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THE CORRELATION OF
SCIENCE AND RELIGION IN THE CHRISTIAN EDUCATION
OF THE SENIOR HIGH SCHOOL STUDENT

by
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INTRODUCTION

INTRODUCTION

A. Statement of the Problem

High schools throughout the country are admitting eager, questioning, intelligent young minds into their classes. Many of these young people come from homes where they have been encouraged to follow the teachings of the Church. It is these adolescents who immediately concern us. The problem of this study is to learn if any correlation is being made between the high school study in science and the Christian Education of this age group; where it is being made, to what extent, and the procedure followed.

B. Definition of the Problem

There was a specific purpose in delimiting this study to the senior high school age, which is from sixteen to eighteen years. This is the age when an earnest study of science is begun. It is also that period in the life of the individual when truth is being eagerly sought. Doubts are prevalent. New ideas are quickly grasped. Old ideas are too readily laid aside. The senior high school welcomes this group of sixteen-year-olds, and in three to four years directs their course of life. The grade schools have these

young lives in their formative years, but the high schools have them in their years of decision.

In the grades the children are introduced to Nature Study -the study of the various kinds of birds, flowers, trees, butterflies, and such. A very elementary approach to astronomy may or may not be included. Collections of leaves, flowers and even butterflies may be made at this time. A research by Margaret Erwin Jones has pointed out the place of nature study in the religious education of the child.¹

If the youth attends Junior High School a more detailed study of these things is taken up under the head of General Science. To the above list are added the study of air, heat, water, minerals, food, electricity, light, radio, mechanics, and physiology. These are generally linked in some way to individual and community life. It is not until they reach senior high school that a specialized study of science is pursued. Specialized branches appear, and they are found studying biology, chemistry, physics, astronomy, and such subjects.

Christian education is the more specific term for religious education in Protestantism, and is the term

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1. See thesis: "A Study of the Use of Nature in the Religious Education of Children", in the Biblical Seminary library in New York City.

applied to the planned efforts of the Church to educate children, adolescents, and adults in the Christian life. Is there a place in the Christian education of adolescents for correlation with senior high school study of science?

C. Significance of This Study

It is felt by many that there is a conflict between science and religion. The question is whether or not conflict is necessary. The boy or girl of the church school is told that, "In the beginning God created the heavens and the earth"¹ and, "in six days Jehovah made the heaven and earth, the sea, and all that in them is"². That same boy or girl upon entering a study of science hears:

"Evolution is the theory that the plants and animals of today are descendants from the simplest forms of plants and animals - those consisting of but one cell and which, according to the evolution theory, were the first forms of life on the earth's surface."³

That at their age this will arouse question is to be expected. Where may he go to have his questions answered? To his school teacher or to his church school teacher? Perhaps upon this will depend the adequacy of his answer. What answer should he be given? In this is evident the problem of the present study.

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1. Genesis 1:1
2. Exodus 20:11
3. College Entrance and Regents -BIOLOGY, p.119

D. Method of Procedure

This study will be made chiefly by first hand observation, personal interviews, questionnaires, and the use of sources. In Chapter I there will be presented an analysis of the senior high school student in relation to the problem of this study. Chapter II will report a survey of the science courses and observation of teaching in selected high schools, including materials, related activities, and classroom procedure. Chapter III will contain reports of personal interviews with senior high school teachers, and a questionnaire study of church school teachers and pupils. Chapter IV will set up criteria and offer suggestions for correlation determined on the basis of all the foregoing study. This will be followed by a general summary and conclusions of the entire study of the problem of correlating science and religion for the senior high school age.

E. The Sources of Data

Much of the data was collected from first hand observation, interviews, or questionnaires. In the study of the senior high school age, with reference to the intellectual and spiritual characteristics, however, it was necessary to analyse such sources as, The Psychology of Adolescence, by Frederick Tracy, The Intimate Problems

of Youth, by Earl S. Rudisill, Psychology of Adolescence, by Luella Cole, Adolescence, Vol.I, by G. Stanley Hall, Piloting Modern Youth, by William S. and Lena K. Sadler, Religious Education of Adolescence, by Norman E. Richardson, Psychology of Religious Experience, by Edward S. Ames, and Psychology of Middle Adolescence, by Mary E. Moxey.

In collecting data for the second chapter, on the courses in science studied in the senior high school, it was necessary to analyse the textbook most generally used, Advanced Biology, by Frank M. Wheat and Elizabeth T. Fitzpatrick. Three syllabi provided information on the subjects covered by the course in biology.

Personal interviews and questionnaires furnished the information for the third chapter.

The criteria reported in Chapter IV were determined on the basis of all this research. For the suggestions for correlation, however, it was found necessary to turn to such sources as, Social and Religious Problems of Young People, by Weston and Harlow, After Its Kind, by Byron C. Nelson, The Bible Confirmed by Science, by W. Bell Dawson, Strength of Religion as Shown by Science, by C.E.deM. Sajous, and Through Science to God, by Nathan Smyth.

The chapter used from Dr. Kagawa's book, The Sculpture of the Soul, and the portion quoted from one of

his recent addresses, were both sent to the writer by Dr. Kagawa's secretary in response to a request for information of a book it was known that Kagawa was writing on the use of nature in religious education. It was found that Dr. Kagawa is extremely interested in the use of nature study with children, and the writer was desirous of knowing if he included young people. Unfortunately he has not, but his secretary was kind enough to include the two pieces of data mentioned above.

CHAPTER I
A STUDY OF THE SENIOR
HIGH SCHOOL STUDENT

CHAPTER I

A STUDY OF THE SENIOR HIGH SCHOOL STUDENT

A. Introduction

In order to correlate science and religion in adolescent experience it is necessary to study the adolescent of high school age. What is meant by the adolescent mind? How does it function? His mental characteristics are of importance to this study, and also the stimuli that he is confronting in his world. It is necessary, also, to know something about his soul; how it functions, and what are its problems. The spiritual characteristics of the high school adolescent are likewise pertinent to this study. This chapter is based upon the background of experience of the author supplemented by research and study of the works of recognized students of adolescent psychology.

B. The Adolescent Mind

When the term "mind" is used here it refers to the intellect, as distinguished from the feelings and will.¹ This must be understood to avoid any confusion of thought when the term is used. One must differentiate the mind of the

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1. Cf. Tracy, Frederick: The Psychology of Adolescence, p.83

adolescent from that of the child and the adult. This will be done briefly at this time.

What is it that distinguishes the adolescent mind from that of the child or adult? In infancy the variety of mental content is deficient, with imperfect correlation and inadequate interpretation. The child develops gradually in intellectual ability. There is a dependence upon the adults in his environment for decisions. There is gradual progress in reasoning power. Imagination and curiosity are very active but not used toward any specific end. Children are more ready to memorize than are adolescents or adults, but it is incorrect to say that they have better memories. The concentrative power of children is of short duration. The child is illogical and inconsistent. But, with the coming of puberty, there are intellectual changes as well as physical.¹ It is during adolescence that the longest strides are made in intellectual development. As indicated by Tracy:

"The progress of an individual mind towards maturity consists partly in a steady increase in the fulness, richness, and variety of the stream of mental contents itself, and partly in a steady advance towards more perfect control, more complete correlation, and more adequate interpretation, of these subjective processes in reference to truth and reality."²

Again he says:

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1. Cf. Tracy, op. cit., p.43
2. Ibid., p.84

"The growth of the cognitive faculty, or the progress of the mind on its intellectual side, might be most briefly described as progress in the discernment of the relevant, or in the ability to distinguish that which is relevant, in any given case, from that which is irrelevant."¹

It is observable that the closer one approaches the adult stage the stronger become the desire to know truth, and to possess knowledge. Tracy points out:

"The intellect is feeling its own powers, and like the young bird trying its wings, flies out over the vast reaches of space and time with exhilaration and exultation. Questions are asked as to the age of the world, of the rocks and hills, what was 'before the beginning', and what will be 'after the end'.²

The end of adolescence does not mean the end of further development. One thinks of adulthood as beginning when responsibilities of life are assumed in full.³

1. The Mental Characteristics of Adolescence

Certain intellectual advances are characteristic of this age. One who has made careful study of the adolescent says of this period:

"Since the very earliest studies of adolescence, stress has been placed upon the characteristic intellectual developments of the period. Anyone who had watched the growth of an individual between the ages of thirteen and twenty-one has been impressed by the rapid gains made in ability to handle ideas. Any high school teacher

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1. Tracy, op. cit., p.95
2. Ibid., p.97
3. Cf. Rudisill, Earl S.: The Intimate Problems of Youth, p.18

knows that subject matter too difficult for freshmen is easily learned by the same pupils when they are seniors. There is an evident increase in judgment, reasoning, comprehension, speed of performance, memory, concentration, or any other mental functions. No doubt exists in the mind of observers in regard to rapid intellectual development during these years."¹

G. Stanley Hall gives many case studies to illustrate the mental changes that take place as the child becomes adolescent and as the adolescent advances from stage to stage. In teaching the adolescent, he suggests that teachers remember "the young and growing mind where perception, intuition, and spontaneity are at their very best and the powers of introspection are weakest."² The reasoning power which appears to a new degree in this period is one of the fundamental bases of the problem. Youth no longer accept without question. In turning to Tracy again we find:

"These questions do not necessarily betoken any special fondness for the abstract formulae of mere measurement and calculation; they are simply an expression of the youthful longing for freedom and expansion in the energies of the mind."³

It is a contradictory age. Youth demand authority at one instance, and discard it at the next. No longer is found the blind unquestioning obedience characteristic of childhood. Parents are "at their wits end" wondering how

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1. Cole, Luella: Psychology of Adolescence, p.186
2. Hall, G. Stanley: Adolescence, Vol.I, p.497
3. Tracy, op. cit., p.97

to curb their turbulent offspring. Unfortunately, and yet characteristically, these offspring tend to follow their own judgment.¹ This judgment, in spite of the new development of reasoning power, often is anything but sound.²

There are certain needs of the adolescent that are pertinent to this discussion. Because it is a period of doubts, he needs certainty. The self is ever present, and he needs understanding. He must have a basis for determining right and wrong, for it is in this period that he sets out to reform himself and society. His instability demands personality-character integration. It is the period when a plan for life becomes essential, and yet he is very uncertain in selecting and formulating such a plan. He will need guidance.³ To quote Hollingworth on the needs of adolescence, she says:

"Suggestions and models are secretly sought among those with whom the individual comes into contact. Guiding lines are caught from adults in the vicinity, from reading, and from pictures. Models are adopted. Emulation becomes one of the characteristic attitudes of youth."⁴

Today, with many new challenges that are being presented to our youth, careful guidance is more necessary than ever.

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1. Cf. Sadler, Wm. S. and Lena K.: Piloting Modern Youth, p.246
2. Cf. Richardson, N. E.: Religious Education of Adolescence, p.106
3. Cf. Hollingworth, Leta: Psychology of the Adolescent, Ch.6
4. Ibid., p.178

The mind is awakened and the increased powers of mental ability and activity delight and challenge the individual to exercise in scientific study and philosophic discussion. New discoveries thrill him.¹ He turns away from anything resembling a "rut". Sadler says, "If I were to be asked what is the largest problem now confronting the American people, I would frankly answer, 'Adequate understanding of the mind of youth.'²

2. The Mental Stimulus of the Present Day

In the above quotation the author has in mind the modern youth. Today, with the multitude of new inventions and advances in every field, the problems of youth are not only manifold, but are beyond the pale of comprehension for many of the older generation/. Turning again to Sadler, on this point, he says:

"The relationship of youth to life has been greatly changed in the last generation, and this has been largely brought about by unprecedented developments of the physical sciences. . . man's control of the powers of nature."³

He adds further:

"Modern youth enjoy a latitude of thinking, acting and reacting to life that was not even the privilege of adults in a former generation."⁴

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1. Hollingworth, op. cit., p.162
2. Sadler, op. cit., p.246
3. Ibid., pp.11,12
4. Ibid., p.12

This present problem of the correlation of science and religion is concerned with the high school youth of today. This distinction must be made in the light of the advances that have occurred in the past half century. Science as a study in secondary schools has made rapid strides. But it is not this alone that must be taken into account. Youth know many things. There is little ignorance as in past generations. The librarians put books into their hands that were unknown twenty-five or thirty years ago. Scientific books, such as The Origin of the Species, by Charles Darwin, have been rewritten so that even eight-year-olds can understand them. Many authors have written to enlighten youth. Children and youth can readily find such books as:

Lewis Browne: This Believing World
Clark and Gerdy: The Early Story of Mankind
Eva Erleigh: In the Beginning
Maxwell Reed: The Earth for Sam
Walker and Mook: Tales of the First Animals
H. G. Wells: How the Present Came from the Past

There are many others. Youth today are reading.¹

Not only are youth reading, but they are seeing and hearing as never before. It is general today to make use of the sound film and the radio as mediums of education. What are youth learning? Mention may be made of the museums to which schools make visits for educative purposes. Today,

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1. Cf. The Pilgrim Elementary Teacher, March and April, 1932, Article, "Others Call It God", by Jeannette Perkins

not only the world, but the mind of the world, is at the feet of youth.

Even our own understanding of youth has been advanced in the past few years. Psychology, comparatively an infant science, developing since the middle of the last century, is now the chief compass for "piloting modern youth."¹ Knowing our youth and realizing the challenges that today presents to them, increases our responsibility.

C. The Adolescent Soul

As with the mind, it is necessary to define the soul. Its use here is the moral and emotional nature as distinguished from the more purely intellectual and mental powers and operations; the seat of the religious tendencies and functions. There is a difference between the religion of childhood and the religion of adolescence which originates in a difference in general mental powers and experiences. The religion of the child is a natural religion, while that of the adult might be considered a doctrinal religion. The religion of the adolescent is more spiritual and personal.² "The adolescent realizes that childish religious ideas will

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1. Cf. Sadler: Piloting Modern Youth, pp.349-354, Bibliography
2. Cf. Tracy, Frederick: The Psychology of Adolescence, pp.188,189

no longer suffice," says Rudisill.¹

1. The Spiritual Characteristics of Adolescence

With this progress in mental development it must not be forgotten that youth's problems are rooted deeply and early in the emotional life of the child. When he reaches adolescence he wants new experiences, a sense of greater security, proper recognition, response to himself, and opportunities to put into practise his lofty ideas, and ideals.² This is the period when religion becomes more personal.³ He is an hero worshiper. Ames says, "The study of adolescence has yielded the assurance that it is the normal period for the rise of religion in the individual."⁴ He inherits from the ages the emotions of reverence and awe. Sadler says, "Religion if properly taught, certainly would help young people to grasp the values of life."⁵ That adolescents have religious tendencies is clear.

The normal religious development through the adolescent period may be considered as treated by Norman E. Richardson. Early adolescent religion is volitional, expressive, and expansive. There is purity of idealism at this period, and a conscious effort to be and to do good.

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1. Rudisill: op. cit., p.175

2. Cf. Sadler: op. cit., pp.4-9

3. Cf. Ibid., p.322

4. Ames, Edward S.: The Psychology of Religious Experience
p. 235

5. Sadler: op. cit., p.325

They are idealistic and critical of others. The nature of the whole might be said to be impulsive. Turning to middle adolescence, wherein is found most of the high school adolescents, it is observed that the volitional has given place to the emotional. There is further expansion. A reaffirmation of loyalty is needed, because of the intensification of social interests. The pure idealism of the earlier period has become a passionate idealism. They are now tempted to "serve two masters". Here is a time of storm and stress. Their religion is intensely personal. Spiritual compromise seems to be the price of friendship, or of vocational success. They measure and test themselves by the ideals they have set up. Wherein the early adolescent is volitional, the middle is emotional, and the later is intellectual.¹ The later adolescent takes in the post-high school group, for the most part, and is therefore not pertinent to this study.

2. The Adolescent Need of Religion

The strides in mental development and the strong religious tendencies of the adolescent are co-related.

Hollingworth says of this relation:

"Religion becomes a problem of adolescence not because there is at that period a development of religious instinct, but because intelligence develops during the teens to a point where question and answer arise as

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1. Cf. Richardson: op. cit., pp.76-93

manifestations of growth in mental power."¹

Adolescents need a sound value-center in life. If this is a period of doubting, youth need assurance. On this point Moxey says:

"Youth has to find some center of personalization, and for this God alone is adequate. It is as natural for boys and girls to fasten their emotional lives to some personality whose strength and sweetness and achievement they admire as it is for ivy to put forth tendrils. The religion of these years is one of loyalty, and it is absolutely essential that this loyalty be fixed to an object it cannot outgrow. . . and that is God himself."²

Youth are facing for the first time, with any degree of comprehension, the fact of death. A recent issue of a devotional booklet makes use of this experience and speaks to youth:

"We young people do not want to die. Death is far from our thoughts. However, as we try to understand God's will for our lives, what reality is there in death? . . . The fear of death is a negative use of our reasoning powers. It is only one side of the total picture of life."³

The author recognizes the fact that death is a real problem to young people.

Youth are yearning for the explanation of what to them seems unexplainable. It is a search for God. Youth want a firm foundation and they want it backed by truth. They have a thirst for knowledge and yet firmly refuse

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1. Hollingworth: op. cit., p.149
2. Moxey, Mary E.: Psychology of Middle Adolescence, p.173
3. Follow Me, Westminster Press, January 30, 1937

to accept anything unproven. Their knowledge must confirm their religion, or there is conflict. Faith must be consistent with knowledge.¹

Youth have an introspective attitude that makes them conscious of a sense of guilt and of sin. They are idealists and at the same time see their own short-comings. They need freedom from this sense of sin, and can find it in God.²

3. The Spiritual Challenges of the Present Day

Modern youth are meeting spiritual challenges that were undreamed of during the past generations. According to Hollingworth:

"Modern adolescents of intellectual equipment enabling them to reach high school in the United States, say that the problems of religion enter much into their thoughts."³

The youth of today are fortunate in having motion pictures, radios, libraries, museums, and such educational devices at their service. The same motion picture, or book, or magazine that stimulates the intellect may at the same time present a problem of conflict. Youth today have more freedom, in their everyday life of social and intellectual contacts, than their parents or grandparents enjoyed. The changes in attitudes, religious and social, have been

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1. Cf. Rudisill: op. cit., pp.179-183
2. Cf. Ibid., p.26
3. Hollingworth: op. cit., p.158

markedly evident during the last fifty years. Understandings and misunderstandings of these add to the confusion of youth. They stand bewildered. This changing quality must be considered by those who would "pilot" modern youth.

D. Summary

The study of the intellect of adolescents is pertinent to the problem of correlating natural science and religion. The adolescent's intellect is distinguished from that of the child or of the adult, as it is the period in which the longest strides are made in intellectual development. There is an advance towards more control, correlation, and interpretation of the mental contents. There is an increase in discernment of relevancy. Certain mental characteristics of this period are of importance to this study. There is increase in judgment, reasoning, comprehension, speed of performance, memory, concentration, perception, intuition, spontaneity, questioning, impulsiveness, and in the accompanying needs. The adolescent intellect is challenged more today than in any previous generation. The industries, libraries, motion pictures, museums, and radio, are used as educative agencies.

The study of the moral and emotional nature of the adolescent is likewise pertinent to this problem of correlation. It is distinguished from that of the child and of the

adult as demanding a spiritual and personal religion, while the child is satisfied by a natural, and the adult a doctrinal religion. The characteristics relevant to this study are the emotional quality, sense of loyalty, idealism, instability, and expressiveness.

That adolescents need religion is of concern here. It is a period of doubting, and they need assurance. They are facing the fact of death, and they need reassurance. They need a Person around whom to center their loyalties. It is a period of adjustment, decision, and consciousness of sin. They need a standard, and a life philosophy that will guide them to personality-character integration. They need freedom from the sense of sin. Modern youth are meeting moral and emotional challenges that were unknown to previous generations. As with the challenges to the intellect, the motion pictures, museums, libraries, and radio are broadening the scope of their questioning. The cross-currents of today's religious and social attitudes present youth with further problems.

The situation of the youth of today, as they face the intellectual, moral, and emotional challenges, demands the attention of leaders of adolescents. High school students are today facing issues that have not been faced by adults of past generations.

CHAPTER II
A SURVEY OF SCIENCE COURSES IN
SENIOR HIGH SCHOOLS

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SENIOR HIGH SCHOOLS

A. Introduction

In considering the correlation of science and religion, in the experience of senior high school pupils, it was found necessary to survey some science courses presented in some representative senior high schools. This survey included the materials, related activities and observations of actual classroom procedure in the biology and general science departments of six New York City senior high schools. From these data collected the writer will seek to select the criteria on which to base the correlation of science and religion for the high school age group.

The chapter to follow will report the personal interviews with high school science teachers, and present an analysis of a questionnaire study of church school teachers and pupils of the senior department. A later chapter will tabulate the data secured from these two surveys and determine the desired criteria basic to the suggestions for correlation of science and religion for the high school students.

This survey included a detailed analysis of the

textbook most generally used, the syllabi followed in the teaching of biology, the supplementary materials, and a detailed description of two of the classrooms. These are followed by reports of observations of the teaching of biology and general science in fifteen class periods.

B. Materials Used in Biology Courses in Senior High Schools

Under this heading will be considered the textbooks used, the syllabi followed, the supplementary materials, and a description of two of the classrooms.

1. Analysis of Textbook

Of the six high schools visited it was found that five of them used as their textbook in biology, Advanced Biology, by Frank M. Wheat and Elizabeth T. Fitzpatrick, published by the American Book Company, New York, in 1929. Two of these five schools also use, Biology for Beginners, by Truman J. Moon and Paul B. Mann, published by Henry Holt and Company, New York, in 1933. The sixth school uses Biology, by Frederick L. Fitzpatrick and Ralph E. Horton, published by the Houghton Mifflin Company, New York, in 1935.

In-as-much as the book by Wheat and Fitzpatrick is most used, a detailed analysis of it is here included. The other two books follow, in content, a similar treatment

of the subject.

NAME: Advanced Biology

AUTHOR(S): Frank M. Wheat and Elizabeth T. Fitzpatrick

PUBLISHERS: American Book Company, New York

DATE: 1929

PURPOSE: "There has been a growing demand for an advanced course in general biology to follow the elementary science course. This text has been written primarily to fill this need. The emphasis of the book is on problems relating to human welfare. The origin and principles of development, structure, and functions of plants and lower animals are introduced mainly as a background for the proper understanding of human problems."¹
(Preface p.v)

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Chapter

Historical Background

- I. The Biology of To-morrow
- II. The Growth of Science
- III. The Microscope

Studies of Cells

- IV. The History of Cells
- V. Functions of a Green Cell
- VI. Typical Animal Cell
- VII. The Resting and Dividing Cell
- VIII. Structure of Higher Plants
- IX. Human Tissues
- X. Human Tissues (cont.)

Hygiene and Nutrition

- XI. Food Nutrients
- XII. The Teeth and Their Care
- XIII. The Digestive System
- XIV. Digestion and Absorption
- XV. Blood and Its Importance
- XVI. Circulatory System
- XVII. Lymphatic System
- XVIII. The Skin and Kidneys
- XIX. Respiration
- XX. Metabolism
- XXI. Ductless Glands

Chapter

Irritability

XXXII. The Nervous System

XXIII. Nervous Reactions

XXIV. Mental Hygiene

Reproduction

XXV. How Life Began

XXVI. Asexual Reproduction

XXVII. Vegetative Propagation

XXVIII. Sexual Reproduction

XXIX. Reproduction of Higher Plants

XXX. Reproduction of Animals

XXXI. Protection of Young

Heredity and Evolution

XXXII. Character of Offspring

XXXIII. Heredity

XXXIV. Mutations

XXXV. Plant and Animal Breeding

XXXVI. Eugenics

XXXVII. Progressive Development

Micro-organisms and Human Welfare

XXXVIII. Bacteria

XXXIX. Beneficial Activities of Bacteria

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XLI. Smallpox and Its Control

XLII. Rabies and Its Control

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The author of this thesis has selected certain quotations and references from this textbook that may prove pertinent to this study of the correlation of science and religion. These follow. Their pertinency was determined on the basis that they may touch on certain points of possible conflict between science and religion in the mind of the high school student.

2. References

"The aim of all science is to ascertain the truth from unbiased experiments without regard to emotional prejudices or statements based on speculation or imagination." Chapter I, p.6

Mendelian Laws of Heredity, Chapter XXXIII, p.331

Chromosome theory of inheritance, Chapter XXXIII, p.331ff

Inheritable variations, Chapter XXXIV

"This sudden departure from the ancestral type is called a mutation and the individual itself is a mutant, provided the new form breeds true to its type." pp.337,338

"All plants and animals of today are thought to be descendants of earlier and more primitive types. Organic evolution is the science that deals with the origins of species and the changes in them from generation to generation. Evolutionists believe two things: (1) that individuals of the same species always vary; and, (2) that many of these new characteristics or variations are transmitted to succeeding generations. Heredity is, therefore, one of the cornerstones of evolution."

Chapter XXXVII, p.371

"There is practically no disagreement among scientists concerning evidences that organic evolution has taken place. But, there is still much disagreement in determining which of the theories thus far formulated most nearly fits the facts. The deVries theory of mutation is one that is generally accepted by many scientists."

Chapter XXXVII, p.377

"Assuming that the production of uranium ceased as soon as the earth and sun separated, geologists have agreed that this lead is about three billion years old. This was determined by estimating the length of time necessary for a small amount of metal uranium to break up into this form of lead. From this time and amount of metal, the age of the lead and, therefore, the earth was calculated." p.378

Evidences of evolution -p.381

- | | |
|-------------------|---------------------------------|
| (1) Geological | -fossils |
| (2) Geographical | -flora and fauna distribution |
| (3) Morphological | -similarity of structure |
| (4) Vestigial | -traces and rudiments of organs |
| (5) Embryological | -similarities of embryos |

3. Syllabi

Of the six high schools visited four were found to follow the course of study suggested in the appendix of the textbook by Wheat and Fitzpatrick.¹ Two of the six schools visited have their own syllabi, mimeographed and placed in the hands of each teacher. Of these three similar courses of study, the one used by the Seward Park High School will be given in detail as typical.

SYLLABUS

ADVANCED BIOLOGY III or GENERAL BIOLOGY I

Week Unit I. General Picture of Life.

1. a. How do living things get along together in nature?
- b. What are the general conditions which limit life on the earth?

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1. Wheat and Fitzpatrick; Advanced Biology, pp.544-549

Week

Factors: Air, light, temperature, pressure, water, food.

c. What are some of the changing conditions to which organisms make constant adjustments?

2. What do the records of the rocks show us about life in the earth in past time?

Ideas: Fossils, rocks, sediments, sequence of appearance of plants, animals, man.

3. How has man been related to other life during his ascent to his present position?

Ideas: a. interference b. use c. balance of nature d. control e. interdependence

Unit II. Unity and Diversity of Life

4. What common stuff pervades all living things: Protoplasm-chemical and physical constitution-varies.

Amoeba, one-celled organisms.

5. What functions has protoplasm, amoeba, paramecium, pleurococcus.

6. Does the cell principle explain the bodies of larger organisms? Cell structure of tissues, leaf, stem, muscle, nerve, et al.

7. Is there any evidence that the increasing specialization of cells can account for ranking of organisms as higher and lower?

a. Pattern of plant body--algae, colonial forms, liverworts; mosses, ferns, flowering plants.

8. b. Patterns of animals, protozoans, colonial forms, hydra, sponges, planaria, earthworm, amphioxus, fish, frog, rat.

9. How does this principle of increasing complexity form a basis for classification: Linnaeus, kingdoms, binomial, & trinomial-systems, phyla of plants, phyla of animals.

Unit III. What are the activities of organisms and how do they obtain the energy for these activities? -Physiology.

10. What activities does a plant engage in? Food,

Week

photosynthesis, respiration, nutrition, growth.

11. What are the classes of energy-producing substances? Foods, nutrients; tests (if not known) Metabolism as energy use.
12. What are the processes of nutrition? Digestion; organs and processes in a man.
13. How is absorption and assimilation accomplished in the human body?
14. How does the digested food reach the cells? How is circulation carried on in man? What are hormones?
15. What is the method of release of energy from food? Respiration vs. photosynthesis. Metabolism, anabolism, katabolism, calorie, conservation.
16. Excretion - How do organisms get rid of wastes?

ADVANCED BIOLOGY IV
or
GENERAL BIOLOGY II

1. Unit IV -Adaptations for Adjustment

1. How do organisms keep aware of their surroundings? Stimulus, response, plants, tropisms, unlearned behavior.
2. How do higher organisms behave? Intelligence - nervous systems - conditioned responses and learning.
3. How do special adaptations of organisms help to solve problems of habitat, defense, food getting, hibernation etc?

Unit V. Reproduction

4. Does all life come from life? General idea of mitosis. Sexual vs. asexual.
5. Reproduction of plants. How do plants continue

Week

their species? Alteration, pollination, fertilization, reduction, division, development of embryos and seeds.

6. What are typical ways by which animals reproduce? What is the secret of successful reproduction? Cleavage, germ layers.

Unit VI. -Racial Change

7. What are evidences of descent of higher animals and plants from lower ones? Fossils, structural resemblances.
8. Variation. What is meant by variation, natural selection and survival of the fittest? Darwin, Linnaeus, Cuvier.
9. Mutation -Is there inheritance of acquired characters?
10. Mendelism. Why do organisms resemble parents in some respects but differ in others? Chromosomes, Punnett Squares, hybrids, etc.
11. Chromosome theory and mutation.
12. Mendel's Laws. How can man use the principles of inheritance? Chromosomes, genes, breeding, crossing, selection.

Unit VII -Economic Biology

13. What is the relation of lower organisms to man? Bacteria -insects. Beneficial - harmful.
14. What is the relation of vertebrates to man, food, shelter, clothing, services, harm. Fish, reptiles mammals.
15. Eugenics and Euthenics. What is the outlook for mankind?

4. Supplementary Materials

In addition to the textbooks and the syllabi certain other materials were found to be used in the teaching of biology in the senior high schools. Each classroom visited had models of various flowers to demonstrate the functions of their structures. One school had among the models one series of the evolution of the foot of the horse through the paleontological ages. Aquariums containing fancy goldfish were likewise to be found in the laboratories of each school. Flower boxes, with young seedlings coming up, were in many windows. Every class observed was supplied with microscopes.

The walls of the classrooms were hung with many charts. These usually pertained to the subject under immediate consideration. In classes that were studying Spirogyra were hung large charts representing that plant, in diagram and color. Every classroom visited was thus equipped. A report of two rooms will be given in detail to serve as examples.

SCHOOL: George Washington High School
LOCATION: 191st Street and Audubon Avenue, New York City
DATE OF VISIT: February 25, 1937
CLASSROOM: Advanced Biology laboratory
OBSERVATIONS: This room was of special interest because, besides the usual aquariums and window boxes, it also had in it large bird cages in which were several birds flying around. The things that caught my attention however, were two mural paintings that were above the birds and took up nearly the entire length of the room. Both were prehistoric scenes. One showed some of the

flora and fauna of that period. The other had action, for there were two prehistoric men with spears in hand stealthily approaching a huge monster that was crouched upon the rocks above them. These pictures were brightly colored.

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SCHOOL: Julia Richman High School

LOCATION: 67th Street and Second Avenue, New York City.

DATE OF VISIT: February 15, 1937

CLASSROOM: Nature Room

OBSERVATIONS: A special room is set aside as the Nature Room. In this room, along the windows, were aquariums containing fancy goldfish, turtles, and an alligator. A miniature greenhouse, and a miniature rock garden, as well as a miniature woodland scene, were flourishing with the desired flora, in the space between the aquariums. A table at the end of the room held bottles and jars containing various twigs sprouting in water. Those nearest to showing life were the forsythia. Others, that were showing fairly good-sized buds, were dogwood, apple, and cherry. More valuable materials are kept locked in cases across the back of the room. These exhibits are changed according to the current topic of study. Minerals, and shells, and jars of specimens in preservative, were noted in the cases.

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Magazines are another source of supplementary material. Two that were particularly noted were: Science, a weekly publication by the Science Press, New York, and Natural History, a bi-monthly journal of the American Museum of Natural History, in New York.

5. Related Activities

Very little was found to be done by way of related activities. Upon inquiring it was learned that there is a great amount of preliminary inconvenience for the teacher in order to get a pupil released from school to take museum

trips, field trips, and such. It is optional for the teacher, and if he cares to do any of these things he may. Field trips, because of the distances to suitable places, are practically out of the question, according to those consulted on this question. One teacher reported taking her class to see the motion picture Louis Pasteur. Occasionally classes are taken to visit the American Museum of Natural History, in New York City.

C. Observations of the Teaching of Biology in the Senior High Schools

In the six high schools visited a total of fifteen classes were observed. These were chiefly classes in Biology. Two of the fifteen were classes in General Science. These observations will be given in detail, followed by a brief analysis of the findings. The observations are recorded below, grouped under the schools visited.

HIGH SCHOOL: Julia Richman
LOCATION: 67th Street and Second Avenue, New York City
DATE OF VISIT: February 15, 1937
NO. OF CLASSES OBSERVED: 2
OBSERVATIONS:

(1) Class in Biology 2

At the outset of the class, the teacher wrote the assignment for the following day, on the blackboard. This was in the form of two questions for further work on the circulatory system. She then called several pupils to the blackboard, and gave them review questions to answer. While they were doing this the teacher called on others to answer some other review questions orally. Special attention was given to the function of veins, arteries, and capillaries, the red and white corpus-

cles, and the plasma. The pupils were not very well prepared and had to turn to their textbooks for the answers to the questions.

(2) Class in Advanced Biology 4

At the beginning of the period some of the pupils were examining Elodea under the microscope, while others were listening to the teacher lecture on Spirogyra. A large drawing of the latter was up in front of the class. The teacher was making another drawing on the blackboard with the help of suggestions from the class. This procedure continued throughout the period.

HIGH SCHOOL: Stuyvesant

LOCATION: First Avenue and 15th Street, New York City

DATE OF VISIT: February 23, 1937

NO. OF CLASSES OBSERVED: 2

OBSERVATIONS:

(1) Class in second semester of Advanced Biology

This class was a discussion group on the subject of vaccines and anti-toxins. The diseases of small-pox and diphtheria were also discussed with methods of diagnosis. This class, composed entirely of boys, was a live-wire group intensely interested in the subject under discussion.

(2) Class of boys in first semester of Advanced Biology.

After a few minutes of lecture and explanation the boys passed into the laboratory, and took up microscopes to study the seaweed, Elodea. The remainder of the period was spent in examination and drawing.

HIGH SCHOOL: George Washington

LOCATION: 191st Street and Audubon Avenue, New York City

DATE OF VISIT: February 25, 1937

NO. OF CLASSES OBSERVED: 3

OBSERVATIONS:

(1) Class in Advanced Biology

This class had done some experiments in vegetative propagation, and the students who had results reported to the rest. One pupil had succeeded in getting a white potatoe to sprout at the eyes. The same pupil explained the principle of grafting. Another pupil had a sweet potatoe sending out rootlets and stems and leaves. These were passed around the class for all to see. At the same time

the teacher had four vials of fruit flies going around the class, to illustrate hereditary characteristics. Evidently the class had been studying genetics. Various genetic charts were still hanging around the room. Another pupil followed the two mentioned above with a report on mitotic and amitotic cell division, illustrating his report with some drawings that he had made. The entire period was summed up by pupil discussion of asexual reproduction.

(2) Class in Advanced Biology

The teacher was prepared to consider reproduction in plants, and had some of the pupils put drawings on the blackboard of the various reproductive organs of flowering plants. However as discussion proceeded he discovered that they were not entirely clear on some previous study of cell-division in animals, and especially the reduction division of chromosomes. He left the plant study and turned to this subject. The entire period was given over to clearing this point. Heredity and environment were touched slightly when one pupil asked why his two fish, which were the same size, and had the same environment, produced two offspring of different sizes. The teacher emphasized environment in this situation in suggesting that perhaps one did not eat as much as the other. He also suggested that the boy himself should do more thinking and less asking. The question had come to the boy's mind perhaps because the class had been using an imaginary pair of fish in working out the chromosome problem. The class was alert and raised many interesting questions, and offered some quite original theories. This use of the imagination was discouraged by the teacher.

(3) Class in Advanced Biology

This class is known as the "slow class". They are behind the others in their work, and are still working on the subject of Spirogyra. The teacher had with him when he entered the room a battery jar, a roll of wire, some modeling clay, and a roll of green crepe paper about an inch in width, and a roll of waxed paper. He announced that out of these materials the class would construct a Spirogyra cell. Various suggestions came reluctantly from the class, and each one who made suggestions was called up front to put them into execution. Finally a rather clumsy representation

of the desired cell was completed. When this was finished and the class seemed to understand just what is meant by the structures of a Spirogyra cell, the teacher turned to the subject of photosynthesis. To determine the part that sunlight plays in this process, the class decided to experiment. They had the teacher place some Elodea, in a flask of pond water, on the window sill. Another similar piece of the plant was placed, in a flask of pond water, in a dark closet of the laboratory table. These are to be carefully watched from week to week to see if there is any notable effect from cutting off the sunlight.

HIGH SCHOOL: Wadleigh

LOCATION: 114th Street and Seventh Avenue, New York City

DATE OF VISIT: February 26, 1937

NO. OF CLASSES OBSERVED: 2

OBSERVATIONS:

(1) Class in Advanced Biology

There were some oral review questions at the beginning of the period, on photosynthesis. The class then went to the microscopes and observed the Paramecia. The rest of the period was spent in doing this. Some pupils were sent to the blackboards to draw what they had observed. They were deeply interested, especially in the microscopic work.

(2) Class in Advanced Biology

This class was conducted along the lines of the class just preceding. There was a brief review at the opening, on photosynthesis. The pupils then tried to observe the paramecia under the microscopes. There was an insistence in this class that the pupils make observations after doing their thinking scientifically. No guesswork or imagination was allowed. Hence, a very well conducted lesson resulted. Two trips were made to the microscopes, and before each the pupils decided just what they were going to look for. Progress of thought and observation were very evident.

HIGH SCHOOL: Seward Park
LOCATION: Essex and Ludlow Streets, New York City
DATE OF VISIT: March 1, 1937
NO. OF CLASSES OBSERVED: 3
OBSERVATIONS:

(1) Class in General Science

The class was studying photosynthesis, and the teacher conducted an experiment to show the need of chlorophyll in this process. The leaf of a green plant was boiled in alcohol to remove the chlorophyll, after which it was boiled in water, to break down the starch granules. Then iodine was poured over the leaf and the part where it had been green turned dark. The pupils watched the experiment and kept record of the steps and observations in their notebooks. It was hard for the teacher to get them to understand just exactly where observation ended and guessing or foreknowledge began.

(2) Class in Advanced Biology

The pupils in this class were given a test on mitosis. They were asked in this to diagram mitotic cell division. There were but a few minutes at the end of the period. During this time the teacher started to review chromosomes, and the formation of the zygote.

(3) Class in General Science

The class was studying osmosis, and taking notes on the experiment that the teacher was conducting. The purpose of the experiment was to show how food materials move from place to place in plants and animals. It was found that starch is insoluble, and will not osmose. Therefore starches must be changed to something soluble. Sugar is soluble and will osmose. The changing of starches to sugar is called digestion. Osmosis is the exchange of liquids or gases through a membrane, and the tendency is for the greater amount to pass from the area of lesser density to that of greater. The class was kept strictly to observation, again an effort on the part of the teacher to obtain some degree of scientific thinking, and avoid a too rash jumping to conclusions.

HIGH SCHOOL: Washington Irving
LOCATION: 40 Irving Place, New York City
DATE OF VISIT: March 2, 1937
NO. OF CLASSES OBSERVED: 3
OBSERVATIONS:

(1) Class in Advanced Biology

The teacher gave the pupils an assignment for the following lesson, on the history of the cell. This was followed by a brief written test on the nervous system. These papers were collected, and the class then discussed the life and work of Anthony Von Leeuwenhoek. They decided that he made three distinct contributions to the field of science; (1) improved the microscope, (2) discovered capillary circulation in the tail of a tadpole, (3) observed micro-organisms in water. The teacher recommended, as interesting reading, Microbe Hunters, by Paul de Kruif.

(2) Class in Advanced Biology

An assignment was made on adaptation, using the fish as the subject of study. The class then had a review on artificial propagation of fish. A large chart was hung in the front of the room to assist the class in discussing the life functions of fish. Just at the close of the hour the teacher launched a project of making a chart showing the comparative structure of heart and brain in lower vertebrates. The models to be used were specimens of hearts and brains in jars of preservative, carefully labeled. The project was scarcely introduced when the bell rang.

(3) Class in Advanced Biology

At the beginning of the period the class had a short written test on the care of the young, as found in plants, birds, and mammals. The papers were exchanged and marked by the pupils. They then discussed the stages in the development of a fertilized frog egg. The textbook was frequently referred to, and portions were read aloud, in answer to questions.

To briefly summarize these observations at this time, it is well to first point out the fact that of the fifteen classes observed, eight were engaged in the field

of cell studies. Two others were studying nutrition, and four were at work on different phases of the subject of reproduction. Only one class was making a study of bacteria.

It would be well to note, too, that four classes were doing some form of microscopic work. Five groups were either conducting their own experiments, or watching one worked out by the teacher. In all cases, drawing was found to be connected with the microscopic work. Reviews were quite prevalent, either written, as with four of the classes, or oral. Projects were noted in but two of the classes. One was on types of asexual reproduction in plants, and the other on a comparative analysis of brain and heart structure. Scientific thinking was stressed by three of the fifteen teachers.

D. Summary

This chapter, in relation to the correlation of science and religion in the experience of the senior high school pupil, has reported a survey of biology and general science courses in senior high schools. First was reported the survey of materials used in these courses. Thirteen classes in biology and two in general science were observed in six high schools in New York City. The matters of interest in this survey were the textbooks and syllabi used,

supplementary materials, and related activities. Five of the six high schools were found to use the same book, Wheat and Fitzpatrick, Advanced Biology. An analysis of this textbook was reported. Four of the schools were found to use as their course of study in biology, the one suggested in the appendix of the above textbook. The other two schools were found to have their own courses of study. One of these three courses is incorporated in this chapter.

Supplementary materials, such as models, microscopes, aquariums, charts, and so forth were noted. Two room descriptions are given in detail as examples of the equipment of a biology classroom. Not much is done by way of related activities in these city high schools.

The remainder of the chapter is devoted to records of the observations made of fifteen classes in natural science. The subjects that these classes were engaged in studying were carefully noted. Somewhat is said of the class procedure. The methods were noted, and the interest of the class. Whenever a teacher was making a conscious effort to get the class to think scientifically, it was recorded by the observer.

In none of the classes observed was any question raised, either by pupil or teacher, that would have direct bearing on the problem of correlating science and religion. The records that were taken, and were here recorded, were

done so with this question of correlation in mind. It is hoped that they will prove to be pertinent, when, in a later chapter, the selection of criteria will be made.

CHAPTER III

A REPORT OF INTERVIEWS AND QUESTIONNAIRES
RELATIVE TO THE CORRELATION OF SCIENCE
AND RELIGION IN THE EXPERIENCE OF THE
SENIOR HIGH SCHOOL STUDENT

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A REPORT OF THE INTERVIEWS AND QUESTIONNAIRES RELATIVE TO THE CORRELATION OF SCIENCE AND RELIGION IN THE EXPERIENCE OF THE SENIOR HIGH SCHOOL STUDENT

A. Introduction

To determine criteria in order to correlate science and religion, in the experience of the senior high school student, certain questions present themselves for answer. What evidence is there of conflict between science and religion in the mind of the high school pupil? What attempt is being made to help them correlate science and religion, to what extent is it being made, and by whom? Two approaches were made to these questions.

In the first place, the writer personally interviewed seventeen science teachers in some New York City high schools. These teachers were asked if they made any attempt in their teaching to correlate science and religion; what, if any, questions were raised by the pupils that would suggest a conflict between science and religion; what type questions most frequently arose; and how these were answered. These interviews will be reported in this chapter.

The second approach was made by means of questionnaires. The substance of these questionnaires will be given

in this chapter. One set was sent to teachers in the Senior departments of the Sunday Church Schools in New York City. The other set was sent to pupils in these departments. The results of both sets are tabulated and analyzed herein.

By means of these approaches answers will be found to the questions pertinent to this study. On the basis of these answers criteria for correlating science and religion, for the senior high school age group, will be determined. These criteria will make possible definite suggestions for correlation.

B. Personal Interviews with Teachers of Biology in Senior High Schools

The personal interviews with seventeen teachers of biology will follow, grouped according to the school in which they are teaching.

1. Personal Interviews

HIGH SCHOOL: Julia Richman
LOCATION: 67th Street and Second Avenue, New York City
DATE OF VISIT: February 15, 1937
INTERVIEWS:

- (1) In inquiring if this teacher ever attempted to make any correlation of science and religion in her teaching, she replied in the negative. She said that God was never mentioned by her in any of her classes, and if the subject came up she merely explained that some people believe in God, others in a force, or in Nature as a force, and that they could feel free to hold their own beliefs, but to try to think scientifically, and

for themselves. She informed me further that when the subjects of eugenics, euthenics, and evolution are taught, that evidence of religious prejudice came out, especially among the Roman Catholic pupils. Birth control is taught, and that also brings the church question to the fore.

- (2) Miss _____ reported that they made no attempt to correlate religion with science; that things of a religious or spiritual nature were not discussed in class.
- (3) This teacher said, "I am glad someone is trying to correlate science and religion." She is a member of a school board in New Jersey where she has introduced certain books which have caused criticism of the members of her board. They are "pigheaded", she comments, and will not see the place of science. She explained that nevertheless there are fossils and such material evidences of evolution, and these cannot be denied. The board members fail to see this, saying that God in His infinite glory placed them there. She asked them if God carried a bag of bones. I asked if she thought that correlation was possible, and her reply was, "There is correlation." I asked, further, if she indicated this in her teaching. She answered that she presents the material in a scientific way and if questions arose, she tells the pupils to think the way they choose to, but to try and think scientifically, and to get the subject matter into their heads whether they believe it or not, for they have to pass the course. She reported that trouble came generally from the Roman Catholics.
- (4) Miss _____ said that the most opposition came from the Roman Catholic pupils, who are told by their priests that they cannot believe what is taught by science. Especially is this true when the subject of evolution is brought up. She begins this subject by sending them to the Catholic Encyclopoedia for the definition of evolution, and also by reading to them a letter that she has from a Catholic priest who favors the study. However, they are prejudiced by their local priests, and dare not go against their orders. The teacher called this the "silly superstitions" of religion. Very little opposition is felt from the Protest-

tant pupils, but some of the Jewish pupils question evolution. She feels that there is correlation possible between science and religion, and that home prejudices are at fault. She tells her pupils to think what they like, but to try to weigh their conclusions and to think things through. However, she added, that there is very little of that done, for they are afraid to go against their beliefs. Especially is this true among the foreign pupils.

HIGH SCHOOL: Stuyvesant

LOCATION: First Avenue and 15th Street, New York City

DATE OF VISIT: February 23, 1937

INTERVIEWS:

- (5) When the question on religion is brought up, as occasionally happens when the subject of evolution is studied, this teacher refuses to discuss it. He gives them scientific evidences saying, "What is true is true." No religious discussion is allowed in class at any time. He gave me some of his personal history, claiming to be a "universal sceptic". He was amused at the idea of there being any possibility of correlation between science and religion. His attitude is that the two are extremes - mutually exclusive, and that science is the truth.

HIGH SCHOOL: George Washington

LOCATION: 191st Street and Audubon Avenue, New York City

DATE OF VISIT: February 25, 1937

INTERVIEWS:

- (6) Mr. _____ refused to be interviewed, carefully avoiding any commitment on the subject of the correlation of science and religion.
- (7) This teacher said that he made no attempt in class to correlate science and religion. His reasons for this were that they are not allowed to get into religious discussions in class, and that it would not be wise because of the variety of religious beliefs in the classes. He teaches them what they are supposed to know to pass the course, and they "can believe what they like". There are very few questions raised, and those come usually during the study of evolution or eugenics. When spontaneous generation is discussed some will ask about the origin of life. He tells them that that is not known to science. In his own personal life he has religious convictions, and has his own

correlation of science and religion, or he "couldn't live with himself".

HIGH SCHOOL: Wadleigh /City
LOCATION: 114th Street and Seventh Avenue, New York
DATE OF VISIT: February 26, 1937
INTERVIEWS:

- (8) Miss _____ said that most questions showing a consciousness of religion, come up during the study of evolution. One incident that she remembered was when one child remarked that she thought the theory of evolution was much more satisfactory and sensible than the Bible story. The teacher tried to show here that these two are not so different, and that many scientists are also deeply religious. Some even have turned away from religion only to return to it, such as Millikan. But the child replied that she still preferred evolution. This teacher tries to make some such correlation whenever questions are raised. Being a student body that is largely negro, the teachers do meet superstitions of some kind or another.
- (9) This teacher makes no attempt to correlate because there are too many different beliefs. She agreed that something ought to be done about correlating science and religion, although most religions now believe in evolution, with the exception of the Roman Catholic. When a pupil raises a question, as is apt to happen when evolution is studied, she tells them that the Bible was written years and years before science had discovered the things that it now knows, and they cannot therefore expect such an old book to have things that are scientifically accurate.
- (10) Miss _____ stated hurriedly in passing, that very few questions come up, except in the study of evolution and spontaneous generation. "When we study these subjects we do correlate them with religion." She hurried off before I could inquire how this was done.

HIGH SCHOOL: Seward Park
LOCATION: Essex and Ludlow Streets, New York City
DATE OF VISIT: March 1, 1937
INTERVIEWS:

- (11) Mr. _____ was not very well acquainted with the Biology Department, for he is regularly one of

the chemistry teachers. He has but two classes in General Science. He said that questions from the religious angle seldom come up, and when they do he lets the pupils express themselves and attempts some correlation.

- (12) This teacher does attempt to correlate when a question comes up in class, as it very often does when the subject of evolution is taught. It is necessary, however, to be very careful for the Board of Education sides with the parents against the teacher if anything is said that they might object to. He tells the pupils that raise questions, that the scientists can take life back to one cell, but cannot tell where that one cell came from, and religion answers the problem of origin. He attempts to show them that there is correlation if you get right down to the bottom of the question. He does all he can, however, to avoid such discussions.
- (13) This was a very brief interview with one of the teachers as he was preparing to take over his class. He does try to correlate when questions arise, as they do when the subject of evolution is taught. He tells them that the story in the Bible about creation, is a very sketchy one. It does compare with the geologic ages, and he points out to the pupils how this is so.
- (14) Mr. _____ "steers clear" of any discussion of religion and science and makes no attempt to correlate.

HIGH SCHOOL: Washington Irving
LOCATION: 40 Irving Place, New York City.

DATE OF VISIT: March 2, 1937

INTERVIEWS:

- (15) The teacher stated that she avoids anything that would tend to bring religion into class discussion. She chooses her words carefully that questions will not be raised. Occasionally a Roman Catholic pupil will raise a question. When she introduces the subject of evolution she tells them at the start that it does not mean that man came from monkeys, or that they have to lay aside their Bibles.
- (16) This teacher presents things in such a way as to avoid questions, because of the heterogeneity of

the group. It is the best way to avoid getting into trouble with the parents. Questions seldom are raised, and if so it is generally when evolution is studied. She herself says that there is no reason why science and religion should not "work together". Whenever there is an atheistic tendency apparent in any pupil she likes to talk to her alone and try to point out that science does not deny God. She feels, however, that high school is not the place to settle these problems. They come later, probably during college work.

- (17) This teacher likewise takes pains to avoid any discussion. Sometimes questions do come up. One that she recalled was from a girl who had heard a lecturer say that scientists did not believe in God. The teacher said that that was not true, for some of them surely do. It was like making a general statement that bankers or grocers do not believe in God. If serious questions do come up she tries to point out that science and religion are not in opposition, but does so carefully because of the prejudices from some of the homes.

2. A Summary of the Findings

To briefly summarize the chief results of these interviews it will be well, first, to consider the questions asked at the beginning of this chapter. Is there, from these interviews, any evidence of conflict between science and religion in the mind of the high school pupil? Through these interviews it was discovered that, of the seventeen teachers, fourteen testified to the fact that questions do come from the pupils on this problem of science and religion. Three of the teachers were non-committal. Three divisions of science were given as particularly troublesome to the

pupils. These are eugenics, euthenics, and evolution. Evolution appears to be the most troublesome. One of the teachers¹ presented a problem raised by some unknown lecturer, who claimed that scientists do not believe in God. This teacher handled the question in a way that would suggest correlation. From the fact that questions do come up in public school classes, it might be assumed that there is some degree of conflict present in the mind of the pupil. A later study of their questionnaires will reveal this further.

Another question in which this chapter is interested, is whether or not any attempt is being made , in teaching, to correlate science and religion. When asked, ten of the teachers stated that they made no attempt to do so. Seven claimed that they do. It is interesting to note the reasons given by the ten for not making any correlation. One says that there are many conceptions of God, or a Supreme Being.² Four avoid any discussion, or refuse to discuss any questions that are raised.³ Two would not commit themselves regarding this question.⁴ Two gave the heterogeneity of the beliefs within a class as their reason for not discussing such questions,⁵ and another lets the pupils express themselves and continues

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| 1. Interview (17) | 4. Interviews (6), (14). |
| 2. Interview (1) | 5. Interviews (7), (9). |
| 3. Interviews (2), (5), (15), (16). | |

with the lesson.¹ The seven attempts at correlation are also worth noting.

Some of the teachers correlate with a scientific emphasis and some with a religious. One teacher, as an example of the first group, claims that correlation exists and should be made. She tells the pupils to think as they choose, but to get the subject matter "into their heads."² Another tells the class to look up the definition of evolution in the Roman Catholic Encyclopoedia at the very beginning of the study of that subject. She finishes this method of correlation by telling the pupils to believe what they wish, but to try to think scientifically.³ Two of the teachers turn to the scientists themselves, and tell their classes that many scientists are religious men.⁴ Another teacher offers religion as the solution of the problem of the origin of the first cell.⁵ One real piece of correlation is worked out by one teacher who compares the creation story in the Bible with the geologic ages.⁶ Of the above instances, but two can be called real correlation of science and religion. The others are more in the nature of evasions.

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1. Interview (11)
2. Interview (3)
3. Interview (4)

4. Interviews (17), (8).
5. Interview (12)
6. Interview (13)

C. Questionnaire Study of Teachers
in the Senior Department of the
Sunday Church School

The questionnaire method was used in approaching the teachers in the Senior Department in the Sunday Church School. It has been shown to what extent public school teachers attempt to correlate science and religion. It was the purpose of these questionnaires to find what attempts are being made by Sunday Church School teachers to correlate science and religion in their teaching. These questionnaires revealed whether or not the pupils are raising questions on science in their classes in Sunday Church School. The procedure of the teacher in answering these questions, and his method of making correlation between these two fields in his own life also were touched upon.

1. The Questions Asked

The questions asked on these questionnaires will be considered as to their purpose and relevancy to the problem of correlating science and religion in the experience of the high school age group. The questions asked were:

1. List evidences you have that the pupils in your class are studying science.
2. What questions, if any, do your pupils raise about religion and science?
3. What is your procedure when these questions are raised?

4. In your teaching, do you attempt to correlate science and religion? If so, indicate how.
5. What questions are in your own mind regarding the possible correlation of science and Christian teaching, and what suggestions can you make regarding this correlation?

The first was mainly for the purpose of determining whether or not their pupils were actually, and at the present time, studying science in school. Because this study is based on science as taught in the high school, it is necessary to limit all data to that field.

The second question was not only to learn if questions are being raised, but also to determine the bases of these questions. It was found through interviewing the high school teachers that questions are stimulated in particular fields. It was of interest to learn if this is true from the experience of the church school teacher. An assurance as to whether or not these teachers are aware of the problems their pupils are facing should come out in a comparison of this question with a similar one on the pupil's questionnaire.

The last three questions were intended to reveal how much is being done by way of correlating science and religion, and the procedure followed. If these church school teachers are attempting to correlate, it is pertinent to know how they have made the correlation in their own experience.

Seventeen questionnaires were used to parallel the seventeen personal interviews with high school science teachers.

2. An Analysis of the Questionnaires

The chart below reveals in parallel columns a comparison of answers given by high school teachers and those who teach in the Senior Department of the Sunday Church School. A slightly different array of subjects, giving rise to questions, is apparent under the Sunday Church School. However, evolution still seems to be the leading source of difficulty. Note that one pupil appears to be troubled on the question of science and religion.

In examining the chart further it is noted that there is a somewhat better attempt at correlation in the church school. It would be to the point at this time to investigate the procedure of correlation followed by the church school teachers.

Each respondent showed a different method of correlation. One makes use of the Psalms and of statements of famous scientists. Another points out that man has received power from God the Creator to develop what He has given him. Two others point out the limitations of science, saying that science reaches a place where it must say "I do not know". An exceedingly valuable process is

TABLE NO.1

COMPARISON OF INTERVIEWS WITH
SENIOR HIGH SCHOOL TEACHERS
AND CHURCH SCHOOL TEACHERS

	<u>Senior High School</u>	<u>Sunday Church School</u>
NO. WHO ATTEMPT TO CORRELATE SCIENCE AND RELIGION IN THEIR TEACHING.	7	11
NO. WHO MAKE NO ATTEMPT TO CORRELATE SCIENCE AND RELIGION IN THEIR TEACHING.	10	4
NO. WHO FIND QUESTIONS ON SCIENCE AND RELIGION BEING RAISED BY THEIR PUPILS.	14	7
NO. WHO DO NOT FIND THEIR PUPILS RAISING QUESTIONS ON SCIENCE AND RELIGION.	3	10
AREAS OF STUDY IN WHICH QUESTIONS ARISE.		
Eugenics	2	
Euthenics	1	
Evolution	12	4
Miracles		3
Natural Laws		1
End of World		1
Science and Religion		1

given below, quoted from one of the answers to this question on correlation.

"...suggesting that the scientist's explanations of the development of life through its evolutionary stages are theories - not wholly proved facts - but that I personally believed that fundamentally their conceptions could be used to supplement the Bible and explain to a certain degree the manner of God's workings -in a way which the Bible writers did not understand -and in a way as to add to our understanding and appreciation of the marvelous power and mind of God the Creator and Ruling Force in the world."

Another reply to this question of correlation is that the Bible answers the question "Who" and science answers "How". One teacher lays aside the matter with the statement that "The Bible from whence we receive our religion is not a science book, but at the same time does not create a real problem with true science." A better correlation than this is made by the teacher who says that science deals with the natural and religion with the supernatural. Such are the varied and valuable attempts made by these teachers to correlate science and religion.

The last question on this questionnaire reveals that the teachers themselves have problems, and whether or not they have solved them satisfactorily. One who has reached a satisfactory solution for herself says, "Nature's laws are God's laws and a Christian has faith to believe and know you must correlate science and Christian teaching." Another says, "The more one understands science the

greater the power of God appears." Two questions are raised by one of the teachers that may be pertinent to a later section of this study. They are: (1) "Should the teacher wait until such a correlation is called for by the student?", and, (2) "If not, at what age would you bring in science's relation to religion?" Another, in order to defend her statement that it is not possible for "true science to conflict with true religion", says, "Truth cannot disprove truth."

One teacher feels that the problem is a college problem rather than one that would be found in high school. She also suggests that correlation may be approached through the creation story and through the "miracles of healing." Doubt as to the possibilities of correlation comes from one source. This is as a result of the suggestion that such a correlation would require co-operation between public school and church school, and that such a co-operation would be difficult to obtain. As a final note of interest to this summary it should be mentioned that five of the teachers thus interviewed have no questions on the matter of correlation in their own minds, and have no suggestions to make.

D. Questionnaire Study of Pupils
in the Senior Department of the
Sunday Church School

The questionnaire approach was used in determining whether or not there is a need of correlation of science and religion in the experience of the high school student. Thirty questionnaires, distributed among various high school students through their Sunday Church School teachers, will be analyzed. The questions asked were:

1. What high school are you attending?
2. What courses in science have you taken, or are now taking?
3. How do you try to relate things learned in Sunday School with your studies in science?
4. What questions about the relation of science and religion do you find coming up in your own mind?
5. What do you do about these questions? Why?
6. List what you have heard your school teachers say when a question of religion is brought up in class.

The first question speaks for itself. The second was to determine how far advanced the pupils are in science. The third was asked to learn if they are making any correlation for themselves. The fourth and the fifth were asked to find out what questions are in their minds and what they do about them. The last is, in a sense, a check on the public school interviews.

Several questionnaires were received from the

following New York City high schools:

Katonah	7	questionnaires received	
Wadleigh	5	"	"
Bryant	3	"	"
Yorkville	2	"	"
DeWitt Clinton	2	"	"
Haaren	3	"	"

One questionnaire was received from each of the following New York City high schools:

Hunter College	Lincoln
Julia Richman	New York Industrial
Washington Irving	

And one each from the following out-of-town high schools:

Brooklyn Technical
Jamaica

The table below will compile the results of questions two, three, and four. Looking at this table it will be noted that all but seven of the thirty pupils interviewed have studied or, are studying, General Science. Eleven of them are having or, have had Biology. Not one of the thirty has not studied either General Science, or Biology, or both. Thus all have been exposed to the teaching of natural science. More than half of them make no correlation between science and religion, and over half of them have questions about it.

The types of questions that are bothering them are worthy of note. Seventeen of the twenty-two who have questions are troubled by the problem of evolution versus creation. Six of the twenty-two have a series of inter-

TABLE NO.2

COMPILATION OF RESULTS OF
QUESTIONS 2, 3, 4.

	<u>No. of Pupils</u>
SCIENCE COURSES	
General Science	23
Biology	11
Physics	6
Chemistry	5
Geology	1
<hr/>	
NO. WHO RELATE SCIENCE AND RELIGION FOR THEM- SELVES.	11
<hr/>	
NO. WHO DO NOT RELATE SCIENCE AND RELIGION FOR THEMSELVES.	19
<hr/>	
NO. WHO HAVE QUESTIONS ON SCIENCE AND RELIGION.	22
<hr/>	
NO. WHO HAVE NO QUESTIONS ON SCIENCE AND RELIGION.	8
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esting questions that are quite different. These questions are listed below:

1. "Why do people say the moon is only a reflection when there can be eclipses caused by the sun?"
2. "Where do scientists get their information?"
3. Is it "God's power" that keeps the stars and planets in place?
4. "Where did God come from, and how did He know He was God?"
5. "Why do so many scientists keep on searching for more horrible implements of War? Why can't they do good in the world?"
6. "When and how will the world end?"

Of these questions, the first is for the science teacher, but the others are possible points of correlation for the church school teacher.

The last question on this questionnaire will show further what is being done by way of correlation in the high school. Four of the pupils have heard teachers say that religion has nothing to do with science. Another heard practically the same thing; that school work has nothing to do with God. Four heard teachers say that everyone has a right to believe as he wishes. One teacher pointed out that the different religions have the same answers to the same questions. Only one pupil heard a teacher claim that there was no reason for conflict between science and religion. One teacher uses the Bible

before questions come up. Another tried a scientific explanation of the miracles. One attested to a Supreme Power in control, and another did not believe in God. Six pupils said that their teachers refused to discuss religion in class, and nine pupils had no recollection of any teacher having had anything to say on the subject.

This is a summary of the answers to the questionnaires distributed among pupils in the Senior Department of the Sunday Church School.

E. Summary

This chapter sought first to discover if there is any evidence of conflict between science and religion in the mind of the high school pupil. This question was approached by means of personal interviews with high school science teachers, questionnaire interviews with Sunday Church School teachers of the high school age group, and by questionnaire studies with the pupils in this department of Sunday Church School. Through the same procedure it was determined also, if any attempt is being made to help correlate science and religion, to what extent, and by whom. The table below will bring the results more clearly before the reader. It will be noted that the large percentage of pupils who have questions bear testimony to the fact that there is conflict. Also

TABLE NO.3

TABLE OF COMPARATIVE NEED
AND ATTEMPTS IN CORRELATING
SCIENCE AND RELIGION

	<u>High School Teachers</u>	<u>Church School Teachers</u>	<u>Pupils</u>
PERCENT OF THOSE INTERVIEWED WHO CLAIM THAT QUES- TIONS DO COME UP.	82.4	41.2	73.3
PERCENT OF THOSE INTERVIEWED WHO ATTEMPT CORRELATION.	41.2	64.7	36.6

Also it is evident that these questions come up in public school more than in church school, and that fewer public school teachers attempt to correlate science and religion. This is more startling when, in referring back to the interviews, it is discovered that out of the seven who claim to make correlation, only two can be said to have correlated truly. The others are merely evasions. There is a greater attempt at correlation made by the church school teachers, and yet, the questions come up more frequently in public school. This shows that the conflict is not only a fact, but that there is not sufficient effort being made to meet it. The church schools are willing to

make the effort, but they are not getting the questions. What can be done to help this situation?

The schools claim that they cannot attempt any real correlation. They base this on the existence of heterogeneity of belief within the classes. The church school teachers are not so aware of the problem, for they are not getting many of the questions. The question asked by one church school teacher might well be repeated here. "Should the teacher wait until such a correlation is called for by the student?"

Where does the conflict make itself felt? Quite evidently, from the results, in the study of evolution. Other questions are also a source of difficulty. It is suggested that these questions might be possible points of correlation.

Evidence that the public school is not handling the question of correlation was substantiated further by the pupils themselves in answer to their last question. It is shown by these interviews and questionnaire studies, that there is a need of correlation, and lack of any real effectual attempt to bring science and religion into harmony. The writer hopes to determine certain criteria on the bases of the first three chapters of this study. These criteria will be used in making suggestions for the correlation of science and religion for the high school student.

CHAPTER IV
CRITERIA AND SUGGESTIONS FOR THE CORRELATION
OF SCIENCE AND RELIGION IN THE CHRISTIAN
EDUCATION OF THE SENIOR HIGH
SCHOOL AGE GROUP

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OF SCIENCE AND RELIGION IN THE CHRISTIAN
EDUCATION OF THE SENIOR HIGH
SCHOOL AGE GROUP

A. Introduction

The determination of criteria pertinent to the correlation of science and religion for the high school student was found to be necessary. These criteria or standards were selected with a view to being used by the church school teacher as a basis either for evaluating a course of study correlating science and religion, or in outlining such a course of study.

These criteria were formulated from the data contained in the foregoing study by means of selecting from each part of the study those facts or suggestions which might relate to the correlation of science and religion. Chapter I of the present study reported an analysis of the mental and spiritual characteristics of the high school adolescent. Chapter II presented the results of a survey of the senior high school study of science. The interviews and questionnaires reported in Chapter III provided many of the suggestions for the criteria following.

Each item or suggestion was listed, and from this list criteria were constructed.

The criteria thus determined were organized into two groups. All those that related to method or procedure were placed together in one group. All those that dealt with subject matter or materials were placed together in another group. In each group the criteria were arranged in logical order. Justification of each criterion, with an indication of its significance in relation to the problem of correlating science and religion, was sought.

B. Criteria Relating to the Procedure of Correlating Science and Religion

High school age pupils should be made to feel free to express their questions pertaining to science and religion. It was observed that more questions on science and religion were raised by pupils in high school than in church school.¹ Many church school teachers reported that their pupils raise no questions. The pupils, however, as their response to the questionnaires indicate, do have problems. The tendency seems to be to voice these questions in high school rather than in church school. Many

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1. Vide ante p.52

reasons may be suggested for this. It may be because the pupils feel that they know what answer to expect from the church school teacher; or that they have more confidence in their high school teacher's fund of information. Whatever the cause of this reticence, the church school teacher should discover it and overcome it, that the pupils may feel encouraged to present their questions.

Prejudicial attitudes of the pupils toward science and religion should be discovered. This quite logically follows the preceding criterion. In encouraging an expression of troublesome questions, attitudes and viewpoints will come out. An extreme example of the damaging effect such an attitude can produce is given by Weston and Harlow:

"An attitude of mind destructive of truth is an enemy of true religion. A friend of mine, a teacher of science, was in a college in India. Among his students were some boys from a tribe which held that one was damned if one took into his mouth any living thing. . . . One day my friend showed one of the boys from this clan a drop of water under a very powerful microscope. There, through the glass, he saw the organic life in that drop of water. Closing his eyes and putting his hand over the microscope he cried out, 'The glass lies, the glass lies!' What ought the attitude of the boy to have been?"¹

In a personal interview with one of New York City's high school teachers, reported in the present study,² is a record of her encounter with a pupil who preferred the theory of evolution to the creation story in the Bible.

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1. Weston & Harlow: Social and Religious Problems of Young People, p.175
2. Vide ante p.45

Another pupil, according to a teacher,¹ had the idea that scientists do not believe in God. Another attitude is suggested by a church school pupil on one of the questionnaires, "I believe that science has advanced only as God has wished it to be given to the world." These are but a few of many different attitudes to be found among pupils who are facing both science and religion.

Such attitudes can be a source of difficulty when it comes to making correlation. If they are unknown to the teacher they cannot be controlled. Prejudices must be replaced by sound deduction. Time and place should be given to this in any plan of correlation.

In correlating science and religion emphasis should be placed upon personal experience. In studying the high school adolescents it was learned that, to them, religion is an intensely personal matter.² This suggested the above criterion. If the prejudices of the pupils are detected and properly handled, the pupils are ready to be led to conclusions based upon reasoning. Through a correlation of science and religion it is hoped that their faith will be strengthened. This will be so only as the correlation becomes personal. It must become a part of themselves.

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1. Vide ante p.46

2. Vide ante p.16

The pupils should be stimulated to investigate for themselves while at the same time being helped to discriminate. It is characteristic of the middle adolescent that he will tend to exercise his rapidly developing intellect in scientific and philosophic thinking.¹ This may give rise to a tendency to accept each new idea that comes along, delve into it briefly, and discard it for the next new one. If he is to build up a series of convictions regarding science and religion, based upon personal experience, the teacher should help him to become selective that he will recognize those ideas that will be of value to him in future contact with science.

The church school teacher will wish to present the ideas for investigation and get his pupils to discuss them. As this discussion proceeds he should let the pupils themselves do the evaluating. One church school teacher in briefly outlining her procedure when questions are raised said she "answers the questions frankly by discussion - other pupils giving their opinions. Pointing out how science does prove the wonderful workings of God in His world.." This discussion method is undoubtedly the best to enable the teacher to follow his pupils' thinking and to inject certain ideas that will stimulate to

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1. Vide ante p.12

further investigation, and help in discriminating.

In line with the above procedure, the pupils should be helped to make for themselves the correlation between science and religion. In the questionnaire study of church school pupils it was discovered that 63% of the respondents make no attempt to correlate science and religion for themselves.¹ A typical answer to this question of, How do you relate things learned in Sunday School with your studies in science? was, "I don't see any relation." Or simply, "I don't." Another said, "I can't relate the two things." It is in their individual experience, therefore, that this correlation of science and religion must take place. For it to become personal to them means that they must do it for themselves. It is suggested that the procedure followed by the church school teacher make this correlation a result of the pupil's own investigations and conclusions.

The value of experimentation, evident in the teaching of science, should be realized by religious educators. Science progresses in accordance with the results derived from experiments. Scientific knowledge is transmitted by means of the repetition of these experiments. Pupils are shown an experiment, or given opportunity to do

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1. Vide ante p.58

one, in order to illustrate a scientific truth. For example, one of the classes observed by the writer was studying the process of osmosis.¹ The teacher was conducting the experiment while the pupils kept records. The experiment showed the process of osmosis, as well as demonstrated why digestion must take place. By watching the actual process and noting it step by step in their notebooks, the pupils were able to grasp this knowledge. This is one of the practices in scientific procedure that religious educators should incorporate in their teaching. The use of experimentation in another class clarified the part played by chlorophyll in the process of photosynthesis.²

Toyohiko Kagawa, in a recent book,³ recommends bringing the child into close contact with Nature. Let him learn the spiritual meaning of the parable of the soil, he says, by actually planting seed in the different kinds of soil. His words are:

"If you want to teach the wonder of life and the laws of love hidden in Nature, show tree-grafting and the power of new life through growth from cuttings. You can contrive very educational projects to illustrate these and the law of heredity, in plants."⁴

Although this is suggested for the religious education of

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1. Vide ante, p.36

2. Vide ante, pp.366

3. Cf. Kagawa, Toyohiko: The Sculpture of the Soul, Ch.4

4. Ibid. Ch.4, Concluding paragraph.

children, it would be valuable also in the religious education of the high school adolescent. The high schools are teaching by means of experimentation, and finding it a successful way of illustrating scientific truth.

There are times when experimentation cannot be coupled with instruction. When this is the case evidences and proofs should be included with instruction. Adolescents have reasoning power to a new degree. They no longer accept without raising question.¹ They have a thirst for knowledge, and will refuse to accept anything unproven. Their knowledge must confirm their religion, and vice versa, or there is conflict.² It was from these characteristics of adolescence that this criterion was determined. The high schools are making use of this principle in presenting their subjects, especially in the presentation of scientific facts. With the study of evolution there is included a study of its evidences. Proof of certain scientific facts is furnished either by experimentation or in some concrete form. They are not told only that capillary circulation takes place in the tail of a tadpole but are given a microscope and a tadpole and permitted to see for themselves.

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1. Vide ante, p.10
2. Vide ante, p.18

A little book that is valuable in bringing out evidences and proofs pertinent to the correlation of science and religion is, After Its Kind, by Byron C. Nelson. This book presents the Bible as authority and the natural world as proof that the "invisible things of Him out of the creation of the world are clearly seen, being understood by the things that are made, even His eternal power and Godhead."¹ An illustration of this author's recognition of this criterion is:

"The Bible is not a textbook of science. In the first chapter of Genesis, however, because it is a matter of greatest religious importance, the Bible speaks clearly and finally on a matter of biology. After its kind is the statement of a biological principle that no human observation has ever known to fail. The most ancient human records engraved on stone or painted on the walls of caves bear witness to the fact that horses have ever been horses, dogs have ever been dogs, pigeons have ever been pigeons, elephants have ever been elephants. The most desperate and subtle efforts of man in modern times have been unable to alter this divine decree."²

Another volume that should prove helpful to the religious educator is The Bible Confirmed by Science, by W. Bell Dawson. The author, who is a Gold Medalist in Geology and Natural Science, at McGill University, a member of the Institute of Civil Engineers, London, and a Laureate of the Academy of Sciences, Paris, speaks with authority. Each chapter balances scientific thought with Biblical material. These are a few suggestions as to the

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1. Epistle to the Romans 1:20
2. Nelson, Byron C.: After Its Kind, p.19

possibility of including evidences and proofs in instruction making for the correlation of science and religion.

The facts of religion and science presented must be worthy of faith. The adolescent wants to prove everything. To adopt any theory, fact, or hypothesis demands faith. There is then a large realm of faith, but it must be consistent with knowledge. Otherwise all that is left are guesses, and adolescents do not like guessing. In working out a correlation between science and religion the church school teacher should test the facts to be presented and determine whether or not they are worthy of faith. Rudisill quotes the words of John Fiske as reassuring:

"The lesson of evolution is that through all these weary ages the Human Soul has not been cherishing in Religion a delusive phantom, but in spite of seemingly endless groping and stumbling it has been rising to the recognition of its essential kinship with the ever living God. Of all the implication of the doctrine of evolution with regard to man, I believe the very deepest and strongest to be that which asserts the Everlasting Reality of Religion.¹

Authority should be based upon reason. When middle adolescence is reached there is a distinct change in attitude toward authority. No longer is found the blind unquestioning obedience characteristic of the child.² Nothing is accepted without question. They are developing

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1. Rudisill, Earl S.: The Intimate Problems of Youth, p.182
2. Vide ante, p.10

in reasoning power and demand that reason replace authority. They should be permitted to know the reasoning that has gone into any procedure that they are requested to follow. The teacher in planning his procedure in correlating science and religion should check carefully to see if the demands to be made on the pupil are reasonable.

Training in discrimination should be introduced with new knowledge. Adolescents seek things that are new and thrilling.¹ They are lacking in judgment since they lack adequate knowledge and sufficient experience. The very fact that they are ~~so~~ ready to adopt the new is a warning that they need guidance in discrimination. Many ideas will be suggested to them in the matter of correlating science and religion. From the questionnaire results revealing that 63% saw no relation between science and religion, it can be deduced that such a correlation is in itself a new idea. The way in which high school adolescents adopt every new fad in dress and in language shows an attraction for the new, with a lack of ability to discriminate.~~as~~ The church school leader could avoid this indiscriminate acceptance of the new by giving time and place to evaluation as each new bit of knowledge is introduced. Let the pupils do their own evaluating and through

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1. Vide ante p.12

that process certain standards for discrimination can be set up.

Adolescents should be counseled carefully against arriving at hasty conclusions. This is a tendency of adolescence. It is this that science teachers are constantly encountering. In the class observations made for this study three of the science teachers spoke against this very thing.¹ They wanted their pupils to think scientifically and to arrive at their conclusions by proper scientific deduction. It was evident in these classes that the tendency was for the pupils to observe and then reach a conclusion without any real thinking. Church school teachers should check on this and insist that pupils make use of their reasoning powers.

In reaching their conclusions the pupils should understand the difference between theory and fact. Dr. Dawson says on this point:

"We find these two aspects of fact and theory in all branches of Science, from the investigation of the physical and material onward to the study of living things, and even in the attempt to understand our own mind which thinks everything out."²

The recognition of this distinction is found in but one of the thirty questionnaires returned by high school pupils. This pupil said, "I accept the theories in science as

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1. Vide ante p.38

2. Dawson, W. Bell: The Bible Confirmed by Science, p.10

theories."

Facts and theories exist together in religion as well as in science. One of the theories in the field of religion is that religion originated in fear and superstition which resulted in nature worship developing through the centuries to the present conception of one God the Creator. The pupils meet facts and theories in every field of life. They will need the help of their leader to understand the difference.

A distinction between evidences and proofs should be made. Theories are backed by evidences, and facts by proofs. In presenting evolution to the high school pupil certain evidences are submitted.¹ These are not proofs. Again, in studying photosynthesis, or osmosis, verification was made by means of experiments. Proofs go beyond evidences. Evidences are stepping-stones, but conclusions are based upon proofs.

Pupils should understand that science is a method.

Weston and Harlow speak on this:

"Few people know much of science. They do know the great things which science has accomplished. They can tell you of the great discoveries which scientists have made, of man's growing control over his environment and his increasing ability to make use of the forces around us. The average person believes that the results of science cannot be questioned and that they aid us in making progress. He would sum up his

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1. Vide ante p.26

understanding of science in terms of results. Turn to a scientist and he would give quite a different interpretation of science. He would tell us that science is, first of all, a method, a way of arriving at facts which may be established with some confidence. This method involves long and hard research. It is in this method that the real meaning of science lies."¹

One of the church school teachers in response to the question: In your teaching do you attempt to correlate science and religion? replied, "I attempt to show my pupils that science attempts to answer the question 'How', while the Bible answers 'Who'."

At this point it is seen that the distinction between bias and scientific deduction should be made clear to the pupils. The damaging effect of pupil prejudices has been considered, but the interviews and questionnaires brought to light the difficulties caused by adult prejudices. One teacher interviewed claims to be a sceptic, refusing to discuss religion. He presents scientific evidences saying, "What is true is true."² Evidences are not truth and such an attitude is bound to have a negative influence upon his pupils. It is better to let them see the reasoning behind his convictions and they can then decide for themselves regarding these theories. Other prejudicial attitudes were evident in the answers given by the pupils to

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1. Weston and Harlow: op. cit., p.173
2. Vide ante p.44

the question, List what you have heard your school teachers say when a question of religion is brought up in class. One pupils reports having heard a teacher say that "we must accept the theory unless we have definite proof it is not true." Another teacher was heard to say, "What good is church or religion?" Another pupil heard teachers say that they do not believe in God. Weston and Harlow give an example of the harm such a prejudice can do:

"Only recently a young woman came to me and said, 'I know there isn't any God.' When I inquired into the source of her information, it proved to be the remark of a skeptical teacher in the classroom that morning. On talking with her she admitted that this teacher's field was not religion and that he had no just reason to speak as an authority in that field."¹

If these school teachers are thrusting their own ideas and convictions upon the pupils, the pupils should be able to recognize them as such, and not accept them as fact.

This fault does not lie wholly at the door of the school teacher. It may be found elsewhere. What have the school teachers to say but that their greatest problem in presenting their subject is to deal with the prejudices that pupils have adopted from home or Church instruction. The Roman Catholic pupils seem to be the worst offenders in this. Let the religious educator, therefore, be careful in teaching, that the pupils are made aware of the process

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1. Weston and Harlow: op. cit., p.76

of reasoning. Then, not only will they know the difference between prejudice and reasonable deduction but their own convictions will come as a result of experience rather than being mere prejudices.

It follows that pupils should be helped to discriminate between superstition and religion. In one of the schools visited, in which the classes were predominantly negro, the teachers spoke of meeting with the problem of superstition. Superstitious fears are to be found among the best classes. Fears of all sorts, of evil spirits, of number thirteen, of black cats, and such, are discovered everywhere. In Weston and Harlow we read: "Superstition seems to me a deadly enemy of real religion, and science certainly helped abolish superstition."¹

There should be co-operation of the public high school and the church school in the matter of correlating science and religion. This suggestion came from one of the church school teachers who feels that anything the Church might do can be readily undone by the school. School teachers by their very refusal to discuss religion in class may bias pupils. There are, however, some teachers who are definitely sympathetic and with their help a more positive co-operation could be obtained. In some

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1. Weston and Harlow: op. cit., p.176

high schools Bible Clubs are being formed. This is true in Philadelphia, Pennsylvania. These clubs are for the purpose of Bible study and related activities. Often they call in speakers from outside of the school. In some communities school and Church work together in week-day religious education projects. These are splendid fields for co-operative planning in the correlation of science and religion.

C. Criteria Relating to Subject
Matter and Materials in the
Correlation of Science and
Religion

These criteria following have to do particularly with subject matter and materials related to a plan for correlating science and religion. Each criterion has direct bearing on the content of such a plan, and the suggestions following are for either evaluating or outlining a course of study making this correlation.

Questions concerning science and religion, that are troubling the adolescent, should be given special attention by the church school teacher. Through interviews and questionnaire studies it was found that the recurring question was the relationship between the theory of evolution and the Bible story of creation. Other questions were mentioned also -six of which are listed in Chapter III. These questions may be used as bases for

working out plans of correlation. None of them should be disregarded.

Considering one of the six questions referred to above, "Why do so many scientists keep on searching for more horrible implements of war? Why can't they do good in the world?", it would be valuable to learn what prompted it. This apparently is not a question peculiar to this individual, for in Weston and Harlow is found this example: "...it has added other fears and problems. Poison gas, high explosives, methods of destruction on a scale little dreamed of by our fathers: these too are the results of science."¹ That such an attitude may be used by a leader as a basis for discussion, and possible correlation, is suggested by the same authors:

"Is not the great need of our generation a philosophy of life, a sense of values that will enable us to control our scientific knowledge and power, so that we shall put it to good ends rather than destructive ends?"²

This may be followed by an investigation into the contributions that science has made to human welfare.

There are many books on the problem of science and religion. Some of them would be invaluable in working out correlation. But books placed in the hands of pupils should be carefully selected. Some are written by

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1. Weston and Harlow: op. cit., p.177

2. Ibid., p.181

inferior scientists. Others are written by equally weak religionists. The author should be checked to learn if he speaks with the authority of a student. A book which has not been first read carefully to determine whether or not the author is biased, or whether the subject is given fair treatment, should not be suggested. That the viewpoint of the author does not compromise religious belief should be ascertained. If there is any book that contains valuable points but does not stand true on all points, let it be given to the pupils with this criticism made clear. If the pupils are trained to discriminate they need not be kept from contacts with contrary viewpoints. Books can be helpful or do much harm. They should be selected wisely.

The church school teacher should be acquainted with the branches of science that the pupils are studying in high school. Subjects which youth are studying in science can be used as a basis for correlation. It is not necessary to wait until some controversial subject is met and questions are raised. The wonders of the universe, of the world of Nature, of our own bodies, can be a basis for teaching the "invisible things" of God. Much can be accomplished by using the material at hand.

Life situations and activities should be used in religious education as now used in science teaching.

In high school science instruction is given in as concrete form as possible. The laboratories are equipped with models, charts, living and preserved specimens, and such. Miniature greenhouses, and gardens, and aquariums bring the realm of nature into the classroom. Experiments are carried on and organisms are examined under microscopes. This activity and use of life situations need not be limited to the schoolroom but could be used to advantage by the church school.

It should be understood that both science and religion are related to problems of personal and social welfare. The church school teacher should make it clear that science as well as religion is interested in problems of human welfare. The science textbook used by five of the six schools observed claims as its emphasis these "problems relating to human welfare."¹ A glance over the content of the book verifies this statement. The welfare of the individual is considered in chapters pertaining to hygiene and nutrition. The whole social order is considered in the chapters on heredity, eugenics, and micro-organisms. Science reaches out to benefit man's physical being, and religion is interested in his spiritual well-being. Dr. Sajous² quotes Professor C.A.Elwood, of the University of

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1. Wheat and Fitzpatrick: Advanced Biology, p. v
2. Sajous, C.E.dEM.: Strength of Religion as Shown by Science, p.33

Missouri, in his 1924 opening address before the Yale Divinity School, as saying, "A new hope has come into the world -- that science may unite with religion in the work of redeeming mankind."

It should be understood that both science and religion are concerned primarily with truth. Adolescents are interested in truth. They are seeking the explanation of what seems to them to be unexplainable.¹ "The aim of science is to ascertain truth", say Wheat and Fitzpatrick.² Science is seeking truth and religion is presenting it. The closer science draws to religion the closer it approaches truth.

It should be understood that conflict between science and religion has long existed. Rudisill says on this point:

"The introduction of the doctrine of evolution in the last century produced a great stir in religious as well as theological circles. To many it seemed the destruction of religion and the elimination of any God. To many likewise in centuries gone by the Copernican view of the universe, the rotundity of the earth, the revised opinion as to the age of our planet, the dissection of the human body and the taking of interest have been causes of serious offence. These older matters have long since come to be regarded as in harmony with religion."³

It was held contrary to Scripture to believe that the earth was round; and then Magellan sailed around the world. New-

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1. Vide ante, p.18
2. Wheat and Fitzpatrick: op. cit., p.6
3. Rudisill: op. cit., p.181

ton's discovery of the law of gravity was considered by the church to be heretical. Science has won out in all these conflicts. Another more recent challenge has come from science in the "recent unveiling of the extent and majesty of the universe."¹ As man thus shrinks into insignificance God grows greater.

Science has made rapid progress. It is necessary that the latest scientific views should be made use of as^{well as} those of long standing. Some of these changes taking place in science are really revolutions in thinking, such as:

"The old strict law of cause and effect has, in the minds of most modern scientists, yielded place to what is called the 'principle of uncertainty' or the 'principle of indeterminacy'."²

Books that could be read in this connection are: The New Background of Science, by Sir James Jeans, 1933, and New Pathways in Science, by A.S.Eddington, 1935. Several very striking statements come from Nathan Smyth regarding modern science. He says, "Twentieth century science has overridden the barrier between the seen and the unseen."³ And again he says, "To recognize with science that beyond our horizon lies impenetrable mystery will serve but to increase our reverence for the glory of the whole."⁴

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1. Weston and Harlow: op. cit., p.30
2. Smyth, Nathan: Through Science to God, p.13
3. Ibid., p.1
4. Ibid., p.5

The church school teacher must keep abreast of what is taking place in science and make use of it in discussion.

In this same connection, opinions and convictions should be modified in the light of present knowledge.

Keeping up with new knowledge means more than just knowing about it; it means allowing the new to modify the old. An example of holding to theories that have been disproved through scientific progress, is given by Sajous in referring to the Scopes trial:

"Another conclusion would have suggested itself to Mr. Bryan and his followers, if a survey of the whole field involved had inspired their attitude towards science in its relations to religion. This is that the views of Darwin and the interpretation of evolution of the second half of the last century including the so-called 'monkey theory' of man's origin, do not represent the true position of science today."¹

Holding on to discarded theories is also a fault to be found with the teaching in the high schools. In the textbook used by five of the six schools observed for this study is the following statement:

"There is practically no disagreement among scientists concerning evidences that organic evolution has taken place. But, there is still much disagreement in determining which of the theories thus far formulated most nearly fits the facts. The deVries theory of mutation is the one that is generally accepted by many scientists."²

The following statement comes from Nelson:

"This theory, while it aroused great hopes among evolutionists for a few years, soon went the way of its fellows, when it was learned that the 'new' species

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1. Sajous: op.cit., p.8
2. Vide ante, p.25

of plants which DeVries thought he had seen produced in his garden were discovered to be but one of the many varieties of forms which the Oenothera is privileged by the Creator to have. . . The abandonment of the speculation of DeVries as to the how of evolution is expressed by Prof. Jeffrey of Harvard University in the following words, 'The mutation theory of DeVries may now be relegated to the limbo of discarded hypotheses.'"¹

Use should be made of scientists who are outstanding both in their work and in religious faith. One of the church school teachers in response to the question on her procedure of correlation said, "I use experience and statements of famous scientists who do harmonize religion and science." One of the high school teachers said that she points out that many of the scientists are "deeply religious".²

Many outstanding scientists of the past were very religious men, and many today are conspicuous for their faith. Professor Millikan is one who had turned from religion, only to return to it. Of him Rudisill speaks, "Of the harmony between science and religion Professor Millikan has borne strong witness: 'There is actually no conflict whatever between science and religion when each is correctly understood.'"³ Rudisill continues:

"He cites as deeply religious Newton, Faraday, Maxwell, Kelvin, Raleigh, and Pasteur, and brings his list up to date by naming the following outstanding scientists

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1. Nelson: op. cit., p.116
2. Vide ante, p.45
3. Rudisill; op. cit., p.181

in America of our day: Walcott, Osborn, Conklin, Merriam, Pupin, Coulter, A.A. and A.W. Noyes, J.R. Angell, Brested, Chamberlain, and Abbott. Of Kelvin it is written: 'His faith was always of a very simple and childlike nature...' . . . Of Pasteur we have this testimony from his biographer: 'Let it be remembered that Pasteur was a deeply religious man' On the other hand we find that the most able religious leaders have been sympathetic to the spirit of science."¹

Since adolescents are interested in people and emulate those they admire, and in this sense are hero-worshippers, nothing can be more challenging in bringing science and religion into harmony than to let them study the lives of some of these famous men mentioned.

Kagawa says in an address given several years ago in China:

"I was told that last year in London there were scientific lectures by such professors as Jeans, Eddington, Thomson, Whitehead and Huxley--even Huxley now is inclining to religion--and these English scientists are religious as compared to those of the nineteenth century. We must find such professors, who will teach religion through science. Unless we find that kind of good professors, religious education in a big institution is a failure."²

In working out a correlation between science and religion for the high school age group there are several points that should be checked. The attitude of public high school teachers on religious questions should be determined. Some of the teachers interviewed were found

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1. Rudisill: op. cit., p.181
2. Kagawa: from carbon copy of address sent to writer by Dr. Kagawa's secretary.

to be in sympathy with the idea of correlation, while others were not. A sympathetic teacher may mean a point of co-operation, and one who is not, a source of difficulty.

Also, the degree of correlation made in public high schools and in church schools should be ascertained. In visiting the six high schools for this study the writer found that very little is being done by the schools to bring religion and science into harmony. Then, when the church school teachers were questioned, it was found that very little, if anything, was being done there. To know just how much, or how little correlation is being made for the pupils will give a definite starting point for a plan of correlation.

None of the above criteria will be effective apart from this, that the principle of correlation should be understood by church school leaders. That it is not understood by high school teachers might be suspected from their reports of how they correlate. The difficulty here is perhaps due to their limitation of time, for according to their answers they hint at correlation but do not really reach it. The opportunities for helpful correlation come to the church school teacher. Yet despite this one church school teacher replied: "Keep the two fields clearly in mind. Don't let either invade the other, but let the two be studied together for correlation." This sounds like trying to correlate parallel

lines. For true correlation there must be points of relationship brought out.

D. Summary

This chapter has presented thirty criteria with a view that they will be useful to the church school leader who is planning to introduce a course of study for the high school adolescent for the purpose of bringing science and religion into closer harmony.

These criteria, determined on the basis of suggestions from the preceding chapters of this study, were followed by recommendations as to their use, made by the writer after careful study into possible situations revealed in the research behind the preceding chapters, and on the reading of sources concerned with this problem of correlation.

The criteria are organized into two groups. The first group, those having to do primarily with method or procedure, attempt to reach the pupil's attitude toward science and religion. Their reticence with reference to raising this question, their prejudices, guidance in discrimination, misunderstandings of evidences, proofs, facts, theories, conclusions, science, scientific thinking, religion, and such, all involve procedure in helping these pupils to correlate science with religion. The second

group, those having to do primarily with subject matter, or materials involved, attempt to check the content of a plan of correlation. The church school teacher should have the questions of the pupils; certain books; a knowledge of the branches of science being studied; a knowledge of the use of life situations and experimentation. He should know science and religion, as they relate to human welfare, and to truth, and to each other in the past; the latest changes in scientific thought; outstanding men of science and religion; present day attitudes on this study; and the degree of correlation already being attempted. He should be sure also that he himself knows the meaning of correlation.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The problem of this study was to learn if any correlation is being made between the high school study in science and the Christian education of this age group; where it is being made, to what extent, and the procedure followed.

Before attacking this problem it was found necessary to make a study of the mental and spiritual characteristics of this group. It was found that there is rapid development and increase in judgment, reasoning, comprehension, speed of performance, memory, concentration, perception, intuition, spontaneity, questioning, and impulsiveness. These changes with their accompanying needs represent a period when the greatest progress is made in the intellectual development of the individual.

Spiritually the adolescent is changing as radically. It was found that they need a personal and vital religion. It is a period when adjustments and decisions are important. The adolescents are meeting intellectual and spiritual challenges at every hand, in the contact with scientific progress and in the religious and social changes of their day. They have more freedom of thought and action than has had any past generation. Adolescence, as a period

in individual development, is better understood than ever before. Knowing the adolescent, and the challenges that he must meet in this modern age but increases the responsibility of his leader as he guides him to best live the Christian life.

It was not possible to approach the problem of the present study without knowing what courses in science youth are studying in high school. Observations were made in six New York City high schools with a view to seeing classes of science in progress, and interviewing the teachers. A well-rounded course in biology was found presented in high school. The textbooks used are of recent writing. They cover the field of biology with the emphasis on the contribution of science to the problems of human welfare. The theory of evolution is still taught as the most likely explanation of origins. Certain portions of the book most generally used were noted as a possible basis for conflict between science and religion. The assumptions of the textbook on certain points approach a rather dogmatic attitude, and are not really up-to-date scientifically. This is true, for example, of the statement that DeVries' theory of mutation is still generally accepted by scientists as the most fitting explanation of evolution.

The classes themselves had much to offer by way of suggestion for procedure in bringing science and religion more closely together. There was the use of experimentation

and first hand study of specimens under the microscope. There were models, specimens, charts, and such, that made concrete teaching possible. A stress on scientific thinking was evident. Unfortunately it was not the time in the school term for the study of branches of science that might give rise to questions on religion in relation to science. A copy of one of the syllabi included in this study shows that at a specified time the classes will be studying reproduction, racial change, eugenics, euthenics, and such subjects which more readily give rise to questions. Such pictures of pre-historic life as were found in one classroom could not but suggest to some serious problem questions.

This study of the courses, books and materials, and observation of classes in science, led to an investigation of the degree of correlation being attempted by high school or church school teachers, and an investigation of the need felt for this correlation, by teachers and pupils. By interviewing the high school teachers it was found that very little correlation is being attempted by them. The teachers either do not see the possibility or are not interested in anything beyond getting their subject matter "into their pupils heads", as some actually said. Questions raised in the minds of the pupils are either avoided or evaded, with very few exceptions.

If the high schools are planting the seed of conflict, and are evading the issue, what are the church schools doing to meet this problem? Questionnaire studies of church school teachers brought the startling fact that on the whole the problem was unrecognized. Teachers excused themselves on the ground that they are not getting any such questions. Of the few who were getting them it seemed the general tendency to withdraw into dogmatism, and attempt to discredit science.

In view of these attitudes among both groups of teachers, it was found necessary to turn to the pupils themselves and learn if there were any real need for correlation. Perhaps the pupils did not have questions. But, this seemed unlikely and proved to be untrue, for, of the thirty respondents to the pupil questionnaires only eight indicated that they had no questions on the problem of religion and science. Nineteen of the twenty-two who had questions claimed that they either did not or, could not, make any correlation between science and religion for themselves.

The high school teachers in general felt, that due to the limitations of time, the heterogeneity of their class groups, and the advice of the board against getting into religious discussions in class, ~~that~~ they had real grounds for not attempting correlation of science and

religion. The excuses of the church school teachers were either that they were not getting such questions, or a fear of suggesting conflict if they should take the initiative. One teacher asked if the subject of correlation should be brought up if the pupils themselves did not introduce it. In face of the evidence that the problem exists, ^hwhether or not the pupils express themselves, *it is* indicated that the church school teacher take the initiative in meeting it.

In view of this certain criteria were suggested in Chapter IV, based upon the study of this whole problem. These, if followed by the church school teacher, will help him in determining whether or not he has a workable plan of correlation. With these criteria and the suggestions included with each, and a knowledge of the needs of his particular group, a plan could be introduced that would put the high school adolescent in an excellent position to find harmony between science and religion in his life.

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