Research by the High School Student

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If he does not know it before, the science student in high school should learn the difference between demonstration experiments and research experiments, and between searching for something in the library and doing research work.

We had some mud-dauber nests on the laboratory table—a few students and I. Eagerly we opened one cell, then another cell, to observe the contents.

In some the mud-wasp egg had not hatched, so its store of food (from five to nine paralyzed spiders) which was left there for the growing larva was still in the cell. In others the fat flabby white legless larva was almost crowding the space. Before long this would have become a darting wasp, carrying little pellets of mud in her mouth to build a nest on the roof of some boathouse or barn to store the eggs and food for the hatching larva, completing the life history.

Arthur Nepstad asked, "How do they get legs and wings and eyes?"

"These develop after they eat the stored food," I answered glibly.

"I'd like to see that happen," Arthur persisted.

"We can break open a new chamber from time to time and see the progress. But if the pupa is left exposed it will dry up."

Arthur thought a bit, then made this thoroughly original suggestion, "Why not put some of them into medicine capsules so we can watch whatever happens?"

I said, "I think that is a wonderful idea! Why not? Why didn't I think of it!"

So we did just that and punched three needle holes in the end of each capsule. Into the capsules went one fat larva of a mud-wasp—one which had already eaten its supply of spiders. Each capsule was given a number in ink, for each grub must have a separate record in notes and drawings. The capsules were kept in a small box, on corrugated white paper. The box provided the darkness of the original cell.

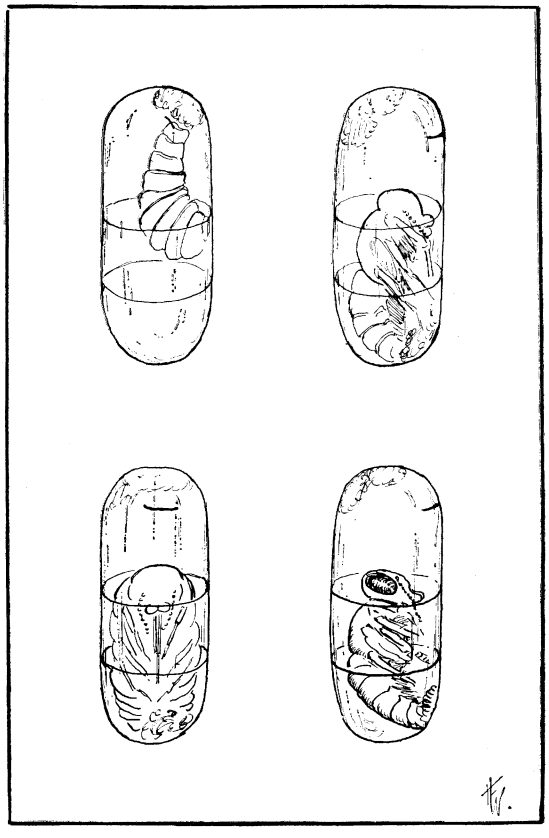

Figure 1. Leaf-cutter pupae.

Arthur said, "Let's try it with the leaf-cutter bees, too." We had a few of their leafy capsules which had been found in a boring in a tree trunk. We kept some of these as they were. From others we peeled off the layers of leaf-ovals until we found the white larva in each. These were also placed in medicine capsules.

We watched and made records in writing and in drawings.

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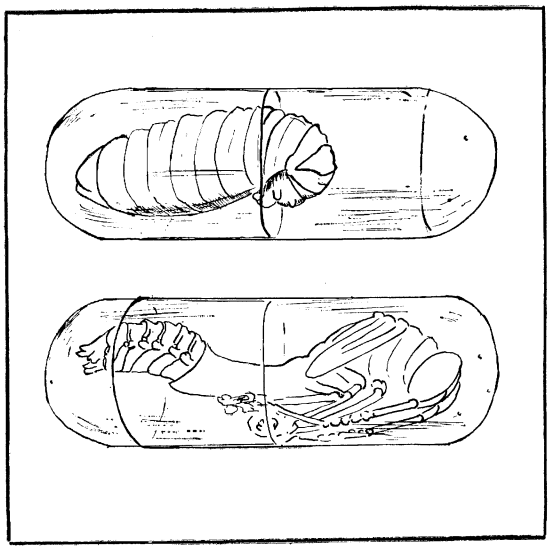

Figure 2. Mud-wasp larva developing into a pupa.

All of this I call research. Arthur's idea was original. It was exciting because it came from a questioning young mind, challenging because no one, so far as we know, had ever thought of doing it before. For when I queried Phil Rau of Kirkwood, Missouri, naturalist and bee specialist and T. D. A. Cockerell of Boulder, Colorado, another authority on wild bees, neither one had thought to try it. I recall Phil Rau's comment, after expressing pleased surprise at the suggestion, "I think I'll try it on some of my pets."

Frequently we hear someone in a library say, "I'm doing some research for a club paper." Perhaps. Probably she is merely searching for some material and is reading and taking notes on this.

Arthur's experiment is an example of simple research.

It is unnecessary, I suppose, to tell you that the dear little larvae fooled us. Whatever took place took place beneath that white outer "skin" which one day split to leave the pupa exposed—with its legs, crumpled wings, great eyes, and antennae already developed. The wings, of course, were to be inflated later. But every part was there.

Still we learned much. We learned how to carry on a simple research problem, which is "systematic investigation into a subject in order to *discover* facts or principles."

The Parasitic Worms In High School Biology

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Introduction:

One of the most fascinating units in High School Biology is the study of the parasitic worms. In an effort to make this topic worth while and practical we devised a unit plan for the teaching of parasitic worms which proved both instructive and interesting as a teaching device in the biology laboratory and classroom.

Aims and objectives:

1. To study the parasitic worms from the standpoint of structures, prevention, disease causes, symptoms, carriers, and relation to public health.

2. To understand practical methods of prevention of these infections in our home community.

3. To indicate the functions and duties of the local, state, and federal public health agencies, in endoparasitic control.

4. To compare the so-called worms, with other animals studied.

5. To arouse appreciation for the keenest of observation of the ancient Hebrews in relation to what we now know to be infestation with trichina; respect for their ability to single out the swine as a transmitter of an illness; respect for their rulers who incorporated the knowledge in the priestly code of laws (Leviticus 11-7 & 8, 34 & 35).

6. To show that swine, as a vector or a transmitter of trichinosis is dependent upon the invention and improvement of such aids as the microscope and also upon modern research techniques in cutting and staining thin sections.

7. To stress in recitation periods, modern methods in animal husbandry; the prevention of the spread of trichinosis in swine is partially dependent upon the use of rat-free quarters (commonly known as hog pens). Hogs will eat rats if hungry. The rat is one of the intermediate hosts of the trichina. The

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