their leaves do not turn brown and fall all at one time, as the leaves of the elm or maple trees do. They fall when they are ready to die and new needles take their places.

Roots Work for Trees

A tree has many roots. It has big roots and many little roots. The big roots keep the tree in the ground. The little roots get water from the ground. The water goes from the roots up into the tree. Water helps to make the tree big, for there is food in the water for the tree. In winter, trees go to sleep. The roots do not work. When winter is over the roots get water for the trees again. When the roots of the maple tree go to work, sugar water is pulled up into the maple tree. Men make maple sirup when the sugar maple roots go to work.

Birds' Nests

There isn't any harm in taking old birds' nests after the little birds are grown and through with them. So we went on a nest-hunting trip. All of the children looked for nests. We found a robin's nest made of mud and grass, and an oriole's nest that was like a soft swing. The different birds make as many different kinds of nests as people do houses.

Specimens of Insects

The specimens we have of insects were killed with gasoline. One drop of gasoline on the head of the insect kills it instantly without any struggle. The gasoline soon evaporates and leaves the insect in perfect condition.

Animals Find Winter Homes

Animals know winter is coming. Many of them grow warm winter coats; others find new homes for winter. Bears eat and eat when winter is coming. They then sleep all winter. Sleeping all winter is known as hibernating. Squirrels and raccoons have homes in trees. Mice and chipmunks live in the ground where they have found holes and stored their food for the winter. Many of the birds fly away for the winter. They find homes down in the South. Other birds stay here all winter and they are the ones we must remember to feed this winter.

Feeding Plants

HELEN FIELD WATSON
Senior High School, Mitchell, South Dakota

For four years students in our high school biology classes have been interested in experiments with plant foods. The first year a few students performed a few experiments. Last year forty or fifty of the hundred and twenty in the department were applying plant foods, potting, watering, watching and recording their observations on corn, lawn grass, house plants, sweet potatoes, and other plants.

Our laboratory has no greenhouse facilities. We have ten windows in the three rooms (laboratory-classroom, stockroom, and office) of which only four are available for plants. Two of these have tiers of glass shelves to give additional space. These sound like poor conditions for handling so many experiments, and we no doubt could do better work with less limited facilities. In spite of that the experiments have been interesting and seemingly profitable.

As yet we do not have enough data to make conclusions about the general usefulness of the nutrient solutions prepared in the laboratory, nor of *Vigoro, Kem,* B_1, nor other prepared soil fertilizers.

The disposal plant for the sewage of our town, like that of many others, accumulates the sludge in dried form. This is available, free, to farmers or townspeople. But as soon as they began to use it came the widespread complaint, "It burns the grass." If you could see the amount spread on some of the town lawns you would understand why "it burns."

At our invitation, one daily paper has twice published pictures of some of the plants raised in our laboratory in which

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Mitchell Disposal Plant sludge was used. It was our attempt to say that, if properly used, this fertilizer aids the growth of some plants. Of course, the reporter wanted some definite statements: how much sludge to use per square foot of soil; how much the grass will grow in a week; whether it is equally good for wheat, oats, and cabbage. To the daily press the scientist often seems slow and annoyingly indefinite, because the scientist wants masses of information before drawing a conclusion. At least our plant experiments could show the interested public that there is material available which can improve the rate of growth, and, in some cases, the color of blossoms of certain plants (Fig. 1). What amount to use in any particular soil for any particular crop must be a matter of experiment with the individual farmer or gardener. To the biologist it is understandable that overfeeding of any crop will "burn" it, presumably by reversing osmotic flow.

Before we tried the disposal sludge as fertilizer we did numerous experiments (and still do) with nutrient solutions. Our first help was received from ELLIS AND SWANEY, *Soilless Growth of Plants* (Reinhold Publishing Company, 340 W. 42nd Avenue, New York City). The chemical formula we have used most often through the four years is from that source. It is as follows:

NUTRIENT SOLUTION

Fertilizing Solution

Monopotassium phosphate	5.9 grams
Calcium nitrate	20.1 "
Magnesium sulphate	10.7 "
Ammonium sulphate	1.8 "

Dissolve each of the above chemicals in about 1 pint or 1 quart of distilled water. Then mix the dissolved salts and add enough distilled water to make 5 gallons.

To provide the necessary "trace elements" we now dissolve together in 1

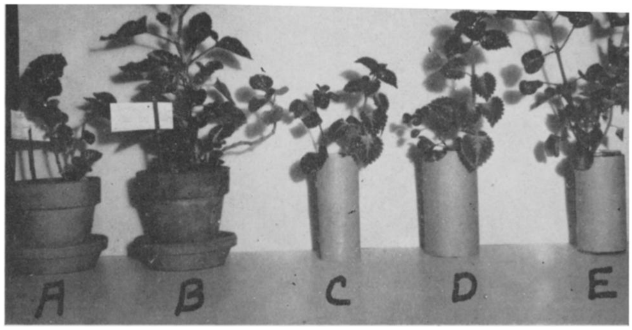

FIG. 1. Growth in fertilized soil and in nutrient solution, 57 days.
A. Begonia, in soil, height, 6½ inches.
B. Begonia, in soil fertilized with sludge from sewage disposal plant, height, 11 inches.
C. Coleus, in distilled water, height, 4½ inches.
D. Coleus, in city water, height, 7½ inches.
E. Coleus, in nutrient solution (Ellis and Swaney), height, 9 inches.

pint of distilled water:

Boric acid crystals	0.8 gram
Manganese sulphate	0.8 "
Zinc sulphate	0.8 "

To each 5 gallons of the *fertilizing solution* as prepared above we add 10 cc. (2 teaspoons) of the boron-manganese-zinc solution.

Because of its tendency to precipitate, the iron is kept in a separate solution. For this, dissolve 0.8 grams of ferrous sulphate (or ferric nitrate, or ferric chloride) in 1 pint of distilled water. Just before introducing to the plant add 5 cc. (1 teaspoon) of this iron solution to each quart of nutrient solution.

To get quick results we have used cuttings from house plants which root readily. With begonias and coleus cuttings the Ellis and Swaney nutrient solution gives spectacular results for growth (Fig. 2). Even with unrooted slips, within a week the student begins to note differences between the one with the experimental factor and the control, which we usually grow in city water rather than in distilled water. And Mitchell city water offers considerable food to a plant. Coleus in the city water often has brighter reds than does that in the nutrient solution. Begonias acquire a beautiful glossiness and bloom earlier with the added chemicals. The vine com-

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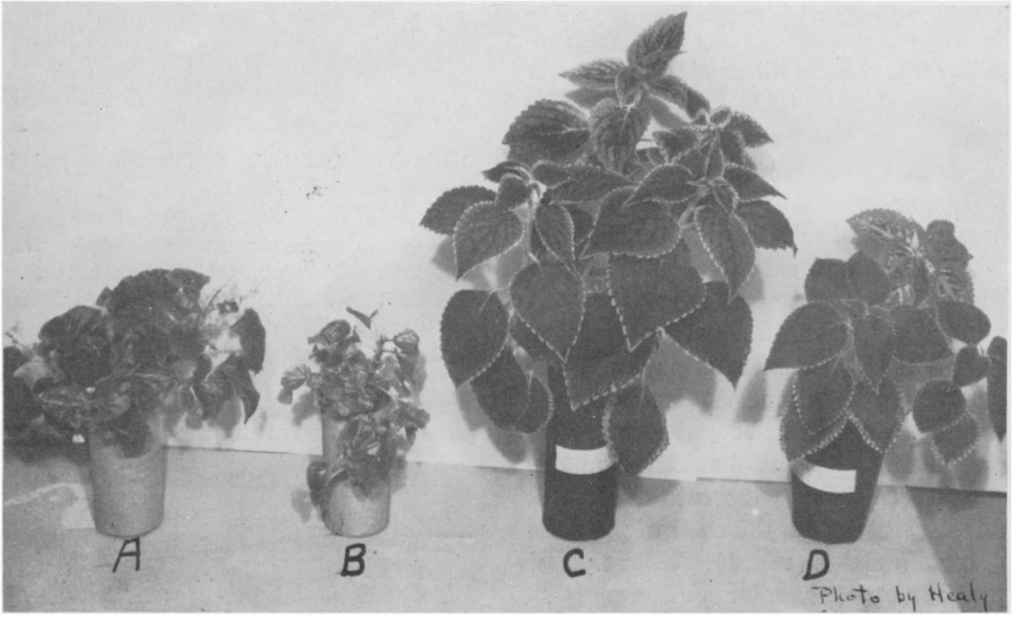

FIG. 2. Growth in nutrient solution and in city water, 42 days.

A. Begonia, in nutrient solution.
B. Begonia, in city water.
C. Coleus, in nutrient solution.
D. Coleus, in city water.

monly called Madera Vine makes amazing speed in growth in the nutrient solution. Sweet potatoes, and especially yams with their bright red stems, delight students as they respond readily to the Ellis and Swaney nutrients and to *Kem,* a commercial preparation.

There is another side to this exciting pastime. Geraniums just won't play at our game. Nothing, so far as we have observed, seems to help or hinder them. We have tried *Kem, Vigoro,* B_1, Mitchell Disposal sludge, and the Ellis and Swaney nutrient solution. Even angleworms, but that is another story. Narcissus bulbs seem to have what food they need stored within them. Our B_1 experiments with Paper White Narcissus bloomed slightly earlier than the controls in a few cases but not in all. Because we have not satisfactorily figured out the problem of supporting seedlings in a solution we have done very little with grains, grasses, and garden vegetables.

Several students have tried these seedlings with Mitchell Disposal Plant sludge, but, as each person brought different soil (usually from his home farm or garden) and has used his own choice of amount for a given measure of soil, we have not yet amassed enough data to make conclusions.

Usually each student had, besides his control (No. 1), two other pots of soil, each with fertilizer added. For example, No. 2 might contain 1 tbsp. pulverized fertilizer to 1 quart of soil, and No. 3 have 2 tbsp. fertilizer to 1 quart of soil. It is not necessary to remind scientists, though it is necessary to remind beginning students, that in a controlled experiment all other factors besides the experimental factors are identical. In this case the identical factors are: kind and size of pots, drainage, basic soil, number and kinds of seeds or plants in a pot, kind of water and amount of water supplied after the original set-up, and the amount of sunshine. With us, sunlight

(Continued on page 15)

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TREASURER'S REPORT FOR JULY AND AUGUST

RECEIPTS

Balance from Dr. Jeffers	$ 716.10
Received from 44–45 members	244.00
" " 45–46 "	7.50
" " 46–47 "	1.50
Member contributions	29.50
Old accounts	1.00
Received from advertising	358.17
Total	$1357.51

EXPENDITURES

Science Press for Feb. and Mar. '44 A.B.T.	$ 575.51
Officer's expenses	61.22
Printing 2000 member postal cards and stationery	66.89
General Biological Supply House, for 16,000 postals	160.00
Cash balance	494.15
Total	$1357.77

Bills Payable

Science Press, Apr. and May '44 A.B.T.	608.05
Swift Print Shop, for programs	18.36
New Method Book Bindery Inc., for binding 3 Vols. A.B.T. for Library of Congress	6.25
Total	$ 632.66
Subtracting the cash balance	494.15
Deficit	138.51
Total paid membership Sept. 1, 1944	749
Total of 150 members extra contributions	$ 224.10

Your continued help in securing new members is much needed. As Dr. Jeffers stated in the May *American Biology Teacher* "If any member feels disposed to make his or her check a little bit bigger, the excess to be applied on the debt, it will be greatly appreciated."

CANADIAN NATURE

Readers in Canada and the northern states will be especially interested in *Canadian Nature,* published five times during the school year by the Whittemore Publishing Company, 177 Jarvis Street, Toronto, Ontario. Each of the five issues contains about 36 pages, richly illustrated with drawings and photographs, some of the latter in color. The objective of the publication is to furnish authentic information about the natural phenomena of Canada, to develop intelligent interest in Nature and to stimulate first hand nature-observation on the part of teachers and pupils. The articles are of medium length, well illustrated and so written as to make good supplementary material to fill in what textbooks in biology cannot include. The Whittemore firm also publishes booklets on flowers, birds, etc., of Canada. Group rates exist for subscriptions to *Canadian Nature* and quantity prices for the booklets.

BY THE WAY

WHEN COLLECTING FALL TWIGS for winter bud study, get a few extra to lay aside for use in the spring when the leaves are emerging. Cover with laquer or varnish to keep the buds, leaf scars, etc. in good condition.

INSECT GALLS can be collected in the fall. If the insects are still in them, place the galls in small jars covered with cheesecloth or glass plates and notice what type of insects emerge.

COLLECT BIRD NESTS in the fall; when the leaves have fallen from the trees the same nests that were so nearly invisible last spring and summer stand out boldly against the sky.

POLLEN GRAINS, SPORES, etc., may be mounted permanently by sprinkling them on slides that have been coated with clear fingernail polish. Allow to dry thoroughly and apply a cover glass in the usual way.

(Continued from page 12)

is always a problem as we have so few windows and such crowded shelves.

Plants in solution should be grown in glass containers in order that the observer may note and record differences in root growth. Glass containers should be covered by a collar of dark paper to exclude sunlight, as algae grow abundantly in the nutrient solution. Both the jar and its collar should have identical labels, giving concise information, in case the collar be removed. All solutions, including water, should be emptied once a week, the plants laid out so the roots can air, then put back into fresh solutions. Each time the plants are given any care observations and care should be clearly recorded.

This article is presented with small concern for our conclusions, but with the hope that it may suggest exciting experiments which teach correct experimental procedure, and with the belief that here is an important tie-up between the school community and the home community.

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