Commercial farming will utilize all the expedients of science and technology as well as of business organization and management. These large farms will be held either by corporations or by farmers' cooperatives. They will be so managed as to promote the conservation of the land, the raising of yield levels and the improvement of crop quality. There will be the question of the distribution of population as it may be affected by large-scale farming, on the one hand, and part-time farming, on the other. There will be the question of agricultural commodities as raw materials in manufacturing of, let us say, fuels, plastics, celluloses, organic acids, higher alcohols and what not. Present-day systems of marketing and distribution will undergo far-reaching changes. The interrelations of agriculture, industry and commerce will be more clearly defined. Our taxation systems, certainly land taxation systems, will, of necessity, undergo substantial modifications. Industry will draw an increasingly greater proportion of its employees from families living on small farms and deriving a part of their living from them. We may thus readily vision land-use planning as the touchstone for the redistribution of population and industry; for the rationalization of production; and for the steady rise of earnings and living standards.

Incidental Use of the Land

In planning the use and conservation of our land resources, we shall make provision for playgrounds; for game preserves and wildlife sanctuaries; for fisheries; for storage reservoirs; and for the effective management of areas that would assure us of flood control. Obviously, agriculture, industry and commerce have a stake in this great enterprise. As we develop and maintain our forest resources, we shall almost automatically provide also for playgrounds, wildlife sanctuaries and more effective control of soil erosion, soil leaching and the silting in of streams and reservoirs. It is no less obvious that we are dealing here with a group of local problems that seem to fuse, as we study them, into one great national problem. Time and again, we must return to the conclusion that the conservation of our land resources lies at the bottom of our national security and progress.

Educational Factors

Physical resources are in themselves of slight value. It is only human intelligence and human knowledge that may put value into these resources. Technical information and a sense of moral values are the key which alone can unlock the door of the treasure house. We must know how to make bread out of stones and beautiful landscapes out of raw earth. It is essential that, in dealing with the conservation of our land resources, we do not fail to educate and train our men and women to the point of greatest adequacy and effectiveness. General and vocational training and education, an understanding of economic and social values and such organization of local, state and federal governments as would provide the needed safeguards, the best guidance and the most thoroughgoing coordination of all social efforts are the ideal toward which we should strive. Our strength lies in the soil; our hope, in the land; our salvation, in the upward climb toward the higher peaks of economic and social justice.

THE CONFUSION OF TONGUES[1]

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To this point in this discussion we have invited you to recall something of the broad scope and fine heritage of the zoological sciences; something of the great significance, and also the adequate establishment, of the evolution principle; and something of the inestimable human values which lie in the numerous disclosures of practically all branches of our science within the past 30 or 35 years. Let us now desert the laboratory and make a bit of an excursion. The direction or distance we go doesn't much matter; wherever we turn we shall meet man—whom Shafer calls a fearful compound of grandeur and misery—and we shall encounter schools and laws and tradition, in short, the world for which we and our laboratories exist.

Within the past thirty years in this country the number of anti-science, anti-medical, anti-vivisection and anti-evolution crusades has greatly increased. Before some state legislatures biologists and medical men must each year give valuable time to fighting the annual anti-vivisection bill. In still other states that fight, like the one on the teaching of evolution in public schools, is already lost. A public unfamiliar with the nature and contribution of animal study is the prepared ground for all these "anti" societies; and on such a public counter-arguments are peculiarly inef-

[1] Continuation of the address of the vice-president, Section F (Zoological Sciences), American Association for the Advancement of Science, St. Louis, January 1, 1936.

fective. Here, as at any other point which we may wish to touch, the biologist of to-day is seen to have become isolated and insulated from the public whom he could so capably serve. These and other things to be encountered on this excursion lead me—as an investigator in biological science—to conclude that far more important than important new biological discovery is now the matter of getting a great many more new ultimate consumers for the body of biological knowledge that is already at hand.

I have recently given some special effort to learning the extent to which the great and rapid enrichment of biological science has been reflected in secondary school teaching during the past thirty years. Though life-science in the high-school curriculum has never been other than a very subordinate subject, and though data permitting a satisfactory comparison scarcely exist, my examination of the question leads to the conclusion that in general not more but less per high-school pupil is being taught to-day than was taught their elders thirty years ago. In some measure we must now document this statement.

In Bulletin No. 16 of the U. S. Office of Education it is reported that in 1905 there were but eighteen subjects studied in our public high schools, while in 1928 there were 156 such subjects. Data for the amount of biological science taught per pupil in 1910 and 1928 —the dates nearest to the periods we want—are there given. In this eighteen-year period the percentage of pupils enrolled in aspects of biological science changed as follows: In physiology, a decrease from 15.3 per cent. to 2.7 per cent.; in botany, from 16.8 per cent. to 1.6 per cent.; in zoology, from 8 per cent. to 0.8 per cent. The apparent losses are partly unreal, since these subjects were in part replaced by 13.6 per cent. of biology and by 17.5 per cent. of general science. Counting as biology one third of this general science course we obtain a total enrolment of 24.5 per cent. in biological science in 1928, compared with 40 per cent. in 1910. Since, however, these figures are subject to error, let us say merely that they suggest a nation-wide decrease in high-school teaching of biological subjects between 1910 and 1928; and then let us note more definitely that (since total enrolment—about five subjects in each of four years—of these pupils was 497 per cent.) the biological instruction of American high schools in 1928 constituted only one twentieth, or 5 per cent., of their total high-school training.

A similar bulletin (No. 17) for 1930 records that—though there were frequent biological electives—biological science was a "required" subject in only 8.6 per cent. of thirty-five specially studied public high schools of small cities (16,000 to 27,000) scattered through the North Central States. Data from these same schools (Stout, Van Dyke) for 1906–11 do not properly cover the point, but it is practically certain that thirty years ago biological science was a "required" subject in much more than 8.6 per cent. of these same schools of North Central States. Again (Bulletin No. 16), "In 1910, 82 per cent. of the total enrolment in public high schools were studying some science, 65 per cent. in 1915, 64 per cent. in 1922, and 61 per cent. in 1928."

Of ninety private secondary schools asked by the Office of Education, about 1932 (Bulletin No. 17), for some special information concerning their curriculums, twenty-six made usable replies. The twenty-six schools are located in all parts of the United States except the far West, and include boys' and girls' schools, military schools, college preparatory schools and schools of various Catholic and Protestant groups. From the published data it appears that only fourteen of these twenty-six schools require any science subject whatever for graduation; three require biology, and eight require science or general science. A rather reasonable calculation from the published data indicates that in these schools, considered as a group, the "required" instruction in all the sciences did not exceed 3 per cent. of their total instruction.

Of the high-school graduates of five cities (Bulletin No. 17) in 1930 the following percentages had studied no science whatever; Denver, 10.7 per cent.; Washington, 0.4 per cent.; Joliet, 5 per cent.; Long Beach, 2 per cent.; and Providence, 7.5 per cent. In the latter city another 67 per cent. of the graduates had studied general science alone; only 1.5 per cent. had studied biology in addition to general science; and another 1 per cent. of those graduates had studied general science, biology and chemistry. Perhaps we should pause to congratulate that group of graduates on its scientific outlook.

A final item of figures. Relative amounts of science, all kinds together, studied by the graduates of seven high schools located in Denver, Providence and Long Beach were obtained (Bulletin No. 17) for the years 1900 and 1930. In 1900 sciences comprised 16.3 per cent., and in 1930 only 6.9 per cent. of the total studies of the graduates of these same schools.

These several items—some dealing with a few schools and some of them national in scope—indicate that biological science now has a very inferior place in our secondary education; and that, at least in many and widely scattered areas of our country, its position is now definitely inferior to that of thirty years ago. Thus in an early stage of our excursion we meet an amazing situation. Since we are students we ask—Why, in its own period of unprecedented fruitfulness, has not biological science obtained and maintained its proper place in the education of our people?

It seems reasonable that our secondary schools should supply most of the needed new consumers of

our biological store. Personally I am fully convinced that at least a fivefold increase in the present teaching of biology in our high schools is necessary alike to an acceptable secondary education and to the most vital aspects of our social and national welfare. In this statement I think of biology, and particularly its zoological aspects, not as an end, only as a means; but—because it supplies the background of man, because it is replete with the things intrinsically important to our own lives and personalities and because it carries the discipline of a solid science—biology takes first place at the high-school age as a means of education. I submit the view that life-science merits study throughout the four-year high-school period; and for that considerable percentage of students which now takes no biology whatever not less than two years of such study should be required. One finds that physics and chemistry have likewise lost part or much of their position of thirty years ago in secondary schools. Prior to forty years ago those sciences probably provided a better discipline than did the biology of that day; the reverse is probably the case now. We all know that the experimental method twinned with checked observation has been the main method of man's rise from barbarism to civilization; that it has been the method by which the awe-inspiring facts about the universe and man himself have been obtained. If our high schools can not find opportunity to give familiarity and training in that method, just what kind of opportunity are they looking for?

But the quantity of biology taught in secondary schools may be affected by or dependent upon many things. Its quality is of even greater importance, and for a moment our excursion may as well turn back to the campus. Once back in our own laboratories we recall that the high-school teacher must be trained, and we may as well unflinchingly confess that any inadequate course offering, or any instruction badly performed there, has surely been a liability, not an asset, to the place of our science in general education. In this day a good biological laboratory is a treasury of opportunity and of fine enterprise; but a bad one is a blight and a menace.

Incidentally, while on the home grounds we may not forget that a great many educational miscarriages occur at points above the high school and college. To men well trained in life-science the mental outlook and equipment of many products of even the graduate school are a source of frequently recurring surprise. I can cite the case of one who, in a discipline related to biological science, was granted the Ph.D. degree by, and now occupies a post in, a great university. This finished product of university teaching does not—even qualifiedly or noddingly—accept the basic principle of organic evolution. Perhaps some of you may know an equally absurd and abortive case.

Across the way from our laboratory is the office of the dean of the college, and we now reflect that it is from there that the vicious influence of college entrance requirements presses down on the curriculum of all high schools. Though only a small percentage of our high-school students ever enter college that dictatorial foreign body largely mandates that no community may do the thing that should be axiomatic—namely, use its high school to produce a good citizenry. It is calamitous that some things are impossible. What a boon to good citizenship if only the endowers of our colleges could come to life and withdraw their gifts from all colleges which can not profitably begin where any good high-school training leaves off!

Again, the school of education is now also here on the campus. Since problems of secondary education are in mind we may first warmly thank our colleagues in education for their unquestionable aid in the correction of many errors of the high-school curriculum of thirty years ago; though those who should perhaps best know the special and irreplaceable values of life-science may greatly doubt that this subject has been properly appraised by most of them. The educationists are also linked with us in the task of making teachers of biology; indeed, it is sometimes found that they have taken over the entire job. This is a matter of much importance. Conceding that most teachers of secondary school biology will profit by some instruction in the art of teaching, it must be equally conceded that a full college course of solid biology is an irreplaceable and still inadequate training in subject-matter. Somehow, teacher training must be quickly done; biological training of the teacher must be thoroughly done. Dean Gildersleeve recently charged that, due to a growing "racket" in teacher training, it is "rapidly becoming impossible for graduates of our best liberal colleges to teach in the public schools of this country." The presumption that for making a teacher of biology there is any substitute for long-continued training under our best college biological departments is an expensive fraud; and the extent to which that presumption is being enforced in one or another guise is now an educational disgrace.

Let us now look more widely about us and learn, if possible, how our best biological research is impressing others. The daily and weekly press supplies most of the reading matter for many or most of the world's population from the high-school age to the end of life. The effectiveness of our biological research and teaching will perhaps be mirrored in newspaper editorials. I elect to quote briefly from a long editorial of the European edition of the *New York Herald*, under date of September 13, 1935. It is captioned "'Evolution' not dead."

> There are scientists who say that evolution is dead, and others that it is not. It is a matter of opinion, for as

Darwin himself said, "evolution is a theory subject to future proof," and there is still no proof today. . . . The controversy came up again at the meeting of the British Association which closed this week at Norwich. It was reopened a few months earlier by a physicist, Sir Ambrose Fleming, who in a presidential address to a meeting of scientists asserted that the Darwinian theory was "the product of imagination." . . . But if "evolution" is not dead, it has hardly the force to-day which it had when Huxley wrote these (omitted) words. The issue has lost much of its passionate interest for the public. It is felt more and more that the theory of evolution is a question for scientists alone.

Now the naïveté of this particular statement is an incidental matter. We have a highly intimate interest in it because it is so truly representative. A biologist would have to be both thick-skinned and asleep to escape the real and personal implications of the unending shower of such editorial expression. We biologists have done amazingly well, but we have failed. The laboratories have conquered, but their triumphs are sealed within their walls. Darwin and Huxley, with quite unfinished materials, met the minds of men far more effectively than we now meet them. Precisely when we have most to contribute we are becoming insulated from the great stream of intellectual life.

We again look elsewhere. During the past fifteen years five states (if we include Utah) have passed laws which prohibit the teaching of evolution in their public schools. This prohibition, and a strong sentiment of similar nature elsewhere, implies several most serious things. We know the importance of the text-book, and we may first note that this sentiment has written itself into some text-books widely used in both high school and college. These books put not emphasis but a wet blanket on one or all aspects of the evolution principle; and they often succeed in leaving only a pale ghost of our science in the student's hands. I submit as evidence some excerpts from an elementary text-book published in 1934 and already introduced into more than 131 normal schools and colleges in at least thirty-seven of our states and territories. A chapter of this book is entitled: "The process of evolution cannot yet be satisfactorily explained." The final section of this chapter is dedicated solely to the proposition that what it calls "the doctrine of evolution"—but evidently only Darwinian work is included—"is quite compatible with a religious faith." Of course to the untrained pupil this can only mean that it is quite compatible with whatever view of religion, or of the supernatural, he or she happens to have at the moment. I quote from four paragraphs the following illuminating lines:

"The reader should remember that even Darwin himself did not believe acceptance of the evolutionary idea to be incompatible with a religious faith. . . . Why should the full-blown rose, the birds in the trees, the beasts in the field, and the stately oaks standing in the forest not be considered to be as much a part of God's world as the subjects of which the Bible treats?" There follow four lines from the Psalmist, and then this: "If this conception of the universe were kept in mind it would obviate much strife and confusion. The scientist can make no distinction between the natural and the so-called supernatural. What man can study, experience, and learn about through his senses is the natural; the supernatural is that part of the universe which he has not yet been able to understand (*sic*) or for which his powers of comprehension are too limited. There is no difference between the two. The difference comes only in man himself. . . . So, then, since evolution neither denies the existence of God nor disclaims His directive influence over natural processes, it cannot be said," etc., etc. Then, "Finally, it must be remembered that the theory of evolution does not attempt to say when, why, or by whom life was first produced upon the earth. The honest scientist when pressed for an answer will say candidly that he does not know."

Why any text-book whose purpose is to outline and guide in the study of life-science should contain a single word on the subject discussed at such length in this book is beyond comprehension. Your zoologist who loves, teaches and builds his science—and is not especially worried about teaching others how to teach zoology—very well knows that his task is to facilitate an advantageous encounter between the student and the useful and vitally significant phenomena and principles of biology. As a true scientist he will not rob his teaching of that special and incomparable discipline which only the sciences can give—his student will have to wrestle with the facts and principles he finds. If, and when, astonishment at the inclusion of such material in a text-book is sufficiently overcome, the biologist who knows that his science to-day is not where Darwin left it will swear that he had not believed it possible—outside of theological discussions—to find words for a few extraneous paragraphs that would so defraud our science.

If one could subtract the emasculated biology taught from such texts in 1935 from the total for 1935, how would the amount of zoology taught now compare with that in 1905? Some of the zoological text-books of thirty years ago may have been dry; but they were not rotten.

Our excursionary effort here is to learn why biological science has not obtained and maintained its proper place in our schools, and why great biologic truth is so little possessed by our people. We have yet to search the motivation of those several instances of state laws which prohibit the teaching of evolution. In any consideration of this matter it is unquestion-

able that it was traditional religion that thus invoked the heavy hand of legislation. It is equally clear that elsewhere, without invoking the law but with its extended and varied influence, traditional religion is now effecting a wide-spread repression of the teaching of this central principle of biology in public schools through the United States and in practically all other civilized countries as well. In this country it sometimes forces the resignation of able zoologists even from college positions; and in high schools and late primary grades there are probably to-day few places where straightforward teaching of the unmitigated evolution principle can be done except at the peril of the teacher. It is obvious that an eviscerated straw-man is set up in place of the reality for the younger students of denominational and parochial schools everywhere. In this country this means that many millions of our present and future citizens are robbed of a biological outlook, or they get one that is warped and unrecognizable, through direct responsibility of the church; while with somewhat less directness the same agency widely exercises a restraint upon effective biological teaching in the public schools.

Biologists in nearly all countries, and particularly in our own, have tried a compromise with religious creeds. That compromise has failed. Most youth of 1935, like those of 1859, leave our schools without having opportunity to learn that the worthy facts concerning man's origin and destiny come not from religious traditions but from biological investigations made within the time of men now living. That compromise now robs most modern youth of opportunity to learn what is known concerning his or her place in nature. In what is said here I am not concerned with the question whether religion is important; nor whether one or another of the creeds of the earth has or has not sufficiently "adjusted" its teachings to modern knowledge; nor whether one or another of them is good, bad or quite indifferent. But whatever the answer to those questions the present restrictive influence of organized religion on the teaching of the best of biology is intolerable. Such an influence, from whatever source, is too highly harmful and dangerous to the well-being of man—to modern beehive aggregations of men who live under ever multiplied rules and laws which must wreck us if based on variegated tradition instead of upon a common knowledge. For moribund traditional beliefs to continue to exercise such influence over the educational program of a country is a confession and declaration either of the apathy, the cowardice, the impotence or the intellectual bankruptcy of enlightened leadership in that country.

It is here that we meet "the confusion of tongues." A hundred years of a germ of truth, or seventy-six years since its bloom in publication, has either catalyzed or attended a very wide-ranging body of facts relating worthily to the nature, origin and destiny of man. That body of facts is well known to a few and, as dimly or partly known, is accepted and welcomed by many; but by many others this prime accomplishment of our science is either rejected outright, or its essentials are first thoroughly eviscerated and the husks then accorded an obscure corner in the attics of tradition. The tongues of the traditionalists are heard not merely from pulpits, but they echo also within our schools—the only possible home of science —and there they now curb or tie the tongues of biologic truth.

This confusion is partly sustained—or at least the voices of tradition are prolonged and made more plausible—by the words of great authorities in one or another branch of learning. To-day, as at Oxford in 1860, a professor can easily be had to support a bishop against a really good and far-reaching biological advance, where this impinges on traditional beliefs. The public can not fix relative values to the words of different scientific men. The biologist who has learned the texture and ways of living stuff knows well enough, however, that when renowned physicists and astronomers elect to speak about life, they really do this as laymen—and all too frequently their words are unconsciously filled with tradition, a thing which they also acquired as laymen. In addition to these volunteer voices from quite outside life-science, we are all aware that some high authorities in one or another branch of biological science persistently ignore the greater biologic accomplishment, and on some points they too still speak with tongues of a day that is gone. We may as well have it out with them.

In conclusion, it is here suggested that no one need espouse intellectual sterility because many and important mysteries still attach to the living world. The task of serious biological analysis—the thrust of observation and experiment against assumption and tradition—was begun only yesterday; and, very unfortunately and quite inexcusably, it is not until an unseen to-morrow that even 1 per cent. of mankind will become conscious of as much as 10 per cent. of the quite important mysteries which a sharp attack has already swept away. The issue to-day is on the question whether our educational facilities and practise will permit eager youth to examine the results of man's scientific efforts to learn man's own nature and man's place in nature; whether ignorance of many fundamental and now satisfactorily appraised biological phenomena shall continue to foster divergent and irreconcilable thought among great biological human populations which must live together; whether the case and the course of civilization is to be guided by knowledge or by the dead hands of the past; whether

the biological investigator of either yesterday or today may be permitted to give his best results to the world or whether he is to be more and more insulated by his own progress; whether, indeed, present man-in-the-mass has evolved sufficiently to prefer light to twilight, truth to tradition. Certainly until this issue has been definitely decided every zoologist will feel sure that mankind is worthy of much more than his very best efforts; but he, along with all other enlightened men, must find, recognize and overcome those forces which now obstruct the release of his best prizes to present generations of man.

SCIENTIFIC EVENTS

RESOLUTIONS PASSED BY THE SIXTH INTERNATIONAL BOTANICAL CONGRESS

AT the sixth International Botanical Congress meeting in Amsterdam from September 2 to 7, the two following resolutions were passed:

It is proposed that the Botanical Section of the International Union of Biological Sciences should act as an administrative connecting link between the successive International Botanical Congresses, which maintain their full independence from an international point of view to such an extent that any country which has not joined the union will have quite the same rights as those which have joined. It is proposed that this Botanical Section be authorized to carry through any resolutions, carried by the International Botanical Congresses.

By reason of the growing financial difficulties and the prohibitive price, for certain museums and laboratories, of transmission by post, rail and boat, it becomes impossible to guarantee the indispensable exchange of collections of dried plants. It is therefore necessary to obtain for this exchange the free transport now accorded to the exchange of scientific publications. The congress asks the Office of the International Union of Biological Sciences to take the necessary steps with various governments in order to obtain this postal privilege.

The following resolution was passed in memory of the late Hugo de Vries:

The Sections of Genetics and Cytology of the Sixth International Botanical Congress take the occasion of their presence in Holland to record the deep sense of debt which the sciences of genetics and cytology owe to Hugo de Vries. It is a satisfaction that he could live to such a ripe old age and thus see imposing structure which has been erected on the foundations in the laying of which his painstaking investigations and prophetic vision had so large a share. The honorary secretary of the congress is hereby requested to spread this resolution on the minutes of the *Proceedings* and to send a copy to Mrs. de Vries with the sympathy of the congress and with the assurance that Hugo de Vries will remain for all time an inspiration to biologists and live as one of the immortal heroes of science.

APPROPRIATION FOR SCIENTIFIC RESEARCH IN THE FEDERAL BUDGET

IN a statement copyrighted by Science Service it is reported that funds for scientific research by the federal government will be increased by about $5,000,000 during the fiscal year starting next July if the allotments in President Roosevelt's budget are followed by the Congress in making appropriations. Part of this increase represents a transfer of items from the emergency budget and part new funds under recent special legislation.

The Department of Agriculture receives most of the $5,000,000 increase with an estimated $3,500,000 more to devote to research than was available last year. New agencies will absorb the larger share of this. First there is the Soil Conservation Service, provided for by new legislation last April, which will receive $2,250,000.

Then there is a special research fund provided for by the Bankhead-Jones Act of June 29, 1935, under which $400,000 will be administered. Funds made available through the operation of this act have already enabled the initiation of nearly forty research projects on fundamental problems in biology, chemistry, meteorology and economics that have more or less direct bearing on agriculture.

The Beltsville, Md., research center will use about $50,000. The Forest Service will receive an estimated extra $300,000. But this amount is less than the emergency funds now available for research purposes that will probably be withdrawn or curtailed next year. The $100,000 allotted for forest products investigations is mainly for the Forest Products Laboratory. This amount, unless augmented by other funds, will not be sufficient to maintain the laboratory in its present running order. Other increases will enable some of the regional stations to maintain or slightly enlarge their regular staffs, but these increases are based upon specific projects and must be used for them.

The Bureau of Chemistry and Soils receives about $150,000. Of this, a part is for a new program of research provided for by the Congress on discovering industrial uses for farm products, but the major part is to be used toward the completion of the national soil survey.

The Public Health Service will get about $1,350,000 more for research than their funds for the present year. This represents the funds provided for by the social security legislation.

The Coast and Geodetic Survey will receive about