courtesies be extended to the commission which it is customary to extend to other judicial bodies and other international committees. Suggestions, advice and objective arguments are welcomed, but polemics of all kinds will be consigned, unconsidered and unanswered, to the waste paper basket.

This public notice is given only after receipt of a number of letters couched in terms which it is exceedingly difficult to construe as within the bounds of professional courtesy or diplomatic usage.

CH. WARDELL STILES,
Secretary

THE ZOOLOGICAL RECORD

The Zoological Record, published annually by the Zoological Society of London, is now also the zoological volume of the International Catalogue of Scientific Literature, and is prepared with the active cooperation of the United States government, through the Smithsonian Institution. In spite of this, when the volume for 1909 came to hand recently, I was called upon to pay $2.50 duty, a larger sum than ever before. I thereupon applied to the Smithsonian Institution, and was informed that the *Record* appeared to be entitled to free entry, according to item 517 on page 71 of the Aldrich-Payne Tariff Bill of 1909. Armed with this information, I took up the matter with the U. S. Treasury, and after a lengthy correspondence with the authorities in Washington, New York and St. Louis, have received a check for the amount paid. I publish these facts for the information of other subscribers. It should be added, that not only is the *Record* entitled to free entry, but all "books and publications issued for their subscribers or exchanges by scientific and literary associations or academies."

T. D. A. COCKERELL

PRIMITIVE COPPER HARDENING

TO THE EDITOR OF SCIENCE: In his notably sane address on "The Lost Arts of Chemistry,"[1] Dr. W. D. Richardson refers to the question, much mooted among archeologists, concerning the hardening of copper in primitive art. While his general conclusion seems just, it is nevertheless liable to be questioned by collectors of primitive artifacts in this country and perhaps elsewhere. Some personal investigation of primitive copper artifacts indicates that for two reasons these are sometimes harder than is ordinarily attained by modern artisans. (1) While ordinary copper artifacts exhumed from mounds and other burial places are commonly coated with the green oxide, the edges of knives and sometimes other portions are patinated; and usually the patina (which may extend on both sides of the blade quite to its edge) is decidedly harder, albeit more brittle, than the unchanged copper. Not infrequently this patina is mistaken for the normal condition of the metal; and the collector regards his artifact as an evidence of artificial hardening beyond the reach of modern artisans. (2) Judging both from the condition of the prehistoric artifacts and from the methods pursued by primitive artisans, the copper implements of the American aborigines were commonly hardened by hammering, albeit rather adventitiously than intentionally. Now, in the process of working, the tools employed (corresponding to hammer and anvil) were not of steel or other resilient metal, but of stone; and experiment indicates that under the blows of an inelastic stone hammer on a thin blade resting on an inelastic stone anvil, the successive impacts are not so well distributed throughout the mass of the metal as are those produced by resilient steel tools; so that the blade undergoes a sort of skin-hardening, naturally culminating in the cutting edge. Of course this effect might easily be imitated by a modern artisan using primitive tools; yet it is a factor to be reckoned with in considering the widespread belief in the superior hardness of primitive copper artifacts. Speaking broadly, the notion of lost arts, which Dr. Richardson effectively combats, is a mischievous one. Of course throughout the long, devious and vacillating course of human progress, arts have disappeared—usually because replaced by superior arts. The indus-

[1] SCIENCE, Vol. XXXIII., 1911, p. 513 et seq.

trial arts especially rank among the most permanent, not to say eternal, of all the manifestations of humanity. It is hardly too much to say that only by the extinction of entire peoples are useful arts ever lost (except as superseded by more useful devices); and until well within the period of writing any arts possibly lost by extinction of peoples left little trace.

W J McGEE

SCIENTIFIC BOOKS

Light and the Behavior of Organisms. By S. O. MAST. New York, John Wiley and Sons. 1911.

While the present volume deals primarily with the question of the orientation of organisms the author tells us that it "may be considered a treatise on the behavior of organisms in their reactions to light." The first three chapters constituting Part I. are devoted to the historical setting of the subject and the statement of general problems and view-points. Part II. is concerned with the way in which organisms turn towards or from a source of stimulation. In addition to giving a very good résumé of the observations of others upon orientation this part contains a considerable amount of new material from the author's own researches. These include investigations of orientation in Indian corn, *Nasturtium, Amœba, Euglena* and a few other flagellates, the swarm spores of *Œdogonium, Hydra, Eudendrium* and some worms and insect larvæ. In general this work gives evidence of having been done with care and accuracy and adds materially to our knowledge of the general *modus operandi* of orientation. It is evident now to every one who has followed the work in this subject during the past few years that orientation is accomplished by a great variety of methods in different organisms. There is no such thing as a general scheme of orientation.

Loeb's theory of orientation is the author's favorite object of attack and he recurs to this doctrine and certain other views of Loeb with the persistence of Cato in urging the destruction of Carthage. It is not difficult to adduce cases that do not fall under Loeb's explanation of the way in which animals become oriented, but some of Mast's own investigations seem to afford about as good support as has been furnished for the theory which he so persistently attacks. No clearer case of orientation through the local response of the part directly stimulated could well be imagined than the one afforded by *Amœba,* and the author admits that the "method of orientation is in harmony with much in Verworn's theory and also with the essentials in Loeb's." But he adds that "it does not, however, support the idea connected with these theories, that a constant intensity produces a constant directive stimulation." I am not sure that I understand the pertinency of the criticism, for there is nothing in the theories of either of these writers which implies that the actual stimulating effect of any directive agency is subject to no variation. Both of these writers have adduced several cases which show that such variation occurs, and it is out of the question to suppose that either of them has overlooked the obvious importance of internal changes in determining the way in which an animal responds.

The author's experiments on the larvæ of *Arenicola* are of especial interest in regard to the problem of orientation. There is no reference either in the text or in the bibliography to the previous work of Lillie on the method of orientation in this form, although there is a quotation from a paper by Lillie dealing with certain features of its structure and development. The observations of Lillie are in general confirmed, but Mast has performed several additional experiments which bring out more clearly the fact that orientation is "due to difference of intensity on opposite sides" of the organism. The orienting response is shown to be due to light falling upon the eyes, the other parts of the body being apparently insensitive to this stimulus. When the larva is suddenly illuminated on one side there are no random or trial movements, but the head is bent directly toward the source of light. All the evidence points to the conclusion that orientation is the result of comparatively