FUN

WITH THE

SCIENCE

MICROSCOPE

A 1900

BAUSCH & LOMB

B&L

To Help You Have the MOST FUN WITH YOUR Bausch & Lomb R1900 MICROSCOPE SET this Experiment and Record Card File has been prepared by Mrs. Price. She urges you to read carefully the General Instructions, Special Procedures and the Experiment Routines.

Ask your science teacher about using your fine new Bausch & Lomb Microscope to help you in your school science class and lab work. Let this instrument help you to learn more and more about the wonders of the unseen world around you. Here is a list of the subjects and experiments on the cards:

SPECIAL PROCEDURES

Preparing a Wet Mount
Preparing a Permanent Dry Mount
How to make a Collecting Jar
Preparing a Gelatin Solution
Preparing a Well Slide
How to make an Experiment Card File Box

EXPERIMENT ROUTINES

1. To learn about cloth fibers
2. The How and Why of Fish Scales
3. To see how a feather is constructed
4. What hair really looks like
5. Kinds and colors of human hair
6. Meeting Spirogyra
7. The World that Lives in Water
8. The Life in an Onion
9. Why stems and stalks are built that way
10. More of the unseen water people
11. Insect wings are wonderful things
12. Finger printing is fun—but more

GENERAL INSTRUCTIONS

This Experiment and Record Card File will help you discover the wonderful world of Microscopy. There are experiments to do and put into a permanent 6 x 4 inch card file. You can get such a card file and additional cards for it from a stationery store or you can make your own. On the back of each experiment card there is blank space left marked *My Experiment Record*. Here you can make your notes, drawings and conclusions about the experiments you do.

In some cases you will need more space, and then it is easy to add a 6 x 4 inch file card for additional notes. Put the number of the experiment with a letter after it in the upper right hand corner of the card you are adding to your record. For example, Experiment 10A. If you need a second card, it would be 10B and so on.

After you have done the experiments suggested, you may think of other similar materials or living things you wish to examine on your own. For these you can make up your own experiments, use blank file cards and write on them the purpose you have in mind for doing the experiment, the materials you'll use, the procedure you'll follow and your record with observations and conclusions. The experiments you do on your own may be more important than the ones we have suggested. In this way your Experiment Record becomes truly your own production.

Before you begin to do any experiment, read it over carefully. Notice the questions that are asked and think about them as you are performing the experiment. Try to answer them in your record. Scientists are always asking themselves

questions. Sometimes they get the wrong answers, but they keep trying until they think they have the right one. The questions will help you think about the discoveries you are making just as a real scientist does.

Make your notes *at the time* you are doing your experiments, rather than afterwards. It's more important to record exactly what happened, even if your record may not be as neat as if you had made it later. If you try to remember afterward, you may not report accurately. Date your experiments, and if hours or minutes are required, keep careful track of time.

Sometimes an experiment won't work the first time. Don't be discouraged. This has happened to the greatest of scientists. Keep trying as they did and eventually you'll succeed. Always keep on the look-out for the unexpected. Some of the most important discoveries in science have been made when scientists were looking for something entirely different.

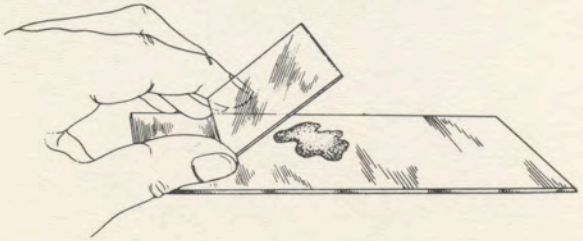
Before you begin the experiments, read over the *Special Procedures*. These ways of doing things are called *techniques*. For example, if an experiment directs you to "Make a Wet Mount," you would look for the instructions on how to do it in the *Special Procedures*. After you have done this many times you will become skilled and will not have to refer to it, but until you do, the *Procedures* will serve as a handbook for your guidance.

Be sure you read these instructions before you perform any of the experiments which follow.

SPECIAL PROCEDURES

Preparing a Wet Mount: Glass slides are used to hold material for examination with your microscope. Many things can be seen mounted merely in a drop of water. Be sure the slide you use is perfectly clean. With a forceps or dissecting needle place the object you wish to examine in the center of your slide. (Sometimes you will be instructed to "tease" the material apart. This means to pull it apart carefully with your dissecting needles.)

With a medicine dropper put a single drop of water on the material to be examined. Hold a clean cover glass by its edges at an angle, with one edge touching the slide. Carefully lower it until the drop of water and the material in it are covered. A gentle pressure on the cover glass with the wooden end of your dissecting needle may remove any air bubbles trapped under it.



Preparing a Permanent Dry Mount: If you want to keep a small specimen permanently on a slide without using any kind of mounting cement, place your specimen in the center of the slide and press a cover glass over it gently. Take a gummed piece of paper (or you can use ordinary paper and rubber cement) and cut a piece about 1½ inches wide and 2½ inches long. Cut a small hole in the center of your paper so that you will be able to see your specimen through it. Be sure that the hole is smaller than the cover glass so that it will hold it in place.

Paste the paper over your cover glass and slide, turning down the edges on either side about ¼ inch and sticking them to the underside of the slide. You will still have room to write the name of your specimen and the date you made it on the paper at the left of your mount.

How to Make a Collecting Jar: There are many interesting insects you may want to collect to study with your microscope. It's a good idea to collect them in the summertime so you will have them when they are not available in the cold winter. You will want to collect them and kill them quickly without harming their tissues. Get a half-pint canning jar with a tight screw lid. In the bottom of the jar put a layer of cotton or several disks of blotting paper.

Cut a round disk of aluminum foil a little smaller than the inside of your jar, so there is a space of about 1/16th inch around the edges of the foil. Moisten the cotton with household ammonia. Do not breathe the fumes or get the liquid on your hands. Place the foil over the cotton quickly and screw the lid on tightly.

When you find an insect you wish to add to your collection, put it in the bottle on the foil. Screw the lid back on tightly and your insect soon will be dead. Each time you go out collecting, wet the blotter or cotton again with ammonia.

Preparing a Gelatin Solution: Put a small pinch of Knox plain gelatin in your watch glass, moisten it with a third of a medicine dropper of cold water, stir, then let stand for 2-3 minutes. Now add a medicine dropper full of very hot water. Stir

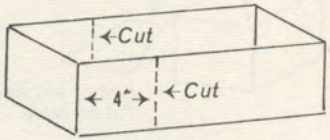
with glass rod until the solution is clear. It will cool enough in a few minutes to add a drop to your slide to slow down the movements of minute animals for more accurate observation.

Preparing a Well Slide: Many times you may want to preserve your specimen for future observation in more than just a drop of water. Well slides can be bought, but it's easy to make them. You can get a one inch plastic curtain ring at the hardware store which you can fasten to your slide with household cement. This makes it possible to keep quite a bit of water around the object you're looking at, and your cover glass will fit over it nicely.

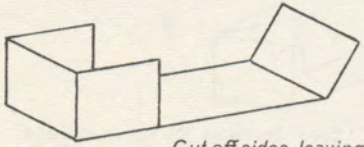
To keep your specimen supplied with water all night, place the slide over a small glass of water and lay a string along the edge of the cover glass with its ends in the water. The string will act as a wick to carry water to the well slide and keep your specimen moist.

HOW TO MAKE A CARD FILE FOR YOUR EXPERIMENT RECORD:

1. With a razor blade cut the sides of a man's shoe box down to the bottom of the box, four inches from one end (A). Do not cut through the bottom cardboard.



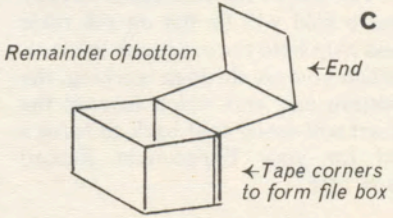
B



Cut off sides, leaving bottom and end of box

2. Cut the sides of the box off the back portion of the bottom and away from the end of the box (B).

3. Bend the bottom pieces up to meet the uncut sides that remain on the front four inches of the box and tape them in position with strong mending tape (C).



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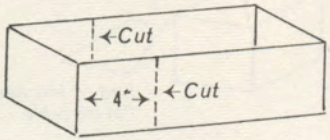

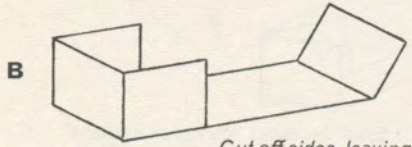

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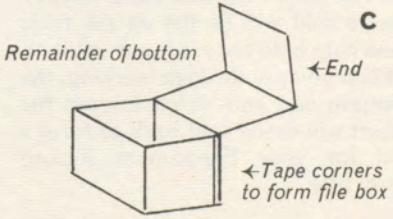
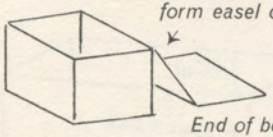
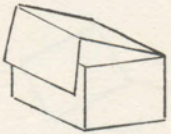


D



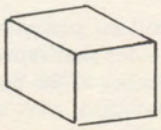
4. Now bend the remainder of the bottom back and down so it forms an easel or rack to hold a file card for easy reading while you are doing an experiment (D).

E



Easel becomes top cover and end overlaps or tucks in front of file box

5. The end of the box which already has a fold will lie flat on the table and help hold the card rack in place. When you are through working, the bottom and end which formed the easel will easily fold back to form a lid for your Experiment Record Box (E).



Closed box

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BAUSCH & LOMB

R1900 EXPERIMENT NO. 1

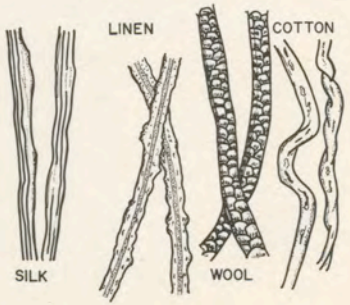
MICRO-SCIENCE

PURPOSE: To learn about the fibers of cloth, natural and synthetic.

MATERIALS: Dissecting needles; pieces of wool, cotton, linen, silk, rayon, dacron and nylon; slide and cover glass, medicine dropper.

PROCEDURE: Cut tiny squares of cloth about ¼ inch, tease out fibers from threads with your dissecting needles and examine them in a wet mount. Wool, cotton, linen and silk material come from living things. Do you know what they are? Examine them one at a time and notice the difference. The pictures show how fibers look to a detective under a higher power microscope. Cotton has a flat twisted appearance, for it is a long, collapsed, twisted tube. Linen is a tube, but its walls are thick and knobs make it look like bamboo. Wool fibers are scaly. Silk is a smooth solid tube.

Compare these fibers with rayon, dacron and nylon. If you were a detective, could you tell the difference? Some fabrics are mixtures of these two. Find some of these and see if you can tell which fibers are synthetic and which come from living things. Can you explain why wool has great shrinkage and synthetics do not? Notice how the material is put together. Can



you tell if it is woven, knitted or plaited? Draw a picture of the way the threads of each sample of cloth are put together.

MY EXPERIMENT RECORD

BAUSCH & LOMB

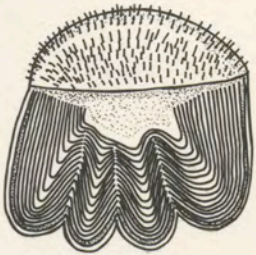
R1900
EXPERIMENT
NO. 2

MICRO-SCIENCE

PURPOSE: To examine fish scales and determine their purpose.

MATERIALS: Forceps, fish scales, medicine dropper, slide and cover glass.

PROCEDURE: Next time your mother buys fish for dinner, examine it to see how the scales are attached. (Often markets remove most of the scales, but usually a few are left.) Notice how they are overlapped like shingles on a roof. They grow separately from the skin and completely cover the body of most fish. (Catfish are an exception.) You should be able to guess their purpose for they are very hard and act like a suit of chain armour. Scales grow with the fish and you can tell how old the fish is by the growth rings you can see if you examine them with your microscope. Pull a scale from the fish with your forceps by getting in at its base, so that you will not break the scale. Put the scale on a slide and examine it first without water. Shine a light down from above on the slide. Look at the base of the scale and examine the scale on both sides, turning it carefully with your forceps. With your microscope you will be able to see rings of ridges that represent growth. The fish grows faster in summer so there are wide bands for summer growth,



narrow dark bands for winter growth. Can you tell how old the fish was from which you took the scales?

Try to get scales from a number of different fish for examination and make drawings and keep records of how they differ. Make wet mounts of the scales also. Have you any idea how long fish live? Would aquarium fish live longer than those in the sea or lakes? If so, why? Try to examine some reptile scales from skins shed from snakes or lizards. Compare them with fish scales.

MY EXPERIMENT RECORD

BAUSCH & LOMB

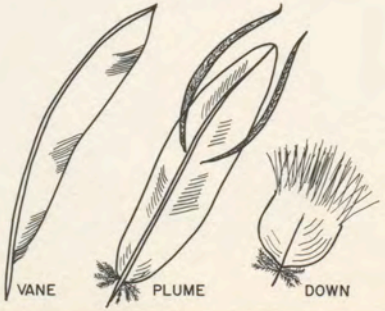
R1900 EXPERIMENT NO. 3

MICRO-SCIENCE

PURPOSE: To see the structure of a feather.

MATERIALS: Dissecting needles; feathers, wing or tail and downy feathers.

PROCEDURE: Place the wing or tail feather on a slide on the stage of your microscope without water. Shine a light down upon it. The strong shaft that goes through the center of a feather has two parts. The lower part is called the *quill* and the upper part is the *rhachis*. This supports the flat part of the feather which is called the *web*. Can you see the *barbs* that branch out from the shaft? In the picture note that each barb has many *barbules* branching out from it and *hooklets* fasten them to hold the whole web together. Can you think why this arrangement is necessary? What would it keep from passing through the feathers? If the web is broken the bird can pull it together as it does when it preens its feathers through its beak. Pull the web apart with your dissecting needles. Try pulling the broken web through your fingers to see if you can accomplish the same thing the bird does with his beak. Examine the down. It has no central shaft and the fibers growing out from the center are soft and silk-like. Sometimes they have tiny hooklets



like teeth which help mat them together. What purpose do you think this would serve? Make wet mounts (See Special Procedures) of small pieces of both kinds of feathers and observe.

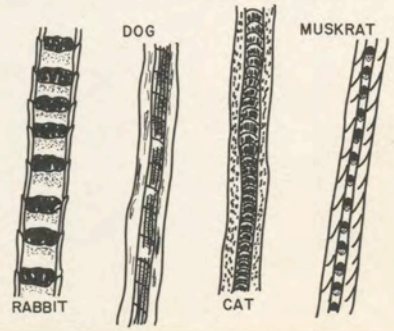
MY EXPERIMENT RECORD

BAUSCH & LOMB
R1900
EXPERIMENT
NO. 4
MICRO-SCIENCE

PURPOSE: To see how animal hair appears.

MATERIALS: A few hairs from a cat, dog, rabbit or any other pet you may have.

PROCEDURE: Make wet mounts of these hairs and examine them carefully with your microscope. Draw what you see. Are they alike or different from each other. Do they look at all like human hair? If you have some old fur take a hair or two of it and examine it in the same manner. Sometimes rabbit fur is falsely called by other names and is dyed various colors and sheared to look like that of another animal. The furrier with his more powerful microscope can see detailed differences in structure like that in the picture. He can tell if a fur which may be called "seal" is what it is supposed to be. Visit a furrier and he may be willing to give you a few hair samples with which you can experiment. Good sketches in your record will help you identify different hairs. Compare what you see with the drawings shown here which were made under a higher power microscope. Identification of animal hairs often helps solve mystery crimes.



MY EXPERIMENT RECORD

BAUSCH & LOMB

R1900 EXPERIMENT NO. 5

MICRO-SCIENCE

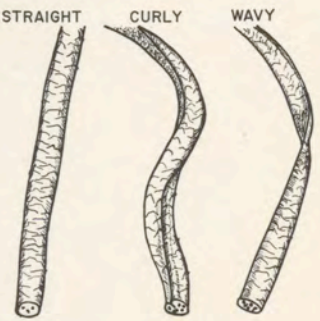
PURPOSE: To see some differences in human hair.

MATERIALS: Samples of blonde, brunette, gray and red hair. Samples of curly hair, straight hair and permanently waved hair. Slide and cover glass, medicine dropper.

PROCEDURE: Hair is not composed of living cells, but it grows in length as the cells at its base add to it. Each hair has a central canal called a medulla and the material which surrounds it contains the pigment which gives it color. This is true except in the case of gray hair where no pigment or very little is left. First wash the hairs you are going to examine in a little soap and water in order to remove any dust or oil.

With a razor blade cut tiny pieces of each color of hair. Make wet mounts of each color and examine them for color pigment. Make notes of how the hairs differ. Which pigment shows up the best in the hairs you examined?

Now examine the curly hair, straight hair and permanently waved hair. You will see very little difference, but detectives can tell the difference by making cross sections of hair to show that straight hair is almost round, naturally curly hair is oval and permanently waved hair



is somewhat flattened, and not as oval as the naturally curly hair.

MY EXPERIMENT RECORD

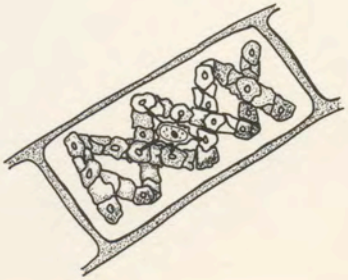
BAUSCH & LOMB
R1900
EXPERIMENT
NO. 6
MICRO-SCIENCE

PURPOSE: To see the structure of *Spirogyra,* one of the simplest plant forms.

MATERIALS: Prepared slide of Spirogyra, pond water, cover glass and slide.

PROCEDURE: This plant is one of the common green algae often found in pond water. It appears to be a long green thread, but you will see from the slide that it is really a chain of cells fastened end to end like bricks. The picture shows more detail which is not visible to you. It is especially interesting because the *chlorophyll* in it, which the plant uses in making its food, is twisted in a spiral in the cell. Draw a row of these cells and anything you can see in them.

If you live near a pond, collect some pond scum with the slimy green threads in it. Make a wet mount (See Special Procedures) of a piece of this thread-like plant to see if you have collected a specimen like the one on the prepared slide. If not, look up the plates of algae in the encyclopedia or reference books and see if you can find one like yours. These plants are among the simplest forms of all plant life. They help supply oxygen to animal life in the pond. The animal life helps to



supply the carbon dioxide for the plants. In the next experiment you will learn more about how these different forms of life live together.

MY EXPERIMENT RECORD

BAUSCH & LOMB

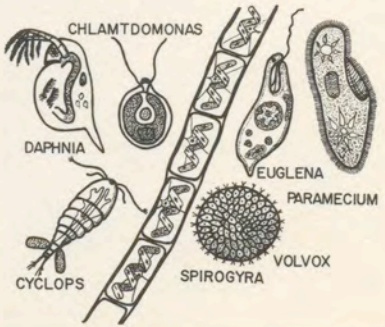
R1900 EXPERIMENT NO. 7

MICRO-SCIENCE

PURPOSE: To discover the web of life in pond water.

MATERIALS: Jar of pond water, watch glass, medicine dropper, slide, cover glass.

PROCEDURE: Collect about a pint jar of pond water from a stagnant pond. Be sure to scoop some organic material and mud from the pond side or bottom, including both living and dead vegetation. Try to catch a pollywog or small fish in it if you can. Let the jar stand on the window sill for a few hours until the mud settles and the water is fairly clear. Put some of the water in a watch glass and examine its contents on the stage of your microscope, using a light to shine down on the watch glass. See how many different plants and animals you can see. Catch some of the tiny animals with a medicine dropper and make a wet mount of them. You are probably looking at tiny crustaceans which are related to the lobsters that people like to eat. See if you can recognize any in the picture. To slow up the creatures so you can observe their movements better, carefully lift the edge of the cover glass with a dissecting needle and add a drop of gelatin solution. Replace cover and watch animals. You may be able to see tiny green plants



which the animals eat. Draw a picture of what you see.

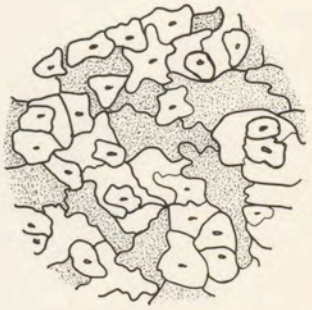
MY EXPERIMENT RECORD

BAUSCH & LOMB
R1900
EXPERIMENT
NO. 8
MICRO-SCIENCE

PURPOSE: To observe living onion cells.

MATERIALS: Onion bulb section, razor blade, forceps, glass rod, household iodine, cover glass, paper towel, dissecting needles, slide, paper towel.

PROCEDURE: Separate one of the layers or scales of a fresh onion bulb. Peel off the very thin, semi-transparent skin from the surface of one of the bulb sections. With a sharp razor blade cut a piece of it about ½ inch square. Place a drop of water on a slide and spread out the onion skin in it with your dissecting needles. Cover with a cover glass. Examine it with your microscope. Be sure to have ample light on the microscope mirror. Remove the slide from the microscope stage and put a touch of iodine at the edge of the cover glass with the glass rod. At the same time hold a piece of paper towel at the opposite edge of the cover glass to help the stain diffuse through the onion tissue. The stain will help you see parts of the onion tissue more clearly when you look at the slide with your microscope. If you look very carefully you will just be able to see the tissue is made up of cells. You may be able to see a tiny brown dot in each cell which is the nucleus, the controlling part of the cell. It will only appear to be a pin-point of color.



Examine a portion of the dry outer onion skin in the same way. What has happened in the dry skin? Are the cells still living? All living cells contain water. Where is most of it in the living onion skin? Draw a few of the cells you see. Can you think of other plants from which you might be able to get a thin tissue of cells? The outer skin of some lily leaves is often thin enough for this experiment. See what similar experiments you can do with other material.

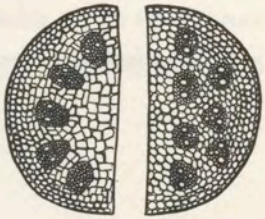
MY EXPERIMENT RECORD

BAUSCH & LOMB
R1900
EXPERIMENT
NO. 9
MICRO-SCIENCE

PURPOSE: To see how the structure of a plant stem is adapted for the work it does.

MATERIALS: Prepared stained slide showing cross section of corn stem and sunflower stem. Celery stalk, slide, red ink or food coloring.

PROCEDURE: When you looked at the slide of the spirogyra, you learned that green plants contain chlorophyll which they use in making their food. The many-celled flowering plants which you see growing all around you have *chlorophyll* in their green leaves too, but a leaf must have something to hold it up to the light and a means of getting water and minerals from its roots. Then it must have a passageway to get the food the plant has manufactured in its leaves back to the roots for storage. A stem serves these purposes. There are two main divisions of flowering plants in the world. Corn is an example of plants called *monocotyledons*. (You may call them *monocots* for short.) A sunflower plant is an example of a *dicotyledon (dicot* for short). The stems of both of these plants serve the same purpose, but their arrangement for conducting food and water to the parts of the plant is different. In both plants the *pith* cells make up the main part of the stem and



DICOT MONOCOT

are the cells that give it support. The cells of the plant that conduct water, minerals and food are put together in an arrangement of tissues called a *vascular bundle*. Look at the cross section of a corn stem. You will see these bundles are scattered through the pith. Now look at the sunflower stem. There you will see the vascular bundles are arranged in a ring. In your record make a diagram of the arrangement of cells in both kinds of plants. Remember to mark the one which is the *monocot* and the one which is the *dicot*. To see how vascular bundles work in living plants, soak a celery stalk in a solution of 1 part ink or food coloring and 2 parts water for several hours. Cut the stem in cross sections at various distances from the base. Examine these sections on a slide with your microscope, without adding water. Where are the vascular bundles in your celery stalk? You will be able to tell by the tissues most darkly stained.

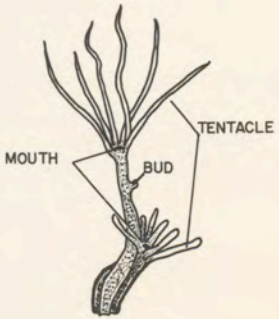
MY EXPERIMENT RECORD

BAUSCH & LOMB
R1900
EXPERIMENT
NO. 10
MICRO-SCIENCE

PURPOSE: To examine a *Hydra* to find out how cells in a simple multicellular animal work together to perform a special task.

MATERIALS: Prepared budding *Hydra* slide, watch glass, well slide, test tubes, pond water, medicine dropper, *Daphnia* (from pond water culture or pet store).

PROCEDURE: The *Hydra* is a little animal living in pond water. It attaches itself by the end of its stalk to a water plant and waits for its prey to come near. *Hydra* paralyze small animals by the stinging cells of their tentacles. Then the tentacles move the paralyzed animal into the *Hydra's* mouth. Examine the prepared *Hydra* slide. Notice the shape of the animal's body and of its tentacles. At which end is its mouth located? Along the side of the *Hydra* you can see a "bud" forming which may look like a little bump. This will grow out like the branch of a plant and will develop tentacles and a mouth at the end of the bud. In time it will break away to become a new *Hydra*. You cannot see the inside structure of a *Hydra* on your slide, but it is interesting to know the body of the *Hydra* is made up of two layers of cells around a central cavity. These cells have special work to do. The ones lining the



cavity make a substance (enzyme) that begins to digest the *Hydra's* food in the body cavity. As the food is broken up, the membranes of the cells bulge out and engulf it and the digestion is finished in the cell. Anything that the *Hydra* can't digest is ejected through the mouth.

MY EXPERIMENT RECORD

BAUSCH & LOMB

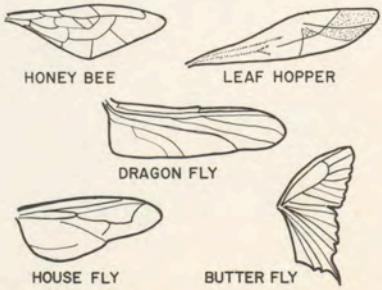
R1900
EXPERIMENT
NO. 11

MICRO-SCIENCE

PURPOSE: To examine the structure of insect wings.

MATERIALS: Housefly, dragon-fly, lady-bird beetle, bee, butterfly, collecting jar, forceps.

PROCEDURE: Collect any or all of the above insects which you may wish to examine to see how their wings are adapted for their flight. To help you learn about this you will want to read some of the books about insects that are listed in your bibliography or look up information in your school encyclopedia. Insects are arranged in groups according to their wing structure. Before removing the wing, look at the whole insect. Count the number of wings it has and see how they are attached to its body. Carefully remove the wing from the killed insect by pulling it at its base with your forceps. Place the wing on a slide on your microscope stage. Shine a light down on it, and examine it for veins, hairs or scales. If you wish you may make a permanent dry mount (See General Procedures) or you may make wet mounts for temporary observations. The wing of the butterfly is covered with colored scales which brush off easily. Catch one and touch the wing to a slide. Cover and examine it dry or make a wet mount. Can you think what



purpose these scales serve? The honey bee has two pairs of wings which it can hook together when it wants extra wing spread. Can you think why? You will want to make individual record cards for each insect to have room enough for all you can find out in this study.

MY EXPERIMENT RECORD

BAUSCH & LOMB

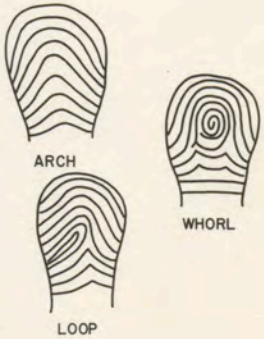
R1900
EXPERIMENT
NO. 12

MICRO-SCIENCE

PURPOSE: To show the use of microscopy in finger print identification.

MATERIALS: Ink pad, glass slides.

PROCEDURE: Microscopy is very important in detective work. You have already seen how the difference in cloth fibers or hairs can give clues to a criminal's identity. The most common means of detection is by finger prints. Scientists make careful studies of these for no two people have the same prints. There are three basic designs that the ridges of the fingers take. They are arches, loops and whorls. Every person has his own arrangement of these patterns that can make identification certain. Some states require the fingerprints of the mother on a child's birth certificate. Others require them on automobile licenses. If you looked at these prints with your naked eye, they might seem alike, but through the microscope the tiniest differences can be seen. Press your forefinger and thumb on an ink pad and then roll them once on a glass slide, side by side. Put a label on the end of the slide to show it is your print. Make prints of other members of your family, labeling them also. These will be your "control" slides. Now have them make prints with the same fingers on other unlabeled slides. Mix them up and see if you



can match them up with the right owners by examining them with the microscope. Roll your own finger prints on your experiment record space.

MY EXPERIMENT RECORD

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