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THE PLACE OF THE AREA COURSE IN THE STUDY OF THE NATURAL SCIENCES

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"In a list of the most important things he learned in College, the late Robert Benchley included the fact that if you put one paper bag inside another, you can carry a milkshake, and that if you turn a sock inside out, the hole appears in a different place.

The Benchley list could be matched by many boys and girls in college today. The modern student has discovered that if you sit in a lecture room with 1,000 other students three times a week for a college year, you can write letters home, read a magazine, catch occasional snatches of talk from the professor, and if you sit long enough, you can graduate."1

This quotation from an article by President Harold Taylor, Sarah Lawrence College, is typical of the many criticisms being leveled at our college programs today.

President Taylor continues his criticism with this statement, "Now collegiate life in this country has always had a certain detachment from the intellect. The word 'collegiate' itself carries memories of raccoon coats, hip flasks and practical jokes. But today, America has reached a point in world history when we cannot afford to be amused by our university education.

We exist in a world full of tensions, conflicts, dangers and agonies. Too many of our youths are uneducated, too few of our adults can help them. It is now crucial that we change our education and, in so doing, change our world."2

This attitude is that of many of our great educators and world leaders. Much of the inadequacies of our educational system may be due to the rapid increase in the number and type of college students. In 1890 we had 2,000 college students, 1900--300,000,3 1949--2,500,000 and predicted for 1952--3,000,000. As President Taylor points out in the article previously quoted, "It is becoming as natural for an American boy or girl to consider college as the next step in his education as it formerly was for him to consider going to high school."4

This problem of mass education has challenged the traditional college curriculum and, particularly, since the Second World War, has shaken its very foundations. Educators everywhere realize that with our increased store of technical and scientific knowledge, and the increased complexities and pressures of "atomic age" living, our past program has failed to train our youth adequately. To quote Dr. Henry P. Van Dusen, "These vast and marvelous factories of learning turn out A.B.'s, B.S.'s, M.A.'s, and even Ph.D's very much like a Ford factory, products beautifully painted, resplendent, efficient, as well-equipped as a Ford Car for the hard work and wear and tear of life; and as ill-equipped for the

2. Ibid.
4. Ibid.
understanding of the deeper meanings and insights of life."

A veteran states our need for an improved curriculum thus, "Now that we are coming back everyone is excessively concerned with the question of what to do about the returning veteran. There is only one answer to this question. You should do for us as veterans what you should have done to prepare us for a crisis in our nation's history. Give us a good education, one which will enable us to measure up to new problems as they arise, an education which will fit us equally well for a Third World War or a World State. Give us ideals we can hang on to no matter what problems confront us."

Such statements have challenged colleges and universities throughout the nation. Almost every college curriculum today is in a state of transition from the traditional to the so-called "general-education" program. The old liberal arts program of 100 years ago with its "six years of Latin and Greek, its mathematics through calculus, surveying and navigation, a year of physics, chemistry and astronomy, a year course each in rhetoric, moral philosophy, political economy and history" is but a relic in old college records.

This program of required studies was replaced by the "elective system" after World War I. Courses were grouped in certain areas or divisions—the student was required to go through various of these areas picking out a course here and there until he had a specified number in each of several areas. These usually were courses in the area of English or Literature, two in foreign languages, two in a laboratory science—any one, it made no difference—two in social studies—anything from history to psychology or economics—sometimes one or two years of mathematics. This type of program persists in many schools today. As Dr. Henry P. Van Dusen describes it, "Indeed, the present-day university curriculum reminds one of nothing so much as a cafeteria, where unnumbered tasty intellectual delicacies are strung along a moving belt for individual choice without benefit of dietary advice or caloric balance. And the result in the mind of the student? All too often, obesity or mental indigestion, or it may be malnutrition and even pernicious intellectual anemia."

To combat this sort of thing the "survey course" was developed and added to the elective list—or in some cases required. These survey courses turned out to be as one person described them—a sort of "Cook's Tour" through an entire field of learning. The student was introduced to all the important things along the "tour" but came away with little comprehension of what it was all about or why it was significant.

So, changes and revisions and more revisions continue. Today terms like "general education," "core curriculum" and "area courses" have become sort of by-words on many of our campuses. We use the term general education to refer to that education which gives a comprehension and understanding of that which is most significant from all areas of learning and the integration of this knowledge with the everyday experiences of the student. "Core

"area courses" refers to that group of courses taken by every student as a part of his requirements for his bachelor's degree. The "area courses" are the specific courses in the "core curriculum" by which the objectives of the "general education" program are to be accomplished. Area courses cut across departmental lines, place their emphasis on the interpretation of an area of learning rather than description, and on the development of concepts of the great principles involved.

Since this type of course is being discussed, organized and taught in many of our colleges today and since there is a need for some revision of our usual program, it would seem wise and proper for a group of specialists to consider the place of such an area course in the study of the Natural Sciences.

"One of the most important problems of our age", says Dr. I. Bernard Cohen in his book, Science, Servant of Man, "is the relation of scientific discovery to our daily lives and to our well being and national security. In our day we can no longer afford to be silent partners in the scientific enterprise; we can be intelligent citizens of the scientific age only if we participate to some extent in the scientific enterprise, pervaded by the spirit of science and cognizant of scientific accomplishments. Of course, we cannot all be scientists. But the obligation lies on each of us to understand both the nature of the processes by which science advances and the way in which practical applications of those advances are made to change and expand the world."9

This, indeed, states the problem facing us today as we realize that eighty to eighty-five per cent of the students in our elementary science classes do not plan to major in any science but whose lives and businesses will be intimately touched by science.

Our elementary courses in the various sciences have had as a primary objective the training of the student for more advanced courses in the field. Yet only 15 to 20 percent of our students in elementary courses plan to continue in the field.

Definitely, then, a new type of course, not replacing elementary courses, but providing the sort of understanding of which Dr. Cohen speaks, needs to be added to our study of the Natural Sciences.

The Area Course in the Natural Sciences is an attempt to supply such a need. A number of outstanding colleges and universities such as Colgate, Boston, University, University of Louisville, Harvard and many others have already adopted such a course. Many are revising and re-revising their area courses in an effort to develop a more satisfactory course. Out of the work of many institutions certain features stand out.

The objectives listed by the individual institutions vary somewhat but several common basic objectives may be noted. McGrath summarizes them thus:

(1) To teach the application of scientific methods to the everyday problems in the student's life—to develop a philosophical, analytical, critical habit of mind toward all aspects of life and reality.

(2) To acquaint the student with facts of science, facts chosen to teach ideas not complete knowledge of the field—"procedural rather than substantive matters".

(3) To teach the impact of Science on modern life.

(4) To acquaint the student with the historical development of science and the evolution of scientific thought.\(^\text{10}\)

The ways by which one may seek to achieve these goals are as numerous as the number of colleges which are trying to accomplish them. Again, though, there are several common factors in all the methods used.

The experience of most colleges has been to start the course with several "specialists" from each department in the Natural Sciences taking the portion of the area course in which they were most "specialized" and discussing it. In many cases this resulted in giving the student many interesting lectures but little or no integration or understanding of the relationship between areas of science. The trend seems now to be away from a number of instructors for the same course. Instead one instructor is usually in charge of the entire course. He may call in as resource lecturers any in the department he needs but the continuity lacking in the several-professors type of course is provided by the single instructor in charge. Dr. Purrow, North Central Workshop Coordinator for this area, believes that one instructor should be in charge at a time but that each instructor should have a turn at teaching it.

It is also suggested that where several professors have a section that regular conferences be held to discuss methods, revisions, evaluation of course and such. In this way improvement would come from a correlating of experiences.

If one instructor is to be in charge though, the problem is "Who?" If the specialist in chemistry (to use my own field) is chosen, he over-emphasizes the chemistry and doesn't feel qualified in the other areas. We need instructors with a broad general background, well-trained in the elementary principles of several sciences. There are very few available today. Perhaps if colleges and universities would provide salaries and promotions commensurate with those of the research professor, more instructors would be interested in this phase of education in the sciences. The University of Chicago has only recently offered graduate study in general education. Other universities are keenly aware of the need for properly trained instructors. As people are trained for this work the goals will more nearly become a reality.

One thing on which there is a great deal of variation is whether or not the course shall be divided into separate courses in the biological and physical sciences or coordinated into a single science course. About as many have it one way as the other. Since integration of all the sciences is one of the objectives of such a course, it would seem that the single-integrated course would have some advantage over the other. However, no definite conclusion can be made at this time. Whichever suits a particular college better would be better for that college.

The method of approach also varies with each institution. Some use the question-problem-project approach. For example, Colgate has about seven major problems such as, "Why does the temperature of the air decrease as one goes to a higher altitude?" This question would introduce a study of the Kinetic Theory, pressure, nature of gases, etc. Harvard, on the other hand, follows a more traditional type of subject matter course--except President Conant who uses case studies such as the "Phlogiston Theory and

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its development" to develop the principles and methods of scientific study. Others select major and significant topics in all areas of the sciences and correlate them.

Certain topics are discussed in almost every course. Some of these are such subjects as The Solar System and the Laws controlling its movements, The Earth and its formation, Soil formation, Weathering and Climatic Conditions, Newton's Laws, Laws of Chemical Combination, Kinetic Theory, Electricity, Heat and Light Phenomena, Mechanics and Simple Machines are frequently listed.

In every instance there is included some application of the Scientific approach and attitude, method or methods—whichever you choose to call it.

A study of matter, its structure, atoms and molecules as well as energy, its transformations and governing laws are discussed. Atomic Energy, Radioactivity and Nuclear Structure are always a part of the course.

Some time is devoted to the historical development of scientific discoveries in nearly every instance. Sometimes the historical approach is used for presenting the problems of the entire course.

In one form or another the geological ages and the origin of the universe are included.

Biological subjects always considered are evolution, reproduction, the origin of life and its variations from virus to cell to complex organism. Some general idea of classification of plants and animal groups is studied. Ecology and environmental inter-relationships are always a part of the course. Heredity and the problems of populations and conservation of human resources is given an important place in all outlines. Food, food needs and food production problems are found in many courses. Practically all bring in a discussion of the Physiology of the systems of the body, with a study of health and disease. Some phase of economic biological problems is usually discussed.

In all cases one usually finds a modification of laboratory work, more demonstration experiments, less of the traditional type. Small discussion groups are common. Whenever possible the classes are limited to 25-30. If the lecture class is large it is divided up and part of the time devoted to discussion in small groups. Visual aids are used generously. Frequently, tests are essay or problem solving type. Every effort seems to be made to individualize the course and to know the individual and know what he is getting from the course.

The area course is in the experimental state. Many problems are yet unsolved. What type course shall it be? What topics shall be taught? How much and what kind of laboratory work shall be included? These are some of the questions most frequently asked.

How is the general course to be related to advanced study? This is another much discussed problem. How can the student get his elementary training, get the area course, and still not lose time before going on with the advanced work in his major field?

Several solutions have been proposed. In some cases the science major is not required to take the area course. In others, a tutorial-laboratory plan is used in which the major does additional work to prepare him for advanced courses. Some suggest a revision of elementary courses so that they will not repeat area course material and will reach into the advanced courses somewhat, thus eliminating loss of time. As yet the area course does not take the place of the elementary courses in any given field.

It seems that such a course is necessary for the non-science student in order for him to see the relationship of scientific study and development to his well-being. The course perhaps has an orientation value for the science major, orientating his special field of interest with the other sciences.

Evidence indicates that such courses can stimulate the student to do real creative thinking. Most colleges agree that such a course, if properly presented, would give the student a greater comprehension of the significance of research science in his life than the mere acquisition of elementary facts in one field of science. The exact nature of the course varies with each institution.

Another serious problem is, "How can we measure our results?" It is essential to have some adequate method if we are to know whether or not we achieve our goals. Objective tests place too much emphasis on the factual rather than comprehension but are used to some extent. Essay questions, problem solving and projects are used with some success. Perhaps the real measure can only be determined as our students face a "Third World War" or "World State".

But the administrations and faculties alike of our colleges are challenged by the problem. This is the first step toward a solution. If we are to find the solution, though, we must continue the experiment.
The following questionnaire was sent to all college science instructors in Arkansas. Results will be tabulated and will be available to any college that would like this information.

QUESTIONNAIRE ON PLACE OF THE AREA COURSE IN THE STUDY OF THE NATURAL SCIENCES

1. Do you feel a need for an area course in science in your college or university?
2. If an area course were adopted which type would you prefer?
   (a) separated into biological and physical (b) integrated into one.
3. If divided what part devoted to (a) Biological (b) Physical.
4. What method of instruction do you believe to be most effective?
   (a) lecture-demonstration-laboratory (b) problem-project (c) case study (d) historical approach.
5. How much time do you think should be devoted to laboratory work?
   All ______ 1/2 ______ 1/3 ______ 1-two hour period per week None ______.
6. What kind of laboratory work do you feel best? (a) Demonstrations only (b) Combination of demonstration and individual work (c) All individual.
7. Should such a course be for majors? ______ Non-majors? ______ Both? ______
8. Would an area course be more effective with (a) One teacher in charge (b) Several instructors teaching portions of the course (c) Several instructors each with a section.
9. The size of the class should be: 25-30 ______ 50 or more ______.
10. Small group discussions are: recommended ______ essential ______ not necessary ______.
11. Check topics which should be included by all means
    (a) Scientific methods used in Research
    (b) Solar System, Laws governing movements - Origin of universe
    (c) Matter - Structure - Nature - Atoms - Molecules - Properties and changes
    (d) Energy - Sources - Kinds - Transformations - Simple Machines - Mechanics - Controlling Laws
    (e) Atomic Theory, Structure of Atom, Atomic energy - Nuclear Structure, Radioactivity
    (f) Electricity, Heat and Light Phenomena
    (g) Earth, geological ages - Formation of Soils, Weather and Climate
    (h) Newton's Laws
    (i) Kinetic Theory, Atmosphere, Oxygen and other gases
    (j) Evolution
    (k) Reproduction and Origin of Life
    (l) Heredity and Population Problems
    (m) Ecology and Environmental Inter-Relationships
    (n) Foods, Food Production
    (o) Physiology of Systems of Body - Health and Disease
    (p) Plant and Animal Groups - Method of Classification
    (q) Economic Biological Problems
    (r) Others

12. Has your college or university been considering the adoption of an area course in the Natural Sciences? already adopted ______ will in the near future ______ considering now ______.
13. Have you been working with such a course? alone _____ with a committee ______ with all members of the division ______.

14. Suggestions for relationship to Humanities and Social Studies:

Remarks

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