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THE TECHNE

LIFE WITHOUT LABOR IS A CRIME. LABOR WITHOUT ART AND THE AMENITIES OF LIFE IS BRUTALITY.—RUSKIN.

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GETTING AT THE TRUTH

If everyone who writes and speaks would try to distinguish between what he knows and can prove and what he just loves, hopes and longs for, the intellectual climate would be cleared of a lot of confusing fog. But most of us want to play the role of little gods and to imagine ourselves 100-percent right all the time on every point everywhere. In view of the human propensity for dogmatism and prostration before dogmatism, I should like to see a little evidence at least on the possibilities of human error and the utility of new searches for light on physical and human nature.—Charles A. Beard in January 30, New Republic.

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THE TECHNE publishes, for the most part, papers on educational subjects, though articles on closely related fields are also used. Part of these papers set forth the results of research; others aim at interpretation of current developments. Through some of the discussions will interest the specialist, it is hoped that in every number there will be something usful for the average teacher.

THE TECHNE is sent free to the alumni, school officials, libraries, and, on request to any person interested in the progress of education.

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FUNCTIONAL BIOLOGY

By O. P. Dellinger

I feel that biology is destined to play an ever increasing role in our social order; that if we teach the biology we should, we shall have a vital part in forming the kind of society we shall have tomorrow. Therefore, we biology teachers are fortunate in having chosen this as our life's work. We are training the youth of today who will either conserve the present order and adjust themselves to it, or throw what we now have into the discard and build another order that is better suited to their needs.

Elementary science is composed of the experiences of the race, tested and set in order so that we can use them. In so far as these experiences are effectively used in the affairs of life, happiness and well-being will result. In so far as they are not tested or are not used, misery, suffering, confusion and death are inevitable. It is our function as biology teachers to pass these tested and orderly experiences on to the youth of today, and to pass them on in such a way that youth can and will use them.

I am not concerned very much about that vast body of knowledge that does not function. Young people of today are not interested in it. They are seeking life and life more abundant. There is a body of biological knowledge that points the way to this abundant life. It is this knowledge that I am interested in passing on to those in our classes.

Such knowledge concerns itself with our daily activities and is the knowledge we must have in order to live effectively and happily. These scientific procedures have been thoroughly tested and proved in the science laboratories and have stood the tests of daily life. To them we have trusted our lives, and upon them we have based many of our procedures of the past. It is this life-sustaining knowledge that the youth of tomorrow must have.

If such information is to function it is also important that we concern ourselves with the method by which young people obtain it. It is much better for one to want and seek knowledge than to have it handed to him ready made. We have far more faith in knowledge which we have tested and proved for ourselves. Therefore, students should be given every opportunity to have first hand experience with the body of knowledge which we are presenting to them. They need to know how to test and prove every new principle or theory that is presented to them. If young people are to have faith in what we teach, and if they are able to use the experiences of the race in their daily lives, they must themselves come in personal contact with many of these experiences. "Book larnin" is of little value unless it corresponds to some of our own experiences.

David Starr Jordan has said that "If knowledge finds its function in the conduct of life, and if the truth finds its test and verification in action, these principles should find a wide application in the field of education." William Lowe Bryan, President of Indiana University, states the first of these principles in another way when he says, "It is better not to know so much than to know so much you can't use it." That knowledge should be verified by use is also indicated by Bryan in the statement that, "It is better not to know so much that is not true."

We teach too much from books. We do not give the students in our classes enough opportunity to test and prove what we are teaching. As a result students enter the high schools from the grades, and colleges from the high school, wedded to the authority of books; and from our high schools and colleges they enter upon life's activities with little confidence in their past training, and therefore do not as they should, apply what they have learned to the art of living.

As previously indicated, I feel that we biology teachers stand in an enviable position in the field of education. The knowledge we have to present functions immediately in the conduct of life. It is necessary to effective living and it is the kind of knowledge the youth of today are seeking. Will we give it to them? If we do, biology will have its rightful place in our changing social order.

What then, you may ask, is the biology that we should teach? The answer to this question can be stated more easily by first pointing out a few things that it should not be. I think you will agree that it is not the biology taught by the inadequately prepared teacher who is neither familiar with the elementary field of botany, zoology, physiology, bacteriology, genetics and evolution, nor who does not know the most recent discoveries in these fields. It is not the biology taught by an individual who depends on textbooks and second hand information; nor is it the biology of plants and animals of distant climes or regions, or the biology of the strange, the peculiar, and the unusual life about us. Neither do I believe that the facts collected by following our ordinary laboratory guides in botany and zoology, or the usual outline in nature study, contain the biology we mean. Moreover, I do not believe that the biology taught in the grades, nor in the high school should be the same as that taught in the college. It is unfortunate that much of high school biology is simply diluted college biology. This is, of course, most likely to be true when the teacher is not adequately prepared.

However, I must get back to the question. What biology should we teach? Or what biology fits our changing social order? I think Hodge in his *Nature Study and Life*, has answered this question so far as the grades are concerned. He says, "We should study those things in nature which are most worth knowing to the end of doing those things that make life most worth living." He puts KNOWING and DOING together as they should always be in good teaching of biology. And the things we are to do should make for better and more beautiful living.

We are not just to teach insects, but to teach a few of the harmful insects of the household, orchard, and garden, and to teach them in such a way that they will be controlled. The control of these pests frees us from loathsome diseases and gives us better fruit and more beautiful flowers and trees. In other words, it makes for better and more beautiful living.

Hodge's treatment of all nature is the same. Sometimes he would have us discover our biological enemies in order that we may control or destroy them. Other times he would have us discover our biological friends so we may conserve and use them. At all times he would teach the child a functioning body of knowledge.

At the high school level, and I take it that it is at this level that most of you are teaching, the question of what biology to teach is a little more difficult. A few years ago when it was found that the high school biology taught was not functioning as it should, and it was being pitched out of our schools "bag and baggage," there was a strong move to have it function in special fields. We developed agricultural botany and zoology, household bacteriology, community biology, civic biology, and what not. At that time when asked what biology we should teach in our high schools one group answered, "Why just teach biology," and from the way they said it they might as well said, "You dumb bells!" The other said, "Teach agricultural biology, household biology, civic biology, any biology that will function." Even high school textbooks in all these special fields of biology appeared. As a result, in Kansas at least, very little biology was taught, and agriculture was slipped into its place in the curricula.

I feel we are in a much better position again and that, if we can find a functioning biology to teach, we are on our way. I feel, although you may not agree, that the biology we teach should not be any special brand of botany or zoology, or even biology. True, it should be a biology that functions in agriculture, in home economics, in physical and health education, in personal hygiene, in home and community sanitation, and in the social sciences. It should give the knowledge that rationalizes procedure in all the above fields. But in addition it should be a biology that gives dominion over the biological forces of nature; a biology that reaches out to the biological problems of the state and nation. Some of these problems are insect control, conservation of natural resources, control of diseases, control of animal and human parasites, animal and plant nutrition, fungus diseases of animals and plants, crime, pauperism and social delinquency. It should give also the biological factors that enter into the development of the individual and the history of the race. It need not concern itself with the theories in these fields but should give the fundamental facts of heredity and the principles of evolution and give them in such a way that they can and will be used in the solution of our social problems.

After the necessities of life are assured, man instinctively turns to other activities to satisfy his nature. Browning had this in mind when he wrote:

"Poor vaunt of life indeed,
Were man but formed to feed.
Such feasting ended, then
As sure an end to men."

And again when he says:

"Rejoice we are allied
To That which doth provide
And not partake, effect and not receive!
A spark disturbs our clod;
Nearer we hold of God
Who gives, than of His tribes that take,
I must believe."

The active, vigorous mind of youth will find something to do. Whether he does good or evil, creates or destroys the beautiful, finds happiness and a joy in living, or misery, suffering and death, depends largely on whether he loves the good and the beautiful and hates the wrong and the ugly, as well as whether or not he knows where health and joyous living are to be found.

While the biology we teach functions immediately in solving the problems of everyday living, I believe it also functions, if properly taught, in the aesthetic, ethical, and religious life of man. Much evil is done through pure ignorance. Young people do not instinctively know what to do to insure happiness and joyous living. They must be taught. Courses in biology, because they are continually emphasizing the rewards of obedience to truth, and because also they are frequently pointing out the inevitable results of disobedience to the laws of nature, always tend to stimulate the individuals to respond in accord with nature's plan. By developing a love of nature one should be led to a love of God, and the pointing of the way to truth points the way to happiness and joy of living.

ECONOMIC VALUE OF BIRDS

By H. H. Hall

"God made Him birds in a pleasant humor;
Tired of planets and suns was He.
He said: "I will add a glory to summer,
Gifts for my creatures banished from me."

One of the greatest values of birds to man is in the joy they add to life, the pleasure of hearing their songs, of seeing their beauty, and of the thrills which come from the sight and sound of the wilder, rarer ones. But besides this aesthetic element, birds hold an all-important place in the balance of nature by feeding in large measure upon the enemies of plant life, both insect and mammal.

The number of insects eaten by birds are incalcuable. A cliff swallow has been found with 47 cotton boll weevils in its stomach, a chikadee with 450 insect eggs, a red-shouldered hawk with 268 grasshoppers, cuckoos with 251 tent caterpillars and 325 fall web-worms, a Franklin gull with 192 grasshoppers, and a nighthawk with 500 mosquitoes. It has been estimated that the birds of Nebraska devour 170 car loads of insects each day.

The chinch bug is devoured in large numbers by swallows and flickers, while more than 100 have been found in single stomaches of bobwhites and meadowlarks, and more than 200 in one of a brown thrasher. The cotton-worm is eaten to the number of 100 to 150 at a meal by cuckoos, white orioles, mocking birds, and cardinals also are enemies of this pest. Great numbers of cut-worms are eaten by prairie chickens, bobwhites, sparrow hawks, night hawks, wood ducks, red-headed woodpeckers, meadowlarks, cardinals, and robins. Grasshoppers are a favorite food of many kinds of birds including gulls, terns, geese, ducks, pelicans, kildeer, crow, kingbirds, cranes, horned larks, upland plover, catbird, and bluebird.

Weeds are a serious pest in grain and grass fields and mourning doves, bobwhites, and sparrows do men a good service by the destruction of their seeds. Mourning doves have been found with as many as 6,400 to 9,200 seeds in their crops, and bobwhites with from 5,000 to 10,000. It has been estimated that the tree sparrows eat 875 tons of weed seed in Iowa each winter, and that various species of sparrows alone saved the farmers of the United States $90,000,000 in 1920 by the destruction of weed seeds.

The chief enemies of mice, rabbits, ground squirrels, and prairie dogs are hawks and owls. Dr. C. Hart Merriam "showed that each hawk and owl was worth on the average of $20 a year to the farmers of the state (Pennsylvania) as a destroyer of mice and insects." As many as 100 grasshoppers have been found in the stomach of a Swainson's hawk, representing a single meal; and in the retreat of a pair of barn owls have been found more than 3000 skulls, the bulk consisting of field mice, house mice, and common rats. Nearly half a bushel of the remains of pocket gophers, animals which are very destructive in certain parts of the United States, was found near a nest of this species. The increase of noxious rodents and damage to crops are due in no small part to the diminished number of birds of prey, which materially aided in keeping down their numbers.

A few hawks are injurious, and most of the depredations on birds and chickens chargeable against hawks is committed by three species, the Cooper's hawk, the sharp-shinned hawk, and the goshawk. People should learn to know these by sight and kill no other bird of prey.

The means of increasing the number of birds about the school, farm, and in the neighborhood of the home are few and simple. Adequate protection, provision of suitable nesting places, food, and water are all that is necessary. The most important factor in attracting birds is cover suitable for their wants. With this provided, save in the case of birds that nest about buildings or in holes, nature will supply the nesting sites as well as take care of the food supply except in winter.

Almost every one who lives in the country or city can do something in the way of attractive planting about his house or grounds; and even in the more closely settled suburbs almost every place, no matter how small, can by judicious planting be made attractive to birds. Even a back yard may in its limited way, with proper treatment, be made a rendezvous for birds in the vicinity.

The planting of trees, shrubs, and vines is all important; on suburban places and in the country the use of evergreens, large plantations when possible, is of prime importance as a protection from the elements, as a source of natural food supply, and on account also of the nesting sites which they afford. Nothing is better than white pine or hemlock. Spruces are beautiful and offer tempting nesting sites, while the native red cedar seems a favorite tree for nest-builders and also contributes the berries toward the winter supply of food.

For deciduous growth to be used for cover, choose those berry-bearing shrubs whose berries are best liked by the birds; and, when possible, choose also those that may offer most convenient sites for nest building. Care should also be taken to get a continuous supply of food; for the summer food supply, cherry, raspberry, blackberry, blueberry, and mulberry; elder and various kinds of dogwood for autumn; hawthorn, mountain ash, barberry bush, sumach, and buckthorn for winter. Hedges are favorite resorts for birds, both in winter and summer.

The native birds that regularly nest in bird boxes in Kansas are: purple martins, bluebirds, house wrens, and tree swallows, while chickadees and Carolina wrens do so at times. Robins and phoebes may be encouraged by shelves conveniently placed beneath the roofs of porches, piazzas and sheds. Vines on trellises are attractive nesting sites for chipping sparrows as well as for robins.

Bird houses in general should be placed in the open or on poles or buildings; the entrance should be near the top; no porch is necessary; a tin can should never be used as the young birds are apt to die of heat. For wrens and chickadees the box should be about 3½ by 6 inches in height with an entrance 1 inch in diameter; for bluebirds the box should be about 4½ inches square and 9 inches high with an entrance 1½ inches in diameter. Purple martins prefer a house with many compartments, each of which should be about 6 inches square and 7 inches high with an entrance near the bottom 2½ inches in diameter.

Water, particularly during the summer months, is necessary for the birds. The proper installment of a drinking fountain or bird bath is a simple affair, and one that is sure to prove a great attraction to the birds. Drinking fountains may be purchased ready-made or manufactured at home. Almost any shallow receptacle will do when placed in some spot, but out of reach of skulking cats.

The simplest scheme of feeding, the least troublesome, and the most attractive to a number of birds, is the tying of a piece of suet to a convenient limb, or to the balustrade of a piazza, in a protected spot and one that can at the same time be easily watched from some window. Feeding trays may be placed in windows and on tops of poles. In all feeding places a variety of food should be supplied, suet, crumbs millet, hemp, rapeseed, and canary seed. These places will be well patronized both in winter and summer.

But all efforts to increase the number of our birds will be wasted if they are not at the same time protected from their enemies. The chief of these are people, English sparrows, and cats.

There are two ways of dealing with people who kill birds illegally and wantonly: one by law and the other by education. The laws must be enforced and a strong public opinion must be developed which disapproves the killing of protected birds. The most helpful method for changing the tactics of the destructive boy is to interest him in the protection and study of birds.

The Audubon Societies are doing a noble work. Many Audubon Societies have been formed in southeastern Kansas. In cities where Audubon Societies have been established the birds receive the food, water, and protection which they so justly deserve. This beneficial influence should be extended by the introduction of these bird clubs into every school in the state.

English sparrows have been disagreeable from almost every point of view: by eating the vegetables in the garden they make it almost impossible to raise gardens in many places; they consume a great deal of grain in the fields; and they drive away bluebirds, swallows, and martins. Perhaps trapping of the adults in sparrow traps and destruction of the nests are the safest methods to employ. To keep English sparrows from bird boxes a .22 calibre rifle is useful, and it is also well to keep martin boxes closed until the rightful owners are expected.

Judging from what has been said in the preceding paragraph in regard to the English sparrow, the writer has changed his opinion in regard to the destructiveness of this bird. Observations made during the past several years indicate that the English sparrow destroys large numbers of grasshoppers, cabbage worms, and in summer this bird may be seen near buildings, on windowsills, waiting for and destroying the termites, one of the most destructive insects in any community.

The worst enemies of our song birds are undoubtedly cats. Cats have been known to kill from 10 to 14 birds a day and many as 100 in a season. It is a heart-rendering experience to have a nestful of one's bird friends destroyed by a neighbor's cat. Vagrant cats should be trapped in box traps and shot when found doing damage on anyone's grounds. Licenses for cats have been tried successively in several cities: St. Petersburg, Florida; Massillon, Ohio; Montclair, New Jersey; and probably others. These ordinances require a fee and a collar for each cat, at the same time allowing the cat to be killed when off its owner's premises.

BIRDS OF OPEN GRASSLAND

As most birds spend more or less time on the ground, so we find that more birds are fitted for terrestial service than for any other. Our largest bird family, the sparrows, is chiefly terrestial, and although its members depend much upon seeds for subsistance they spend no little share of their time in searching for insects.

Some birds have become so closely adapted to life under certain conditions that they can live only where these conditions are present. The crow and English sparrow have become generalized; that is, they can adapt themselves to life almost anywhere. These, with the pine siskin, redpoll, goldfinch, and bob-white may be seen either in the woods or in the field, but since we see them more frequently in the open, we may class them as field birds.

Others that may especially be seen in the fields and open grassland are the Savannah sparrow, vesper sparrow, field sparrow, dickcissel, mourning dove, short-eared owl, horned lark, cowbird, meadowlark, rusty blackbird, bronzed grackle, grasshopper sparrow, fox sparrow, logger-head shrike, sparrow hawk, prairie chickens, and pheasants.

BIRDS OF THICKETS

The birds of Kansas, considered from the practical side, may be compared to a police force, the chief duty of which is to check the ravages of insects. To do this task effectively birds must be variously equipped. Birds may be grouped in families which resemble each other in a general way, yet among the members of the several families are marked variations of habits which fit them for their diversified duties. Just as some birds prefer forests, open woodlands, marsh areas, we have another group which prefers thickets.

Near the thickets and under the shrubs we may see and hear the brown thrasher in search for its food. The notes of the white-throated sparrow, tree sparrow, song sparrow, and fox sparrow may be heard. The "chewink" of the towhee and whistle of the cardinal are familiar songs. The beautiful indigo bunting may be seen flitting from branch to branch; and the catbird with its varied calls. Other birds which frequent thickets are rose-breasted grosbeak, logger-head shrike, blue bird, ruby and golden crowned kinglets, house wren, yellow-breasted chat, Maryland yellow throat, purple finch, and yellow warbler.

BIRDS OF FORESTS

At every stage of their growth from the seed to the mature tree, our forest, shade, and orchard trees are subject to the attacks of insect enemies which if unchecked would soon destroy them. These insect foes of trees are not without their own enemies, and among them are many species of birds whose equipment and habits specially fit them to deal with insects and whose lives are spent in pursuit of them.

Many of the tree-inhabiting birds which come about our homes are forest birds which when the forests disappear or decrease adapt themselves to the change and are found about the trees in orchards, gardens, and parks.

Many insects at one or another stage of their existance burrow deeply into the bark or even into the living wood of trees, and are quite safe from ordinary bird enemies. Woodpeckers, however, being among the most highly specialized of birds, are wonderfully equipped to dig into wood and to destroy these insects. Certain insects that attack smaller branches and terminal twigs are sought out and preyed upon by nuthatches, creepers, titmice, and warblers. Other insects attack the blossoms and foliage. Here it is that the sharpeyed warblers render their service. The owl family, longeared, barred, screech, great horned, and barn owl are just as much at home near the habitation of men as in their natural habitat. The great horned owl will not leave its forest dwelling; and when this disappears it seeks another like it. The short-eared owl belongs among the "field birds."

Hawks nest in the forests and are true wood-inhabiting birds. They may be seen in the fields wherever there are trees. The hawk's equipment of strong, sharp, curved talons, and its hooked, tearing bill enable it to prey upon mice and shrews, lizards, frogs, birds and other animals.

To the above forest birds we must add the whip-poor-will, Carolina wren, mockingbird, chickadee, cedar waxwing, blue headed vireo, scarlet tanager, tree sparrow, wood pewee, pine siskin, and thrushes. The most solitary of all thrushes is the hermit thrush and it may be seen only in deep woods.

BIRDS OF MARSH AREAS

From the time of earliest settlement of our country the bird life of marsh areas has proved to be a national asset. The streams, lakes, ponds, and marsh areas of America were covered with waterfowl, and its rivers and shores furnished highways for myriads of shore birds as they pasased north and south. Great number of ducks and shore birds found food and safety during the nesting period on our western prairies and in the innumerable lakes and ponds.

Nature has equipped in a wonderful way the birds that inhabit marsh areas. Swimming and wading birds are provided with toes that are more or less completely lobed. The bills are of many shapes and sizes but all are adapted for a specific use in nature. About the ponds we may hear the rattle of the kingfisher, the "tweet-tweet-tweet" of the spotted sandpiper, the "cow-cow-cow" of the pied-billed grebe, the "kil-dee" of the kildeer. Near soggy fields and meadows live the Wilson snipe, the swamp sparrow, the solitary sandpiper, least sandpiper, yellow legs, semipalmated sandpiper. Along streams and marshes are the greater yellow-legs, many of the sandpipers, green heron, bittern, Virginia rail, and soras. Along lakes and marsh areas many of the ducks such as mallard, pintail, green-winged teal, scaup duck, great blue heron, Franklin's gull, black tern, hooded tern, hooded merganser, and bufflehead duck. The pelicans and skimmers scoop up fishes and other animals from the water; the avocet uses its long curved bill like a scythe, swinging it from side to side near the bottom in shallow water and securing food it can not see; and the woodcock employs its bill as a probe for capturing small animals in the muddy shores of ponds and streams.

GAME LAWS OF KANSAS

The laws protecting birds, both federal and state, are on the whole good. There is, however, much violation of the laws through ignorance and deliberate intent.

Birds are divided into three classes according to the laws: first, those that are supposed to be injurious and may be killed at any time by owners of orchards and farms for the protection of other birds, fruits, and grains; others may be killed for the protection of game birds and poultry. The following birds come under the first class: bluejays, crows, blackbirds (bronzed grackle, purple grackle, rusty blackbird, cowbird, red-winged blackbird, bobolink), Cooper's hawks, sharp-shinned hawk, goshawk, and great horned owls. The English and European sparrows are not in the list of protected birds.

The game birds that may be shot and the open season on each may be found on the hunting license issued by the State Game and Fish Comissioner.

All birds not listed in class one and class two are protected at all times. This would mean that "all wild song or insectiverous birds" are protected at all times by state laws, and the destruction of nests or eggs is forbidden. Sec. 23, ch. 221. L. 1927.

It is the duty of all citizens to become informed upon the laws that concern the birds. Copies of the "Fish and Game Laws of Kansas" may be obtained from the Forestry, Fish and Game Commission at Pratt, Kansas, and a Farmer's Bulletin on the game laws of the United States will be sent upon request from the Office of Publications, U. S. Dept. of

Agriculture, Washington, D. C. Those who hunt should know just what are and what are not game birds, a subject on which there seems to exist a woeful ignorance. Those whose chief interest is in the protection of birds, should also know the laws so as to be competent to help enforce them. We need in Kansas an enlightened and educated public to uphold the statutes and condemn the law breaker.

The following farmer's bulletins may be obtained free from the Office of Publications, U. S. Department of Agriculture, Washington, D. C.

896. House Rats and Mice.

912. How to Attract Birds in the East Central States.

493. The English Sparrow as a Pest.

609. Bird Houses and How to Build Them.

1239. Community Bird Refuges.

An excellent bulletin in that by E. H. Forbush, "The Domestic Cat; Bird Killer, Mouser and Destroyer of Wild Life," Economic Biology Bulletin 2, 1916. Massachusetts State Board of Agriculture, Boston.

The following are good books that every teacher should have in his or her library.

Allen, Arthur A., 1930. The Book of Bird Life. D. Van Norstrand Company. New York City.

Bailey, Florence Merriam. Handbook of the Birds of the Western United States. Houghton Mifflin Co., Boston Mass.

Chapman, Frank M. 1932. Handbook of Birds of Eastern North America. D. Appelton and Co., New York City.

Henderson, Julius. 1927. The Practical Value of Birds. The Macmillian Company, New York City.

CONCERNING SOME ERRONEOUS CONCEPTS OF BIOLOGICAL PRINCIPLES

By Claude Leist

The teaching of biological courses to college freshmen who have had these or related courses in secondary schools has shown me that an appreciable number of these students have either a hazy concept of certain fundamental principles of biology, or an entirely erroneous idea of them. Such concepts are a detriment to the student and slows up his progress in college courses in biology. The hazy concepts must be made clear to the student, the erroneous erased from his mind and replaced with correct ones, else they, acting as stumbling blocks, will further confuse him in the progress of a biological subject. To do this takes time and so delays instruction in the course. Furthermore, a student who possesses such hazy or erroneous ideas may be really handicapped as compared to a student who has had no biological training in his secondary education for the mind of the latter is not encumbered with confusion and error.

The above state of affairs has been called to my attention by other teachers of science. I have frequently heard it said that it would be easier to teach a student having no previous knowledge of the subject than to teach one having certain preconceived ideas about the subject which, in error, he has carried over from his high school days. Fortunately, the majority of college freshmen come to us from the various high schools as well grounded in biological subjects as the facilities of the secondary schools permit due, in no small part, to the teachers of science in these schools. The purpose of this paper is to point out a few of those biological principles which many students have not clearly in mind or are in error and to bring these principles in mind to the teachers of our secondary schools in order that they may find some way to present these fundamentals of biology more efficiently.

Some of the subject matter of biology about which many freshmen entertain erroneous ideas are listed here, as follows: They see little or no difference between protoplasm and the cell. They have a very hazy conception of the physiological activities called respiration and breathing. They see little or no differences between respiration and photosynthesis, the latter, in many cases, they call plant respiration. They tell me that stomata are pores through which the plant breathes. Transpiration is to them little more than respiration and photosynthesis. They have been taught osmosis and have that not clear in mind, but who has? They have no clear distinction between the various classes of the vertebrate phylum—the phylum to which they belong. It is not expected of the students to have a thorough knowledge of these subjects for such attainment can never be reached in any institution of learning, but he should have some clear concepts of them.

I believe the chief reason for a student seeing little or no difference between protoplasm and the cell is due to associating the cell with protoplasm without first getting a clear distinction between the two. One is prone to speak of protoplasm as some intangible substance that cannot be touched and cannot be seen with the unaided eye. If protoplasm is, as usually defined, the living substance of living things, then it and some of its products can be seen without the use of a microscope. We forget that protoplasm may make up the larger part of the living organism and that some aspects of it may be seen with the unaided eye, for example, muscle tissue which is largely protoplasm. It is its minute structure that requires the aid of the microscope; its ultimate structure may never be seen. In order to see some of its minute structure some unicellular plant or animal, preferably the animal is used as an example, because a protozoan is a relative large cell, displays certain movements of its cytoplasm and shows certain cytoplasmic structures and cell inclusions. Now it happens that the cytoplasm and nucleus of the protozoan is also its protoplasm since a protozoan is a single cell. In the multicelluar animal or plant the cytoplasm of each cell becomes a part of the protoplasmic whole.

If logical methods should be used in teaching, when demonstrating protoplasm by using the cell for an example, lest the student may become hopelessly confused. A student is shown a cell; the cytoplasm is pointed out to him; he is told that the cytoplasm is the protoplasm of the cell, which is true, but if it has not been made clear to the student beforehand just what is to be demonstrated he may be led into this kind of reasoning to wit: The cytoplasm is the protoplasm of the cell; the cell is made up of cytoplasm; therefore the cell is protoplasm and he may reason the converse true that protoplasm is the cell. For this reason care in lesson planning should be taken, and one should be assured that the student has a clear concept of protoplasm and cells before the structure of the cell is demonstrated.

The indiscriminate use of the words breathing and respiration may be a source of confusion to students. Breathing and respiration are words, each used to express the phenomenon of oxidation of assimilated foods to obtain energy for the organism and the elimination of carbon dioxide and water. I believe it would be better to restrict the meaning of these words. In physiology the word respiration is richer in meaning. The student, in early childhood, is taught that breathing is the inhaling and exhaling of air together with the accompanying thoracic muscular movements associated with such activity as found in animals possessing lungs. The part that the blood and tissues play in the role of respiration, the internal respiration of the physiologists, he learns about later. Thoracic and throat movements together with inhaling and exhaling of air can be much easier understood or at least demonstrated than gaseous exchange within the tissues, so it is easier for the student to get a mental picture of the former than the latter. However gaseous exchange in tissues and cells, that is, oxidation of assimilated foods and the elimination of carbon dioxide gos on in all living animals, with or without lungs, unicellular or multicellular animals, and exactly the same process is carried out in all plants as well. Since the student is first acquainted with breathing or respiration as manifested in animals with lungs it is hard for him to grasp the meaning of the same phenomenon in all plants and animals. It is my plea that the words, respiration and breathing, should be restricted in meaning when used in teaching secondary school biology. The word respiration should be substituted for the word breathing in almost all cases, especially when referring to gaseous exchange within tissues of animals and plants, while the term breathing, if used at all, should apply only to those muscular movements, etc., manifested in lung, gill, or tracheal bearing animals.

One of the most strikingly erroneous concepts harbored in the minds of college freshmen that come to me concerns that of respiration and photosynthesis. This is an old one and it is surprising how well it survives in spite of science teaching. Students of high mental calibre tell me that the difference between animals and plants is that "animals breathe in oxygen and breathe out carbondioxide and that plants do the reverse," Here the bugbear "breathing" again as well as confusion in meaning of photosynthesis and respiration.. When asked where they got such erroneous information, they tell me they learned it in high school biology. Many say that their teacher told them so. That the teacher gave them such information may be partly true, but I am inclined to think that, in most cases, the teacher has not dwelled on the subject long enough and has not fully made plain the difference between the two phenomena.

Photosythesis and respiration are entirely different processes in nature. Each utilizes the eliminated products of the other, but for entirely different ends. Photosynthetic processes require carbondioxide and water and combines (synthesizes) them in such a way that a simple sugar, glucose, is formed. The surplus oxygen is thrown off into the air. This surplus oxygen is utilized in respiration a process that breaks down glucose or other photosynthetic products releasing the energy contained therein. The end products of respiration, carbondioxode and water, are thrown off as waste products from the animal or plant body in respiratory processes. Thus photosynthesis is a process whereby food is built up and energy is accumulated, while respiration releases the accumulated energy in the food by reducing the food to the elementary compounds of which it is composed. Photosynthesis occurs only in green plants in the presence of light while respiration takes place in all animals and plants in darkness as well as in light. To repeat what already has been said photosynthesis requires carbondioxide, chlorophyll (the green substance in plants), water, and sunlight; respiration requires oxygen and food on which the oxygen reacts. Since both phenomena are activities in which gaseous exchange is involved, to the careless thinker they are construed as the same or manifestations of the same processes in different form. Such an idea is far from the facts since they are two entirely opposite processes. If any phenomena in nature should be made clear to students it is that of photosynthesis, the source of potential energy and food, and respiration the means of releasing this potential energy and putting it to work in life processes.

The belief that stomata are the "breathing (respiratory) pores" of the plant is due to confusing photosynthesis with respiration and also to the failure to understand the function of leaves. The leaf is an organ of photosynthesis which i sadmirably adapted for that function. It is true that the stomata are pores which perforate the leaf epidermis in order to permit air to contact the middle tissues of the leaf but it is the carbondioxide of the air that is wanted by the leaf for photosynthesis, not the oxygen for respiration. A little oxygen is used in leaf respiration but much more oxygen is liberated by the leaves than is taken in by them. This liberation of oxygen is the result of photosynthesis only, not the result of respiration. The false conception of the function of leaves has led to the often repeated statement that the leaves are the lungs of the tree. If this statement were true it would be hard to explain how deciduous plants respire in winter when devoid of leaves since the living plant must respire at all times, in winter as well as in summer, although plant respiration in winter is sluggish as compared to summer. This error in referring to leaves as analagous to lungs is due to the belief that respiration and photosynthesis are the same processes.

The phenomenon of transpiration is sometimes confused with respiration and photosynthes. In fact I have heard students use the words transpiration and respiration interchangeably when referring to respiratory process. Perhaps in this case the student has not noted the difference in the spelling and pronunciation of these two words and I am sure he is not clear as to their meaning. Transpiration refers to an almost unavoidable loss of water from the plant while the plant continues to adjust itself to its environment in order to carry on its life processes. Most plants, in order to carry on photosynthesis must expose enormous areas of its surface to the air and sunlight, and in order to absorb water and nutrient salts must likewise expose surfaces to the soil. The plants, most familiar to us, expose their surfaces to the air mainly by means of the leaves, and to the soil by means of root hairs on the roots. Leaf and root cells have large amounts of water incorporated in their cytoplasm and vacuoles. Now water evaporates in the presence of warm air, wind and heat. Since the exposed surfaces of the plant, filled with water, are in contact with the air, wind, and the heat of the sun, the water of the plant is continually evaporating into the air so that the plant loses water whether it is beneficial to it or not. Loss of water by this means we call transpiration, or, in other words, transpiration is loss of water by a living plant due to evaporation. Likewise the roots may lose water should such agencies as air, wind and heat so dry the soil that the adhered water on the soil particles becomes less than the water content in the roots. It is not within the scope of this paper to discuss the benefits of transpiration, its evils, or means of its partial control by the plant. It is hoped to convey to the mind that transpiration is due to the physical forces acting upon the plant from without. It should not be construed as having any direct relation to respiration and photosynthesis which are really processes going on in the plant tissues.

The phenomenon of osmosis is almost beyond the ken of high school students. In fact it is difficult for college students to grasp. Its true nature i sstill in debate among physiologists and physical chemists. Yet the subject of osmosis is discussed in nearly all, if not all, high school texts in biology. About all that can be done in high school biology is to show that water and some dissolved substances will pass through a membrane and that some dissolved substances will not, although water will. It is useless to try to explain why because the learned are not sure. Perhaps it would be wise not to use the word osmosis for the above phenomena, since osmosis implies more than the passing of substances through a membrane. All we can say is that water and certain substances pass in, the water and other substances may pass out of the cell walls or membranes and a demonstration of osmosis does little more than express this idea to the student.

I believe that high school students should be able to classify vertebrates sufficiently so as to be able to place them in the proper class to which they belong, since they are the most common types of animals, except possibly the arthropods, met with in the life of the ordinary individual. Many times spotted salamanders have been brought to me and I have been asked what kind of "lizards" they were. I have known some college seniors to classify a bat as a bird, when on second thought they should have known that it was a mammal because it was covered with hair and not feathers as is the case in all birds. The identity of fishes as such is seldom in error since their fins, gills, and the contour of their bodies are so universally alike that it is easy to distinguish them from all other vertebrates. Birds are commonly known as such because of their feathers and horny beaks but occasionally I hear some student stoutly defending the notion that birds of the farm-yard are not birds but fowls or poultry.

Reptiles and amphibians are usually confused especially those groups comprising the salamanders and lizards. It should be impressed upon the student that amphibians have no claws or nails; no scales; and usually a slimy skin—the toad, being the exception, having a dry, warty skin but no claws and no scales. All reptiles have claws with the exception of the snakes and the legless lizard(commonly called the glass snake). All reptiles are covered with scales and the scales are dry. We have no slimy lizards. The resemblance of salamanders to lizards is only superficial. On careful scrutiny it will be seen that salamanders have true amphibian and the lizards true reptilian characteristics. Perhaps more time should be devoted to the classification of vertebrates and to their economic importance than has been given, and much erroneous folklore and silly superstition concerning the various individual orders of vertebrates could with profit to the student be erradicated from his mind.

There are other erroneous concepts of biological principles. I have listed those that I most commonly meet with. I have endeavored to find a reason why they are made and tried in the brief space allowed to replace error with right. I am well aware that the primary object of secondary education is not preparation for institutions of higher learning but a preparation for a fuller life whatever the student's calling may be. A right concept of biological principals is better than erroneous ones if for no other reason that truth is better than error. I was taught as a child that whatever is worth doing is worth doing well; I believe that whatever is worth knowing is worth knowing well, and to paraphrase further, whatever is worth teaching is worth teaching well.

THE PREPARATION OF VISUAL SENSORY AIDS FOR INSTRUCTION IN BIOLOGY

By J. A. Trent

The use of visual-sensory aids for teaching purposes is probably greater than ever before. Living in a complex society necessitates a different teaching technique from that of our parents. With the advent of those forces which have modernized society, comes the need of methods of instruction to provide means by which the boy and girl may acquire training suitable to fit into the changing order. With the coming of many courses into the curriculum, it was necessary to turn away largely from the verbalistic methods of teaching, as employed mainly with the three R's, to the use of visual-sensory aids. Increased enrollments, heavier teaching loads and slashed budgets, further necessitate the use of aids. It also becomes necessary, because of reduced budgets, to make many of our aids by hand, or otherwise. This is not altogether regretable because both teacher and student derive a certain amount of pleasure and benefit from making their own aids. This discussion will deal with some of the common aids which can be made in the average high school by the teachers of biology and their students.

Visual-sensory aids may be grouped under four main headings, namely:

1. The Concrete Aids
2. Pictorial Illustrations
3. Projected and Reflected Pictures—motion and still
4. Miscellaneous Aids

THE CONCRETE AIDS

The question of the selection of objects and specimens for teaching purposes is mainly a local one. The problems pertaining to the methods of collecting, perserving, and maintaining of living specimens in the laboratory are too extensive to be treated here, therefore only references where such information may be found will be mentioned. The General Biological Supply House, 761 East 69th Place, Chicago, supplies gratis to teachers some excellent material on the subject of collecting and perserving specimens. This information is found in their monthly publication, "Turtox News," mailed free to biology teachers, and their "Service Leaflets," also free to teachers of biology. It is wise to carefully preserve the "News" and "Leaflets" as they provide a source of valuable information and are authentic.

Modeling is an interesting as well as an instructive activity for students. Students often visualize laboratory objects better by reproducing them with clay than by sketching them on paper by means of drawings. For instance, the student gets a better idea of the appearance of a paramoecium by making a temporary model of it with plastic clay than by sketching it on paper—he can better understand the arrangement of cilia which is difficult to show in sketches. For the most part models made in the laboratory should be of a temporary nature. Plastic clay should be used as it may be used over and over again. However, if permanent models are desired, a clay may be secured which hardens on drying, and such models may become a part of the permanent teaching collection. Baking is not necessary for some types of clay in order to make permanent models. The permanent models may be painted any desired color. Also the plastic clays may be secured in various colors. Clays may be purchased at most any school supply house at a nominal cost. The tools needed in simple modeling are almost negligible. Pointed and sharpened sticks as needed can be made by hand by the students.

Most schools can have some sort of a museum case for exhibiting its specimens, objects, and models. Teachers with the aid of their students can gradually build a permanent teaching collection. Most students like to make contributions to such a collection. Many commercial concerns furnish instructional exhibits to schools at little or no cost.

PICTORIAL ILLUSTRATIONS

Every teacher should constantly be adding to a collection of pictures for teaching purposes. There are many sources from which the teacher of biology and nature study may obtain suitable teaching pictures. There are sources from which pictures may be purchased at a nominal cost as well as several sources of free material in limited amounts. Bird pictures may be purchased from the National Association of Audubon Societies, 1974 Broadway, New York City. Nature pictures of various kinds may be purchased from Joseph Dodson, Kankakee, Illinois, and from the American Nature Association, Washington, D. C. Among the commercial concerns furnishing limited amounts, mainly bird pictures, free to teachers, are The Singer Sewing Machine Co., New York City; The Coca Cola Bottling Co., of most any city; and The Church and Dwight Co., New York City. Of course such pictures carry advertising and may be objectionable in certain instances. Good pictures may often be obtained from magazines, especially from the National Geographic, and sometimes from rotogravure sections of newspapers.

If a picture is of permanent value, it should be mounted on a cardboard suitable for filing. The size of the cardboard should be uniform as nearly as possible—not more than two or three different sizes, say 6" x 8", 8" x 10", etc. The filing space would determine the size if there are already cabinets for such purposes. A six ply cardboard should be saitsfactory for most pictures. Paste should be spread evenly on the back of the picture which is then immediately placed on the cardboard, after which they should be pressed under a heavy object to straighten them. Someone has found rubber cement, obtainable from automobile supply houses, suitable for mounting pictures. It has the advantage in that it prevents curling. It needs to be applied to both picture and card, however, before mounitng.

Photographic prints are valuable as teaching aids and can be made by anyone who is willing to take the time to develop the technique. Besides being valuable, it is a most interesting hobby. Most anyone has a kodak or camera of some sort that can be used to make satisfactory pictures of landscapes, flowers, plant and animal habitats, etc. One does not need an expensive camera for average outside work. Developing and printing are simple processes which can be acquired by anyone through some diligent practice. Besides it is less expensive to make one's own prints provided a considerable number are to be made. Also there is the satisfaction that comes from making them. For simple developing and printing one needs to purchase only the bare essentials—film, paper, chemicals, and a safelight. The other necessities can be picked up around the home or school or easily constructed by hand. Any one interested in making pictures should read "How to Make Good Pictures," Eastman Kodak Company, which can be purchased for fifty cents. Directions are often included with paper and films when purchased. Good photographic prints should be mounted in the same way as other pictures. Some prefer to make albums of them. By securing discarded clothing sample books from tailors, removing the samples and pasting white paper over the pages, durable and attractive albums can be made. More will be said concerning photography in another connection.

PROJECTED AND REFLECTED PICTURES—MOTION AND STILL

To many, projected pictures is the full meaning of visual instruction, however, there are numerous other types of visual aids. I shall not consider the motion picture in this connection, as the educational motion picture is rather expensive to produce and impracticable for the average teacher both from the standpoint of expense and the time involved. However, some enthuiasts are producing amateur pictures suitable for teaching purposes. Consideration will here be given to some of the more common still pictures used for projection purposes.

The lantern slide is the most commonly used still picture in projection work. They are made on glass 4¼ by 4 inches in size, and are sometimes referred to as transparencies. This type of picture is projected in the "lantern" or stereoptician.

Photographic lantern slides are positive pictures made from negatives printed on glass rather than paper. They can be printed from any average negative which is suitable for making a paper print, and are made in the same way. Thus the slide can be made from any negative that one may have—flowers, plant and animal habitats, etc. Of course the negative must be small enough to be printed on the 3¼x4 inch surface. It is best to use only about 2 2-3x3 inches of the slide in order to provide room for binding and labeling. One may also make copies of pictures, diagrams from books, or copies of one's own sketches or drawings. For this work, however, a camera with a ground glass is necessary for fine focusing. Often an old discarded plate camera can be secured for a small sum which is satisfactory for this work. This type of camera is satisfactory for making photomicrographs also. This is done by removing the lens of the camera and placing the eye piece of the microscope in the opening. After focusing on the ground glass, the plate of film may be inserted and the exposure made, after which the plate or film is handled in the usual way. As a matter of fact, most any hand camera can be used for making photomicrographs by setting the distance at infinity, if a folding camera, and placing the lens of the camera and microcsope close together to eliminate the stray light between the lenses, as only the light passing through the microscope should reach the film. After a few trials one can determine the proper exposure time. After the slide is finished, it should be covered with a clear glass of the same size and bound around the edges with a durable tape and labeled. Such slides can be made for about fifteen cents whereas the professional slides cost from fifty cents to one dollar each.

There are many types of hand-made lantern slides that can be made rather inexpensively.

India ink slides can be made by writing on clear glass with India ink. Clear glass can be cut of the desired size at a small cost or purchased already cut, if desired. The glass must be as clean as possible. It may be cleaned by using Bon Ami or washing the glass in ammonia water.

Ground glass slides may be produced by grinding the surface of the glass with an abrasive such as valve grinding compound. This enables one to write or draw with ease on the roughened surface. The finer abrasives are better. By placing a small amount of the abrasive between two glass slides and rubbing them together one can produce ground surfaces at a fairly rapid rate. Etched slides may be purchased, if desired. There is on the market now a composition known as "glassive" made by the Teaching Aids Service, Weban, Massachusetts, and selling for fifty cents, for preparing slides. On the ground surface various types of materials can be used such as pencil, crayons, and inks. The Keystone View Company, Meadsville, Pennsylvania, makes special inks and crayons in various colors especially for lantern slide work. Scarborite Transparent Colors made by Scarborite Colors Incorporated, Scarborough-on-Hudson, New York, are made especially for lantern slide work. Most ordinary colors such as water colors are not satisfactory for making lantern slides as many contain lead which is opaque, thus interfering with the projection of true colors.

Cellophane may be used for making slides by either drawing or typing and mounting between two clear glass plates. One can use black india ink or the colored inks referred to in the preceding paragraph. In typing on cellophane it is most satisfactory to place the cellophane sheet of the desired size between two sheets of carbon paper, thus making the same impression on both sides. The cellophane may be purchased at little cost and in different colors if desired. Radio mats already prepared for typing with the carbon inserted are also available.

Specimen slides may be made by mounting specimens between clear glass plates. There are a few types of specimens which lend themselves to such treatment, as leaf skeletons, insect wings, ect. The specimen is merely mounted on the glass in balsam, or in some instances it may be covered with shellac, after which it is covered with a cover glass.

Although there are many other types of slides which can be made by hand, the above mentioned are most useful for teachers of biology and nature study. For the most part students enjoy making lantern slides. They take much pride in seeing their slides projected. It may be well in some instances to have students make laboratory drawings on glass rather than on notebook paper, and from the best of these build a teaching collection.

The still film is a series of pictures and written material placed on film divided into sections the size of the standard lantern slide. These are projected in horizontal position with a slide lantern equipped with a special attachment which replaces the slide carrier. Cellophane may be uesd in making the hand-made still film. Cellophane may be purchased in large sheets from which is cut strips three inches wide and then divided into sections four inches long. Within this area the drawing or typed material is placed. The method of typing and drawing is the same as for making the slides discussed in the preceding paragraph. Again here the various colored inks may be used. Dr. Earl C. H. Davies of West Virginia University is the originator of the idea. He, along with his associates, Bonar and Ross, published the complete details, accompanied by sketches, in an article entitled "Cellophane Roll Films for Slide Lanterns," in the Journal of Chemical Education, Feb. 1933.

The film strip or the film slide is distinguished from the still film in being much smaller. It is printed on the regular 35mm. positive motion picture film, the picture area being ¾ x 1 inch. The film strip requires a special projector or a special attachment for the slide lantern. They are much less expensive than either the lantern slide or the still film and for most classrooms groups are very satisfactory. If one wishes to make his own strips, they can be produced at a cost of three or four cents per picture. Special equipment is needed to produce them. First a camera in which one can use the 35 mm. film is essential. And to do all kinds of work, supplementary copying lenses are needed. The negatives are printed on a positive film as in lantern slide work. A special printer is necessary, however.

For the projection of reflected pictures a reflectoscope of some type is necessary, and any mounted picture of the correct size may be used.

Some kind of screen is necessary in projection work. There are two general types of screens: those that reflect the image, and those that transmit the image.

In many instances the bare wall, provided it is smooth and light in color, can be used satisfactorily as a reflecting screen. Also, one may make reflecting screens of different kinds of materials, such as a good grade of white muslin, sateen o ra light weight white canvas.

Some prefer to paint the canvas with a good grade of silver or aluminum paint. Old window shades make desirable screens after being painted. The cloth should first be filled with linseed oil or other filler, and the paint preferably sprayed on in order to make it as smooth as possible. It is best to mount the cloth on a roller so it may be rolled up. One may also use a board or cardboard for a screen. They may be treated much as the cloth as far as paints are concerned.

Translucent screens, or "day light" screens, transmit the image and are thus placed between the projector and the audience. They can be used to an advantage where rooms cannot be well darkened. Of course the film or slide must be reversed from the position from which it is used with the reflecting screen. A fairly satisfactory "day light" screen may be made by placing architect's tracing cloth tautly over a frame of the desired size. Tracing cloth may be purchased for around one dollar a yard. It should be protected from water as it is easily spotted. A water proof cover should be provided or the surface covered with paraffin for protection against water. The paraffin should dissolved in xylol or benzine before applying it.

AGRICULTURE FOR RURAL TEACHERS

By George Ruggles

It is a generally accepted fact of everyday observation, supported by scientific investigation, that the standard of life among rural people generally in the United States is quite inferior to that of the middle and upper economic classes of the towns and cities, although better than that of the average urban laborer. Farmers as a group seem clearly to have less income per worker, less education, poorer houses, fewer home conveniences, fewer luxuries, less leisure, less recreation, less art, and less culture than city people of these upper classes.

The reasons for this state of affairs are not far away. The primary economic cause is inadequate income from the industry of agriculture. It is not enough, however, to state the main reason. It is necessary to explain why the income is insufficient. Although there are several important causes, the most fundamental is believed to be a lack of economic and scientific information among the majority of farmers.

The assertion that the average farmer needs to know more about the business of farming than he does is sometimes resented. For this reason, at least some of the facts on which this statement rests should be mentioned. In the first place, this is the conviction of the specialists who have spent their lives in agricultlral extension work among farmers, and it is the basis for the existence of the United States Department of Agriculture and of the state agricultural colleges and experiment stations. In the second place, agriculture has only recently emerged from a self-sufficing stage and become a commercialized industry. However much experience the average farmer has had with growing crops and livestock, he has had little or no experience with such powerful and complex economic forces affecting his success as those of marketing, organization, finance, and modrn business methods. The failure of farmers to organize in the midst of industrial organization and the excessive competition prevailing among them, is evidence of their relative lack of economic knowledge and skill, Thirdly, farming itself involves both technical and economic problems as complex as those of commerce or manufacturing, Yet the average farmer with his scant education relies very largely on his own limited local contacts in individual experience and is inclined to reject any aid that is offered him from scientific sources.

If it be granted that American farmers as a class need increased vocational efficiency in order to hold their own in our present complex economic system, an important conclusion which may be drawn is that any thorough-going plan to aid our farmers must include some systematic education in the economic and scientific facts of their calling.

Agencies which are at present engaged in agricultural education among American farmers and their children are six in number. They are: (1) county agricultural agents, representing the state agricultural colleges and the United States Department of Agriculture; (2) teachers of vocational agriculture in the high schools employed under the Smith-Hughes Act; (3) teachers of agriculture in rural high schools not employed under the Smith-Hughes Act; (4) field agents of various growers' and breeders' associations; (5) farm journals; and (6) teachers in rural elementary schools.

No one acquainted with conditions in the rural United States would contend that all of these agncies combined are meeting the needs that exist for agricultural education. Certainly no one would assert that any one of the agencies unaided by the others is meeting this need.

The county agricultural agents are unceasingly at work among farmers and farm boys, and their achievements are probably more noticeable in proportion to their numbers than are those of any other class of workers in agricultural education. Yet a brief examination shows the inadequacy of the county agent system. In the average county there are about 3,000 farmers and 4,000 farm boys. We may admire the efforts of one man to teach better agriculture to 7,000 individuals scattered over an entire county of several thousand acres, but we should not expect him to achieve much of an educational result with more than a small per cent of this number. Probably the chief function of the county agent should be to assume leadership of all forces engaged in agricultural education in the county.

Another type of agricultural specialist is the vocational instructor of agriculture in high schools, commonly known as a "Smith-Hughes Man." He has the same limitations as the county agents, being able to reach only a very small proportion of farm boys.

The non-vocational rural high schools deal with but a limited number of farm boys. Only about 25 per cent of all rural boys in the United States attend high schools of any kind. We should increase the number of farm children in high school, if we are to have the kind of rural life we desire.

Farm journals are good factors for rural education, but a prejudice exists against all agricultural information in printed form.

The last agency giving agricultural training to the farmer and his children is the rural elementary school. About 90 per cent of our farm children attend the elementary school. The rural school is in close contact with almost all the rural people. The rural high school and elementary school also have the advantage of dealing with children by regulating conditions five days of the week for eight months of the year.

The conclusion we reach, then, is that if the elementary schools give no aid in the teaching of agriculture, all the other agencies combined will only reach a small minority of the rural population. This does not mean that the rural teacher should enter the field of vocational agriculture, for he has much to do in his own field. Farm children of the upper grades may profit from an introductory study of agriculture and may consider the subject from one of three views: (1) appreciation, (2) natural science, and (3) prevocational.

Teaching agriculture in rural elementary schools has various obstacles. The rural teacher is usually a woman, not trained in agriculture, and knowing less about the practical side of farming than the big boys of the class. These boys have gained this knowledge from their fathers. What these boys need to be taught is what their fathers do not know—the value of better breeds of livestock and crops, characteristics of farm insect pests, principles of animal and plant breeding elementary soil chemistry, and many other similar phases.

These facts about scientific production are, however, probably not so important to the rural boy as the modern business methods that should be applied to farming—the principles of marketing, importance of farm units, economy of home-grown food and feed, care of modern machinery, agriculture as a vocation, value of scientific literature on agriculture, appreciation of good rural homes, appreciation for good schools and churches.

Probably the best way to teach them is to follow a good textbook, omitting all "practical" things and subjects foreign to the locality, and emphasizing those scientific and economic topics which seem to be of greatest locl importance. Such a text can be supplemented with year books and bulletins from the United States Department of Agriculture. The pupils may receive some of these for themselves and take them home. Such literature is just as important for a progressive farmer as scientific literature is for any professional man.

In teaching agriculture the rural teacher should not pretend she knows "practical" agriculture. She should merely take the attitude that she is going to study in the class. She should not be tempted into taking a firm stand on any principle learned in their study but should let the literature be its own authority, contenting herself with teaching how to test the soundness of the principle. It is probably wise to refer to outstanding farmers and county agents.

The rural teacher of agriculture should keep in mind: (1) that field trips can not be too numerous and that they must be planned to provide special opportunities for learning through actual observation and participation, such as the filling of a silo; (2) that a certain amount of laboratory demonstrations should be done, as testing seeds, testing milk, and testing soil for acidity; (3) that topics in agriculture should be studied when they are "in season" on the local farms; for example, the corn-ear worm should be studied when these insects are active in the corn fields.

For many years no agency except the rural elementary school will be in position to teach the majority of farm children some of these phases of agriculture and better rural living which they should know and which they cannot learn at home. Therefore the obligation falls upon the teachers of these schools. They must do their best to help meet the fundamental needs in rural education. They must endeavor to assist in solving problems in their immediate localities and must do all that is possible to point the way to a richer and fuller standard of living for rural people.

FACULTY SKETCHES

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SOME NEEDS OF EDUCATION AS I SEE THEM

That there be a closer relation between theory and practice; more tested and acccepted truth and less opinion and untested theory; more education and less propaganda.

That those who teach be more familiar with the social, economic, industrial, and political life in which the knowledge they teach is to function.

That there be a larger measure of science and scientific method in education and less book learning.

J. A. TRENT, Assistant Professor of Biological Sciences. A. B. Carson and Newman College, 1926. Had formerly attended East Tennessee State Teachers College and Lincoln Memorial University. A. M. University of Illinois, 1929. Seven years teaching and administrative duties in the public schools of Tennessee and West Virginia. Instructor in Biology Broaddus College, (W. Va.) summer, 1929. Present position, 1929.

SOME NEEDS OF EDUCATION AS I SEE THEM

1. A broader cultural background for our teachers in training.

2. More academic and professional preparation for many of our teachers in service.

3. More emphasis on a richer and fuller life as a result of obtaining an education—financial gain being secondary.

4. Place more emphasis on the "every day problems" of the immediate environment of the student. More personal direction is needed.

5. More training for the proper use of leisure time.

HARRY H. HALL, Professor of Biological Sciences, Southeast Missouri Teacher's College, 1901-1905; University of Missouri, Summer Sessions, 1912, 1916; B. S., Kansas State Teachers College of Pittsburg, 1921; A. M. University of Colorado, 1929; University of Iowa, Summer Sessions, 1931; Ph. D. University of Colorado, 1932.

Teaching and Administrative Experience in Schools of Missouri and Kansas, 1905-1920.

SOME NEEDS AS I SEE THEM

Out of every hundred who enter high school only six finish college and yet much of our high school educational system, with all of its elaborate and expensive enterprise is directed toward preparation for college.

Education should prepare the individual so that he will get the experiences which are most useful in fitting him to meet the present changes in the social and economic order, and also that he shall get these in the order in which he can best profit by them.

It should open up the young mind to real, practical living in his everyday world.

GEORGE E. RUGGLES, M. S., Assistant Professor of Biological Science. B. S. Kansas State Teachers College of Pittsburg, 1929, M. S. 1930. Seven years in the Public Schools of Kansas; Instructor in Biology, Kansas State Teachers College, 1929. Present position, 1930.

SOME NEEDS OF EDUCATION AS I SEE THEM

1. We should increase our vocational guidance program.
2. Our vocational efficiency can be increased by giving more vocational training.
3. The younger generation should be taught conservation of our natural resources.
4. There is a great need of education so our leisure time may be absorbed.

CLAUDE LEIST, A. M., Associate Professor of Biological Sciences. A. B. University of Illinois, 1918; A. M., 1921. Instructor in Biology, Hamline University, 1921-1924; Assistant Teacher of Biology, University of Minnesota, 1924-1926; Assistant Professor of Biological Sciences, Kansas State Teachers College of Pittsburg, 1926. Present position, 1928.

SOME NEEDS OF EDUCATION AS I SEE THEM

We are now passing through a period in which we hear mush about a changing order of society, an aftermath of a great war and a world-wide depression. It is, I believe, a time for our educational system to increase its efforts in teaching:

1. A citizenship that will give to our boys and girls a more wholesome love and respect for their country and those worthy principles on which it was founded, but without selfish nationalism.

2. A respect for private and public property.

3. A wholesome respect for their elders without imposing upon them reverential fear or ancestral worship.

4. A full appreciation of the fine arts and the natural beauty of their country.

5. How to preserve our country's natural resources.

6. To apprehend as far as possible natural phenomena.

7. How to make the best of those talents which the student possesses, but not to have a selfish satisfaction in them.