museum. Undoubtedly many come merely to toy with the apparatus, but some few pore over the explanations and ask questions about them. That it has awakened an interest in the subject in many for the first time may be taken for granted. One very definite advantage is that it allows the instructor to refer his students to certain experiments in the museum with the request that they try them and report on the results, *e.g.*, all our elementary students determine, from its period, the length of the large pendulum.

However, while it seems eminently worth while it is needless to say that such a museum, simple as it is, will not run itself. Although it does not require the presence of an attendant, its continued demand for new experiments as well as the upkeep of the old ones would constitute a perhaps unwarranted liability on the time of the instructional force of the department if it could not, as in the present case, be entirely turned over to an ingenious and able apparatus man.

L. R. Ingersoll

Madison, Wis.,
November 5, 1921

HOW TO DO RESEARCH [1]

I have never done any research. I am therefore able to give unbiased advice regarding it.

Research—in the broadest sense—consists largely of repairing leaks in glass tubing.

More specifically, it consists of gathering in a cell down in the Ryerson basement a weird assembly of switches, wires and glass tubing—and then keeping other students from borrowing it.

Apparatus may be borrowed or acquired. If you borrow it you are expected to return it. If you acquire it, you keep it until you are found out.

Tools at one time could be found in the student's shop. Now you find them everywhere.

[1] Read at a gathering of the graduate students in Physics of the Ryerson Physical Laboratory on a social occasion preceding Professor Milliken's departure from Chicago.

In order to do research, one must have ideas. *One* idea is sufficient. Two ideas are apt to contradict each other.

Ideas are easy to get. If you haven't any, consult Dr. Gale. He can be found adjusting gratings down in the basement.

By all means do *not* search for something original. If you think you have a *new* idea read Professor Groszkopf's articles in "Zeitschrift für So und So" published about 1700. You will find he suggested the same thing two centuries ago.

After all, it is doubtful whether even one idea is necessary. Merely get some apparatus, solder it together and take readings.

Readings are always taken through a telescope.

You will get certain numbers. Plot these numbers against other numbers which you get from variable parts of the apparatus.

If you get a straight line on plotting your observations you know at once that the results could have been predicted.

However, if you get a curve the situation is different. Examine the curve carefully for sharp bends or breaks. If you find one, you have made a discovery. These breaks are significant. Consider carefully what may have caused such breaks. Try to trace them to atomic or electronic phenomena. Draw a picture of the atom. Don't be discouraged if your picture doesn't agree with other pictures. Dr. Lunn will show it doesn't mean anything anyhow.

Having obtained a curve and concocted a theory, it is befitting that you present the whole to the Physics Club.

The Physics Club was invented to keep research students from getting the big head. It consists of a crowd of professional knockers. There is one booster. You are the booster.

It is fitting here to give you details on your conduct at the meeting.

The latter is always preceded by tea. While this is being served go into the lecture room and copy a few weird sketches of your apparatus on the board. Make everything as complicated as possible. Also prepare a few slides. They may be shown at embarrassing moments.

As soon as the club is assembled, gaze upon them with a dreamy eye and begin your talk.

The first step is to write nine long equations on the board.

Somebody will call your attention to the fact that the fifth term of the first equation should have a minus sign.

Memorize the equations beforehand if possible. Write them rapidly.

The success of your talk will depend directly on the number of people you can shake off at this point.

Mathematics is always helpful in this way. If your audience looks too intelligent, cover the board with partial derivatives and integral signs.

Having presented the equations dwell at great length on the sub-electron, the rigidity of the ether, or the density of petrified rhubarb in Siberia.

Finally when you see that vacant stare, indicative of a temporary lapse of intelligence, steal into the eyes of the front row, it is time to stop.

Pause for effect. Gather up your books—several volumes of "Annalen der Physik" and four score and seven sheets of loose notebook paper and ask for questions.

There will always be questions. They are indicative of an intelligent audience.

Then there will be a discussion. In this *you* will have no part. However, at its close you will be convinced of three things:

First: that you were entirely wrong.

Second: that you did a fine piece of work.

Third: that it doesn't mean anything.

The moral of this paper is: It is much easier to take data than to interpret the results.

A. W. Simon

SCIENTIFIC BOOKS

Organic Dependence and Disease: their Origin and Significance. By John M. Clarke. Yale University Press, 1921. Pp. 113, 105 text figs.

In a new book, marked by deep thinking, and written with Huxleian vigor and picturesqueness of phrase, we have presented to us the philosophy of righteous living as seen by a paleontologist, a life-long student of Paleozoic faunas and floras. Beginning with a study of mutual and commensal living, we are shown how this develops into parasitism, and out of it all comes to us the true significance of ease in life and dependence. Progress, racial or individual, does not lie in this direction, and once entered upon, there is no return road to independence, the only righteous mode of living.

We need not present the evidence on which Clarke's philosophy is based, since the book itself gives this so clearly, but can go at once to the conclusions. Parenthetically, however, we would advise the reader to study along with the book under review Conklin's "The Direction of Human Evolution," a most interesting work on philosophical naturalism, showing what evolution has done for man morphologically, and what in all probability social evolution will do for him. In these two books we have revealed to us the naturalist's religion as Nature has unfolded it throughout the geological ages. As Conklin says,

> The new wine of science is fermenting powerfully in the old bottles of theology.

The purpose of Clarke's essay is to set forth the apparent controls governing the historical origin of dependent and abnormal conditions of life, and from this evidence to generalize their significance to humanity. The bases of this knowledge are Paleozoic invertebrate fossils, plus the vista of organic accomplishments through untold millions of years. The evidence is presented without embarrassing detail and the conclusions without bias, and their human concerns are of high moment.

The author states that "disease is discomfort," and agrees with Huxley that "disease . . . is a perturbation of the normal activities of a living body." In other words,