male hummer near the nest after the young were hatched. I was lying in the shade of the bushes a few feet from the nest one afternoon. For two whole days, I had been watching and photographing and no other hummer had been near. Suddenly, a male darted up the canyon and lit on a dead twig opposite the nest. He hadn't settled before the mother hurtled at him. I jumped up to watch. They shot up and down the hillside like winged bullets, through trees and over stumps, the mother, with tail spread and all the while squeaking like mad. It looked like the chase of two meteors, that were likely to disappear in a shower of sparks, had they struck anything. If it was the father, he didn't get a squint at the bantlings. If it was a bachelor a-wooing, he got a hot reception.

YOUNG RUFOUS HUMMERS ON NEST IN BLACKBERRY BUSH

I can't believe the male rufous is an intentional shirk and a deserter. I think somewhere back through the generations of hummingbird experience, it was found that such bright colors and such devotion about the home were clues, unmistakable for enemies. It is therefore the law of self-protection, that he keep away entirely during the period of incubation and the rearing of the young.

Portland, Oregon.

The Future Problems and Aims of Ornithology

LETTERS FROM PROF. ALFRED RUSSEL WALLACE, DR. LEONHARD STEJNEGER, AND DR. PHILIP LUTLEY SCLATER

EDITORIAL NOTE. Occasionally it is said, half seriously, that ornithology is becoming overworked, and this sentiment is usually evident in some of the less scientific literature of the day. Perhaps it is not stated boldly, but an acute reader may sometimes peruse between the lines. Concerning strictly scientific ornithology I am optimistic, because the limits of work in this line depend upon the limitations of the worker. In other words if a science, and especially one of the biological sciences, begins to play out, as it were, it is usually a good sign that something is wrong either with the scientist or his methods, or with both.

Recently I sent a number of questions to several well-known ornithologists with the intention of gaining their ideas concerning the future aims of ornithology, and its special problems. A few indulgent scientists have kindly responded, and I feel sure the letters will prove of more than passing value to professional

and amateur alike. No harm, at any rate, can arise from a sober discussion of a subject of common interest. It will be readily understood, of course, that these letters do not in any manner constitute a controversy, but represent only a free-will expression of the writers' opinions. The series will be continued in the July issue.—W. K. F.

Broadstone, Wimborne, England, February 22, 1905.

DEAR SIR:

The chief department of Zoology that I take much interest in now, is the carrying out of experimental observations on the various alleged *instincts* of the higher animals (as the alleged instinct of direction) and also of experiments to prove or disprove the alleged *heredity* of acquired *characters*, and similar problems. With such a large endowment as the Leland Stanford University has, I wonder some experimental farm for these purposes has not been founded. Almost every other department of biology seems now to be overdone—except also the accurate observation of animal life in *the tropics*, for the purpose of detecting the *utility* of all the *special* characters of the various groups of land animals.

I trust these hints may induce some students with independent means to take up some of these studies.

Yours very truly,

[Signed] ALFRED R. WALLACE.

Washington, D. C., February 20, 1905.

DEAR MR. FISHER:

I thank you very much for your letter of February 2, and for the chance you give me to express my views on the future aims and work of ornithology, for such is the import of your questions, though worded differently for the specific purpose of advising the younger generation, i. e., the future ornithologists, those who are to take up the work where we are leaving it.

Allow me therefore to reply more in general without taking up your questions formally and seriatim. I hope that by the time I am through an answer to most of them may be gathered from what I have to say. Throughout your inquiry there manifests itself a certain regret akin to that of Alexander the Great, when he despaired because there were no more worlds to conquer, as if all the work had been accomplished by this time, and that none—at least of any importance—has been left for the younger men. For my own part, I only regret that I was born too early, that I became an ornithologist at a time when only the rough work fell to our lot. The generations before ours cleared the underbrush, broke the ground, ploughed a small part of it, and put in some seed. The generation to which we belong has ploughed other patches and put in some more seed. We have seen some tender sprouts come up, we have weeded and watered in spots, but we have wasted an enormous amount of work, and energy, because we had only experience bought at the expense of many failures to teach us. We have discovered that those before us did not plough deep enough and that most of our own work, even, has to be gone over again. Moreover, when we started out, we did not first take into consideration the nature of the soil. We spent as much work on the waste land as on the fertile ground capable of producing crops. But we have learned something, and the future generation will profit by our mistakes. They will see the whole field in bloom and some of them may live to taste the first ripe fruits.

This may seem a hard judgement on the work done, well intentioned and faithfully as it has been done. The workers are not to be blamed; they knew no better, *could* not know better. The work in ornithology has suffered exactly the same fate as nearly all the work in the biological sciences. The fact nevertheless remains, that most of the seed has fallen on stony, desert ground, and that consequently the sickly plants which came up withered under the rays of the scorching sun. Look over the amazing pile of literature which ornithologists have accumulated during the past century! You might fill room ofter room with such a library. And think of all the work involved and the money expended in the gigantic undertaking! Not only the cost of the books themselves, though some of the works run up into the hundreds of dollars, but cost of establishing and maintaining all the collections, private and public, which form the basis of all this accumulation. So vast is the pile that it requires bibliographic experts, for this branch alone, to keep track of the production. Nearly a score of journals, especially devoted to ornithology, have been pouring a flood of literature, every one, two, or three months, over the head of the unlucky ornithologist, not to speak of all the other innumerable biological journals, magazines, bulletins, and proceedings which nearly all contain ornithological matter. It is highly amusing to read Temminck's despairing declamation, in the epilogue of his "Manuel d'Ornithologie," of 1840[a], against the overwhelming deluge of periodicals, "from the southern part of Australia to the ice of the [north] pole." He ought to live today! And in all this colossal aggregation, how much is of permanent value! When a man is searching for records of real, detailed facts to be used in solving any of the enticing problems which spring up all around us, how many hundreds of papers has he not to go through without finding a single, solitary *fact* upon which he can rely. If he is a worker with means and men at his disposal, he will turn his back upon the books and pamphlets, and send his agent into the field, if he cannot go himself, to ascertain that fact. And in most cases I think it will be found that the field is not in some distant continent in a place where no white man has yet set his foot, but right in some nearer region where ornithologists have repeatedly collected and studied, often even in localities famed for their ornithological associations!

The ploughing must in many cases be done over again! We must plough deeper!

With the exception of a large amount of the preliminary work done in this country during the last forty years and some of that recently begun in other countries, it must all be done over again, but in an entirely different manner. The new work must be done according to plan and system, and with well-defined objects in view. The essentials must be recognized, the unnecessary ballast thrown overboard. Not only the main connecting features must be kept in mind and not lost sight of in the mass of details, but the latter must be worked out with such conscientious care and accuracy as only a few great men of the former ornithological generation applied or ever dreamt of. The other minutiæ which have no bearing on the ornithological problems can be left to those whose chief aim is not the advancement of science but their own private amusement. They do not concern us in this connection.

It is plain that ornithology is thus to put on a new aspect. The trouble before has been to a great extent that ornithologists were ornithologists and nothing more. But if they are not to become mere *sciolists* in fact, they must occupy the broad field of zoology or better still, biology. Zoology itself is changing its aspects, and the sooner ornithology follows suit, the better.

Now by this I do not mean that the end has come to specialization. Far from

a Volume IV, pp. 658-659.

it yet, unfortunately! On the contrary, we must specialize still more than before, but the specialization must take place along entirely different lines from what it has been before, and at the same time the connection with the whole must not be lost. We have now specialists whose specialty is North American birds, or Florida birds, or New England owls, or Californian gulls; some whose business it is to split up all the fine races within a group of limited extent, either zoologically or geographically; others who make a specialty of eggs, of feather tracts, of bones, etc.

A new line of cleavage is distinctly visible in zoology; the so-called systematic zoologist has already parted company from the histologist, and embryologist. The mere classifier and describer will soon be distanced. Birds in the future will be studied in the light of other sciences, such as geography and physiography, and in the light of study of other animals or of plants. Meteorology and biometric methods, paleontology, and cartography will all claim attenton of the future ornithologists.

This new tendency was forcibly impressed upon me at the last meeting of the American Association for the Advancement of Science in Philadelphia (Dec. 1904). Of course I belong to Section F, Zoology; but though I am by no means an extreme specialist, there was but one paper that had any relation to the work I am doing, and the author of this paper afterwards told me that had he known of a more appreciative audience, he would have presented it there. If he had accompanied me, he would have found it. I turned to the Association of American Geographers just then forming. There I found congenial spirits. There was a man whose specialty is fresh water mussels, another whose object of study is certain orders of insects, another who was a botanist, and so forth. But I listened with interest to all they had to say, and they repaid me the same compliment because we were all interested in the same problem, to the solution of which we each contributed our mite. There was the geologist who discussed the past history of the ground, where our animals or plants are now located, and there was the explorer and the physiographer who described the prominent features of the country where the objects of our study live; and we began to see the connection between the past and present. A zoologist read a paper, a physiographer and a paleontologist discussed it!

I do not believe that I am wrong, when pointing in this direction for the guidance of the future ornithologist. He has the whole world before him to reconquer; he need not lose heart for fear of having nothing to do. But he must study, he must study hard and many things. He must study under competent teachers, and be satisfied to be guided some time before he can stand on his own legs. The time of the autodidact is past. Now, as before, there will continue to be two kinds of scientific ornithologists, one who spends most of his time in the field, and one who spends most of his time in the closet; but the distinction must gradually cease to one of reproach. In the future no ornithologist who confines himself to the closet will ever rise to the highest point in his science. By this I do not mean that he must necessarily spend his time in studying birds' habits, song, etc., but he must know the habitat and station of the birds he deals with in all their aspects from actual personal observations in the field, or he will fail to properly interpret their interrelations to their surroundings in space and time. I cannot imagine the future ornithologist or zoologist, working exclusively in his closet any more than the geologist, and for the same reason.

After this it is not difficult to specify the qualifications the future ornithologist must possess. Apart from aptitude for scientific pursuit, he must be well grounded in the fundamental principles of biology. He should have an extensive knowledge of general zoology; a not too elementary course in geology, especially

glacial geology, and in physiography, is indispensable; he then must acquire by patient work in the closet the vast amount of detailed knowledge of species and subspecies, and by training in the field the necessary qualifications as collector and observer. When he has thus mastered his "technique" he will be prepared to take up various problems under proper guidance, and in course of time be able to take a leading part in advancing a branch of zoology which has always held a prominent and honorable place among the biological sciences.

It is not necessary for me here to indicate the many problems which await solution. Let the young student of ornithology prepare himself under competent teachers, and if he amounts to anything, he will soon be associated in the work, and guided toward the problems which present themselves. As a rule, the man of science does not go around hunting for problems, asking himself: "What shall I investigate next?" On the contrary, the problems grip him by the throat, and demand to be solved, and give him no rest until he tackles them and subdues them as best he can with the weapons he can command.

I am afraid you wish me to give the young man more definite advice along specified lines. This I am unable to do, but it seems to me that if he reads the above, he may be able to formulate his own "do" and "don't." I have only been wanting to speak to the earnest student who desires to follow ornithology as a *science*, and a life work. My advice is not for the man or boy who seeks in bird study an agreeable pastime, or an interesting hobby. They need not my advise, and would not take it if given! Do not think that I am down on the amateur as such; on the contrary, I am not. He is, and has been, exceedingly useful. But it is the amateur who poses as a scientific ornithologist without having the true scientific instinct who is a nuisance. The amateur's proper field is the gathering of facts, the professional's is to apply them. While the former requires some training in order that his observations may be of value, the latter requires the preparation and training which only a life devoted exclusively to the scientific subject can give. And right here is the difference between the professional and amateur in science, in contradistinction to the meaning of the two terms in sport. In the latter, the criterion is whether the man performs a certain work for money, or not; in science it depends upon whether the scientific pursuit is the main activity of the man's life, or only a side issue subordinate to other work and other duties. It is for the future professional ornithologist that I have written.

Yours sincerely,

[Signed] LEONHARD STEJNEGER.

Odiham Priory, Winchfield, England, Feb. 24, 1905.

DEAR MR. FISHER:

In reply to your questions I may say that there is still an enormous amount of good work to be done in Ornithology, especially in the branches of Anatomy and Pterylography, in which there are few workers at present. But I should not recommend any students to take it up solely with the idea that they could make a livelihood on it. They might be disappointed. But if they have a real love of birds let them pay special attention to these branches, as recommended in several of the prefaces to "The Ibis."

Yours very faithfully,

[Signed] P. L. SCLATER.