proc. Ent. Soc. Lond.,* 1913: 60–69, 1914.

point out that, in this book, mimicry is regarded as a mere question of "similar patterns" (pp. 181, 192). On page 193 we find that color may be "purely incidental" and the suggestion is made that spots occur in a certain place "because in that position the physiological gradient decrees the appropriate mutation." The extremely narrow view of mimicry which prompts such argument ignores the fact that mimicry is not merely a question of color and pattern but of shape, instincts and habits.

Moreover, such an argument takes no account of the resemblance of a moth, beetle or caterpillar to a bird-dropping, of a spider to an ant or of a young grasshopper in which resemblance to an ant is produced by the artistic process of painting out by pale pigment a large part of the corpulent abdomen, so that the narrow "waist" of the ant is pictured by a thin strip of the normal dark color, the remainder of the robust body being rendered invisible in its natural surroundings.

The writer concludes with commending to all students and critics of mimicry the slogan, "Mimicry deceives the artist but not the anatomist."

G. D. HALE CARPENTER
UNIVERSITY MUSEUM, OXFORD

A SYSTEM FOR FILING MONOGRAPHS, PAMPHLETS AND REPRINTS

SEVERAL systems for filing pamphlets and reprints have been suggested (Stone[1]; Storer[2]; Eikenberry[3]; Morrey[4]; Harper[5]; Miller[6]; Montgomery[7]; Boring[8] and Smith[9]). Each of these systems embodies certain useful and helpful suggestions. The following plan has been used by me for several years and it has been found to be very efficient. Since many of my friends have commented favorably on the system, I am presenting a brief outline of it so that others may adopt it or certain parts of it.

As monographs, pamphlets and reprints are received, they are classified according to their subjects. If more than one subject is included in a single reprint, as is often the case, then an effort is made to select the subject-division which seems to be the best one suited for my collection. As soon as the reprints are classified according to subjects, a white gum label, 1½ by 15/16 inches, is placed on the upper left-hand corner of the front cover of each reprint or, if the reprint does not have a cover, the label is placed on the corresponding position of the front page. The subject-division of the classification, the number of the reprint in that division and the total series number are all written in that order on the label. For example, the 117th reprint on "Blood" was the 869th paper classified, and the 620th paper on "Endocrines" was the 1880th paper classified. The notations on the labels for these two reprints appear as follows:

Blood	Endocrines
#117	#620
No. 869	No. 1880

If a series of two or more reprints are bound under one cover by the publishers, as is sometimes the case for economic reasons, then the label carries as many numbers as there are separate papers bound together. The label is used so that the notations may be easily read, and this is a definite advantage, since many covers are colored. Also the label serves as an identification tag if one loans his reprints to other individuals.

A card catalogue is arranged according to both authors and subjects for all the classified reprints, and regular 3 × 5 cards are used. If there is only one author's name appearing on a reprint, then it is necessary to make two cards. On one of these the author's name appears first, and it is followed by the title and reference in that order. On the other card, the title appears first, and it is followed by the name of the author and the reference. If there are two authors' names appearing on the reprint, then it is necessary to make three cards: one where the subject appears first, and then each author's name appears first on individual cards. If there are two or more author's names, they are arranged so that each one heads the list. The notations on the label on a reprint are typed in the upper right corner of both the author's and the title cards. The author's cards are arranged alphabetically and kept in a filing cabinet. The subject or title cards are filed in the same order as the reprints appear in a division, and in the same order that the divisions appear in the classified systems, and therefore the title cards for a particular division are kept together in the files. This is particularly handy for surveying the various titles in a division, since it is more convenient to remove several hundred cards to one's desk than it is to remove a corresponding number of reprints. Also, this method tends to preserve the reprints, since they are handled only when they are needed.

As soon as the index cards have been prepared, the separate reprints are filed in drawers with their front covers forward and their backs uppermost. This makes it easy to read the notations on the labels.

If a reprint does not fall into one of my divisions,

[1] Witmer Stone, SCIENCE, 22: 53, 1905.
[2] Tracy I. Storer, SCIENCE, 44: 735–739, 1916.
[3] W. L. Eikenberry, SCIENCE, 45: 64–65, 1917.
[4] Chas. B. Morrey, SCIENCE, 45: 87, 1917.
[5] R. M. Harper, SCIENCE, 45: 315–318, 1917.
[6] M. R. Miller, SCIENCE, 46: 263–264, 1917.
[7] Priscilla B. Montgomery, SCIENCE, 52: 583, 1920.
[8] Edwin G. Boring, SCIENCE, 58: 329–330, 1923.
[9] Erwin F. Smith, SCIENCE, 58: 396–397, 1923.