CHALLENGE ACCEPTED!

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Within the past decade, educators and educational systems have been targets for many critical shafts. An encouraging outcome of these open attacks was the diligence with which school systems began to re-examine and re-evaluate their methods and procedures which the general public had called into question. This almost universal dissatisfaction challenged the faculty and administrators of Saint Xavier College to initiate a self study of the aims and organization of their own liberal arts college. Although a program of self-criticism had been in practice since 1935, a vigorous stimulus to this movement came, in 1953, in the form of a grant from the Fund for the Advancement of Education.

Saint Xavier College has for its goal the liberal education of the Christian person. It is dedicated to the belief that the liberal arts should be taught to all students in our American schools. Concisely stated by one of our staff, "In a democratic society every young person should have the opportunity to achieve some mastery of the liberal arts, including the reluctant and unmotivated, not because the liberal arts are college preparatory, but because they are the rightful heritage of every human being."

Introduction

Members of the combined faculties of Saint Xavier College and the Albertus Magnus Lyceum of Natural Science cooperated in developing and implementing our plan. The various committees appointed to this endeavour soon became cognizant of the fact that a revision of college courses would be futile if the present high-school courses were pursued. Likewise, a re-examination and re-ordering of the secondary program demanded a further revision at the grade-school level. So, as the work progressed it became more and more evident that, to establish a model system of liberal education, the present system—from grade school through college—would have to be reconstructed.

Fortunately the faculty of Saint Xavier College was in a better position to undertake such a wholesale revision of an educational system than were some other educators faced with a similar desire. Saint Xavier College is conducted by the Sisters of Mercy of the Chicago Province, a religious order whose members also teach in approximately 50 grade schools and 7 high schools in the Chicago area. These provide an ideal proving ground for the educational theories resulting from the self-study program.

This summary will attempt to give the general ideas currently being developed in this experimental curriculum and will include some detail regarding the science program. The development of the natural science program was greatly aided by a grant from the Carnegie Corporation of New York.

Schooling at the elementary level confines itself to pre-scientific studies and the pre-liberal arts. Natural science, precisely as a science or habit of mind distinct from other habits, can only be taught at the college level. The acquisition of this habit requires extensive factual knowledge, considerable exercise in logic and mathematics, and a maturity of mind that cannot be expected at the lower levels. Consequently, the experiential and experimental knowledge of nature gained at the elementary level is the prerequisite for the science itself. Moreover, the liberal arts must fulfill two conditions—they must produce an order within the mind by means of mental relations and they must be useful instruments for the sciences. At the elementary level the student is expected to achieve a certain mastery of the linguistic arts and the fine arts, as well as the mathematical skills. All these deal rather with external signs than with the ordering of internal concepts; consequently, these disciplines are called pre-liberal arts. The liberal arts proper, being intermediate between elementary and higher education, are reserved for the secondary-school student to pursue. And, although the college is primarily concerned with imparting knowledge in the fields of science, humanities, and wisdom, the college freshmen and sophomores continue their mastery of the liberal arts and general education subjects begun in the high school.

The science program in our school system is constructed on the premise that it is from natural science that the social sciences and theology derive their natural basic concepts, since both the social sciences and wisdom depend materially on sense experience. Natural science is the study of the world of nature and of ourselves as part of that world, knowledge of which is derived through our senses. The liberal arts are the basic tools needed by the student to equip him for a formal study of science.

Elementary-School Program

Therefore, science in the strict sense is not taught in the elementary school, but at this level the child is led to develop an observational knowledge of nature in order to accumulate a rich background of factual experience to which he can revert later in his educational life when he is searching for theoretical explanations of scientific phenomena.

Nature study, even at the primary level, is not haphazard, but orderly and systematic in its development, being integrated closely with religion and social studies. For example, in first grade, or what is designated as the first level of achievement, the aim of nature study is to bring the child to a realization of the order and beauty of the world around him. He observes the sky, the heavenly bodies, the families of plants and animals. His personal

experiences are enriched with the Bible stories of creation, nature stories, poems, and the making of drawings and plastic replicas of objects he has observed in nature. Meanwhile, in social studies, the child is learning about the family unit, the need of tolerance and mutual love in daily life.

As his experiences increase, he becomes aware that the sun and moon follow an orderly pattern, obeying certain physical laws; the plants and animals, too, submit to laws governing the cycle of the seasons; concurrently, the child is learning the necessity of authority and obedience in his social life. The child that is made to realize that the plant and animal friends of the classroom, home, or field must be given proper care, if they are to survive, will more readily accept the principle taught in his social science lesson that personal sacrifice is often necessary to promote the common good.

From the achievement level corresponding to about fourth grade through the upper grades, nature study becomes autonomous but is still closely correlated with social studies. The child at the intermediate level augments his store of aesthetic facts about nature, while in his social studies he is becoming acquainted with those worshippers of beauty, the people of the Mediterranean world. He learns how much the culture, science, and art of the Greek world contributed to his own cultural heritage.

A study of modern conservation methods in a science lesson ties up nicely with the Medieval period of history, wherein the effects of monasticism on medieval agrarian economy may be seen. The age of chivalry, guilds, and monastic schools bequeathed many social, cultural, and economic benefits, not the least of which were methods of cultivation inaugurated in the reclamation movement of the time.

At the upper level of the child's elementary schooling, the development of modern technology and inventions (discovered largely by experimental methods) is considered and evaluated. Simultaneously, in social science, he is following the development of the modern world, the American way of life.

Secondary-School Program

The high-school freshmen and the sophomores, in a science course entitled "Man in His World," expand the basic facts about nature gleaned in the elementary school. The content of the course is relatively the same as the traditional general science and biology courses of the secondary school. However, the subject matter has been reordered to make man the central topic of this study. In first-year high school the structures and functions of the human systems are studied in a logical sequence and the general science matter related to each system is studied conjointly. Beginning with the skeletal system, since its structure accounts for man's unique upright position, the student learns the names and locations of the common bones, and the general functions of this system. The general science topic correlated with this subject is good posture. Since the bones fulfill their function of movement with the aid of the muscles, the muscular system is next studied. The bone-

muscle interrelationship illustrates several simple principles of mechanics. Usually a student is fascinated by the idea that he uses a simple machine every time he nods his head, stands on tiptoe, plays handball, rolls his eyes, or takes a swinging stride. Consequently, that part of general science dealing with the simple concepts of work and types of simple machines, *i.e.*, the three classes of levers, pulleys, and the pendulum, comprises the correlation here.

Seeking for the source of the energy required for the body to do the work of muscular movement, the pupil progresses to a study of the digestive system. Correlated with the study of the structure and function of this system is the study of nutrition, oral hygiene, and an introduction to elementary concepts of food chemistry — elements, compounds, mixtures, physical and chemical changes, oxidation, etc.

The problem next raised is how the food reaches all parts of the body; hence, the circulatory system is investigated. The marvelous pumping organ of the body arouses the students' curiosity regarding the principle behind simple hydraulic and suction pumps which are then studied.

Interrelated with the consideration of the respiratory system, which furnishes the oxygen transported by the blood, is a study of the composition and physical properties of air, and the sequential topics of weather, and climate. The instruments studied in conjunction with weather call into use mathematical skills necessary to convert readings on the thermometer and barometer.

The student becomes aware of a simplified concept of filtration when he studies the parts of the excretory system of man; here, too, hygienic habits of regular elimination and body cleanliness are emphasized.

A search for the system responsible for coordinating all the systems of the body reveals the work of the nervous system. As the special sense organs are studied, there follow the physical sciences related to each. For example, a study of light follows the study of the eye. This in turn leads to the source of light, the solar system; hence the simple facts of astronomy are acquired. The structure and function of the ear are not separated from the physical phenomena of sound. The student learns, too, that man has internal as well as external senses and is introduced to some elementary principles of psychology at which time he considers the value of developing a sound theory of mental hygiene.

The course concludes with the reproductive system and topics in related fields of cytology, genetics, and anthropology. Contrary to traditional courses in which the student is introduced to biology through a study of the cell, in this science course, the student begins his investigation with the macroscopic unit, man. The adolescent is primarily interested in himself and needs little motivation to study himself in detail; moreover, he is more familiar with man than with the microscopic units of which man is composed. The cell and mitotic cell division are treated at the end of the course in conjunction with the study of the reproductive system. By this time the student should be sufficient-

ly mature to take microscopic study seriously.

Upon completing his study of man, the student is aware that man can control himself and that man is in a position to control parts of his environment. Therefore, the second-year course begins with a study of how man can control disease and preserve his good health. The anatomical and physiological background acquired in the freshman course makes intelligible the units on disease and medicine usually found in general science texts. This topic also provides a good transition between the first- and second-year courses. The greater part of the subject matter for the second year follows the traditional study of the botanical and zoological facts found in most second-year science books. It includes, in addition to this, the general science topics not covered in the first year. After learning about plants and animals in man's environment, the student proceeds to observe how man influences his environment. The study of conservation of soil, forest, wildlife, and water shows how man rationally uses his natural resources. The topic of how man controls fire to preserve forest and wildlife leads to a consideration of how man controls energy—mechanical, chemical, and nuclear. Consequently, the types of simple mechanical machines not covered in the first-year courses are studied at this point; here, too, the problem of the atom and hydrogen bomb is discussed.

With this rich background of factual knowledge accumulated through elementary school and the first two years in high school, the high-school junior begins to learn the techniques of natural science. He now applies to controlled laboratory investigations of problems in physics and chemistry the mathematical skills he has acquired and, in addition, learns the fundamental laws of scientific investigation. Aiding his understanding of the dialectical methods used in the empirical sciences will be his knowledge of logic gained in the courses in critical analysis. It is our firm belief that logic lives when it is transplanted to special situations while it is still "warm."

College Program

All students in our college are required to take a two-year course in natural science. The first semester treats of the basic concepts and principles underlying natural science, *i.e.*, nature, causality, motion, and its concomitants of time, space, place, and the continuum. The student is now interested not only in the fact, but the reason for the fact, and uses his knowledge of logic and general philosophical principles to guide experimentation and analyze results; in other words, he learns the value of strict scientific demonstration.

In the second semester of his freshman year, application of the general principles learned in the fundamental course is made in the field of the physical sciences. The principal concepts of Newtonian physics are examined and analyzed in a study of Newtonian mechanics and gravitational motion. Other topics include the structure of matter, light, sound, and the periodicity of the elements. The accumulation of facts is kept at a minimum, being

confined to those necessary to a proper understanding of the concepts under discussion.

A course entitled the "Principles and Methods of Biology" comprises the third-semester of work in natural science. Again, concepts and principles are stressed and the fundamental ideas learned in a general way in the introductory course are applied to particular cases in the field of biology. The activities and organization common to all organisms are investigated in order to be able to define and classify living things. A typical lower plant and a higher plant, as well as an invertebrate and a vertebrate animal, are then studied in some detail. In seeking explanations for the biological phenomena which a study of these forms reveals, a causal analysis is used that goes beyond that of many modern scientists who frame their concepts within the limits of Newtonian physics and overlook, or ignore, causality.

The fourth-semester course completes the study of living things by proceeding to a knowledge of man's appetitive and intellective powers. It is entitled "Principles and Methods of Psychology" and stresses the important principles of that field.

Laboratory exercises and techniques proper to the sciences pursued in each semester are assigned to give empirical knowledge in the four areas mentioned.

This two-year course required of our students is designed to satisfy the needs of the collegian desiring a general education. Moreover, it is so planned as to utilize the liberal arts; and through reading assignments of classical experiments in each of the three fields covered, it exemplifies how the leading contributors in the field have used the liberal arts. It is our hope that this course will motivate students to elect a major in the field of science.

After completing this basic two-year sequence in the natural sciences, the college student is in a position to advance to the specialized study of science, fortified with a view of nature that has depth, and possessing a methodology that should produce pentrating thinkers in science, not merely technologists.

The plan as outlined here is still in the early experimental stages of development, and years may pass before results can be properly evaluated. Nonetheless, the faculty of Saint Xavier College feels that it is moving in the right direction—away from the accumulation of facts, and toward an understanding of the philosophical principles underlying the observed facts. The teachers cannot promise themselves success, but the explanation of triumph is all in the first syllable—*try*.