

open for him who enjoys this line of work and who is willing to leave behind all hope of opulence.

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OUTLOOK FOR YOUNG MEN IN ZOOLOGY

IN the ten minutes allotted, I shall attempt to answer six questions of special interest to those who are planning to enter zoology as a profession. Through the kindness of Professors Mark, Minot, Comstock, Sedgwick, Reighard, Lillie, Conklin, Ward and Jennings, who have generously responded to my appeal for information, I am in a position to state the outlook for young men somewhat from the standpoint of their experience. As far as possible, the answers to the questions relating to the topic assigned me will be given in the words of the above-named zoologists.

1. *How do the chances for getting good positions compare with those of a decade ago?*

All of the zoologists who have expressed an opinion on this question agree that the chances are much better than they were a decade ago. Professor Comstock writes: "I should say that they are much better. It is only fair to emphasize, however, that the man who takes up work along these lines purely as a financial venture, apart from other considerations, will be disappointed. And I should say also that a large part of the demand for entomologists in recent years has been due largely to the great increase of this kind of work in the Department of Agriculture at Washington. Many men have found places with Dr. Howard or have taken places vacated by others who have gone to Dr. Howard. If the government support of this kind of work were to cease it would make a great difference in the chances for getting good positions."

Dr. Mark writes: "Have been surprised

that the demand has increased so rapidly. This has been more noticeable in the field of comparative anatomy than in other lines during the past five or ten years."

According to Dr. Minot, "There is great difficulty in getting any men for positions in anatomical and zoological laboratories, and I believe that for a few years the opportunities will be unusually good. But for heaven's sake, do not encourage any mediocrities to go into science. If you can, have them Oslerized at sixteen."

Dr. Conklin thinks that the chances of a young man's going at once from his graduation to the headship of a department are probably not so great now "as they were a decade ago."

Dr. Jennings says that "it is difficult to get the men needed for positions in zoology, and this is true all along the line from assistantships up to full professorships."

2. *Is it ever necessary for a man with a doctor's degree to rest on his oars for a year because no desirable college or university position is open to him?*

The reply of Dr. Lillie is typical of the answers given to this question: "In the course of a good many years several of our doctors of philosophy have accepted positions in high schools and normal schools; in such cases it has usually been a matter of preference with them. So far as I know, there has never been a case of one of our doctors of philosophy being obliged to go without a position for even a year."

According to Dr. Jennings, "many excellent positions have gone to men without the doctorate."

3. *Does the number of desirable positions equal the number of candidates?*

Dean Ward writes that "there have been more desirable positions in zoology which have come to my attention in the last five years than I could have filled three times over if every one of my advanced students

had been ready to consider such opportunities. We have not been able to furnish enough teachers to supply the college demand, nor enough collectors and workers for museum and government positions. The expansion in connection with college teaching, the demand for more men in old institutions and for new men in those recently founded has exceeded the supply."

Dr. Reighard writes that in his department "the number of applications for candidates to fill positions in biology and zoology has for some years fallen far short of the supply. I have had about ten applications for the present year and have been able to fill *none* of them with men directly from my laboratory. Two were, however, filled with men who have recently been here. These were applications for *men* and for positions above secondary-school grade."

4. *Has the number of men entering zoology as a profession increased or decreased?*

"There certainly has been no increase in proportion to demand," says Dr. Jennings. Dr. Reighard, however, writes that "the number of students in advanced classes with the definite purpose of preparing to teach in institutions above secondary-school rank, is *less*."

5. *Are any new fields opening up for zoological students?*

According to Dr. Sedgwick "The demand for men in physiology and sanitary biology is particularly brisk, especially in the latter subject. For several years it has been impossible to meet the demands for young men properly equipped to fill positions in sanitary or industrial biology."

Dr. Reighard writes that "to a certain extent new fields are opening up: (a) I have had two applications within a month for men to fill positions in experimental

research work particularly breeding experiments, in agricultural colleges, under the Adams act. (b) There is a slowly increasing demand for men to undertake museum work. We have difficulty in keeping good museum men here. (c) Some of the older educational institutions are reorganizing their zoological departments and expanding them. (d) The normal schools are seeking men (and women) with the newer, ecological training, capable of organizing work along 'natural study' lines. I have had a couple of calls of this sort within a few months."

According to Dr. Jennings, "Some new fields are opening for zoological students. The various research institutions recently established take a number. The Adams act recently enacted by Congress promises to call a number into the service of state experiment stations, and has begun to do so already. I should judge that many more educational institutions require competent men in this line, or a greater number of them, than was the case a few years ago. On the whole, I should say that the prospects are excellent in zoology at present, particularly for the investigator."

6. *Is the demand for zoologists likely to continue as great as at present?*

There seems to be good reason to believe that the conditions which have kept up the demand for the past decade will continue in the next. Even financial depression such as that of the present time does not seem to diminish the number of students in higher institutions of learning nor the demand for additional instructors. The policy of the General Education Board and of the Carnegie Foundation will tend not only to open up new positions for younger men, but also to make college and university positions more attractive.

From such considerations, we need not hesitate to encourage the exceptional man whose tastes lead him in that direction to

enter zoology as a profession, with the well grounded hope of attaining such a position as his talents deserve.

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*THE CHEMICAL EDUCATION OF THE
ENGINEER¹*

THE academic education of the civil engineer is a thing of yesterday; or rather, it is a thing of to-day. Yesterday it was not. I use the word, "civil" in its original sense. Balbus was, without doubt, a military engineer. The great roads of antiquity were built by soldiers. In the Motherland, yours and mine, there were no roads till the Roman legions made them. On this continent, the canoe and the blazed trail were sufficient till Braddock's three hundred axemen hewed their way through the forest from the sea to Fort Duquesne, and our Governor Simcoe connected Lake Ontario with the lake that bears his name by the military road which, in imitation of the old Roman Watling Street, he called, as we call it still—Yonge Street.

But steam changed all this. With steam came railways; and with railways came the civil and the mechanical engineer, and to them has been added, in our own day, the electrical engineer. At first, the civil and the mechanical engineer learned their trade, like everybody else in those days, by apprenticeship. They learned to play the fiddle by playing the fiddle, without any lectures on the physical and the physiological bases of harmony or any exercises "zur Fingerfertigkeit." And grand musicians they were, those old masters who wrote their opera on staves of iron ruled across two continents; whose treble was the shriek of the locomotive, and whose bass was the roar of the blast furnace, whose

choruses were sung by the toilers of the nations, and whose libretto was the record of the world's progress.

It is a truism that genius often gains its end by bursting barriers and breaking rules. But for all that, we have come to think that education will not hinder the genius, and will surely help the engineer.

It is noteworthy that France, where one word stands for both genius and engineering, led the way in this matter. Engineering education dates from the foundation of the *École des Ponts et Chaussées*. Germany followed; then America, like one born out of due time, but now become the greatest of the Apostles. Nay, at last, even my countrymen, clothed as they are with a contempt for theory which throws off the undulations of the intellectual ether more completely than polished nickel, backed by a conservatism more impermeable than infusorial earth, even Englishmen are giving signs of viscosity; and British public opinion is flowing forward with a motion like that of a glacier, slow, indeed, but sure and irresistible.

We agree then that the engineer shall be educated. But shall chemistry form one of the subjects of his education? Assuredly yes. For what is an engineer? He is a man who devises and supervises the construction and use of engines—contrivances—that is, for yoking the forces of nature to the service of man; and what are chemistry and physics but the ordered and methodical study of these forces and of their action on the materials of which machines are constructed and upon which they work.

I am speaking to-day as a chemist to chemists, and it is safe to say that we are all pretty well agreed as to the kind of teaching that is best for the professional chemist, whether his career is to be technical or academic.

¹Read at the Chicago meeting of the American Chemical Society.