

SCIENTIFIC ATTITUDES IN SCIENCE TEACHING
IN LEBANON

By

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SCIENTIFIC ATTITUDES

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PREFACE

This is a study of the relationship between scientific attitudes and science teaching in Lebanon. The studied group includes a sample of high school students in the final grade in some secondary schools of Lebanon offering programs of science in English, and a sample of college students following different majors in the various schools and departments of the American University of Beirut.

The testing was carried out by means of a test of scientific attitudes - actually a battery of tests which were compiled especially for this study.

The plan of the thesis is to give an analysis of what scientific attitudes are and what effect science teaching may have in the development of such attitudes. The relationship between science teaching and the consequent development of scientific attitudes as investigated by others is presented.

Descriptions of the construction of the test and the refining stages through which the test passed are also included. A statement of results follows, with the implications this study has to offer regarding the teaching of science in this part of the world.

The writer should like here to pay tribute to Professor Arthur G. Hoff of the University of Redlands, California, U.S.A. The inspiration of Dr. Hoff's work and his correspondence have been of valuable help not

only in the construction of the test for scientific attitudes, to which he contributed a great deal, but also in the development of the study as a whole.

Thanks are also due to my advisor, Professor Frederick R. Korf, whose guidance has accompanied the thesis for almost two years, and whose help in the statistical parts was invaluable.

The writer wishes also to thank Professors William A. West, Emile Dumit, Richard Glade, Pergrouhi Najarian and Howard Leavitt, all of the American University of Beirut, for the suggestions they made concerning the identification and measurement of scientific attitudes.

To my wife, Shirine Khatib, I am indebted for valuable suggestions and assistance in various aspects throughout the preparation of this study.

Thanks are also due to the three hundred or more students who took the test or the pretest, to the many teachers who helped in administering the test, and to the directors of departments or schools who cooperated by permitting the administration of the test in their classes.

ABSTRACT

Without exception, statements on the aims of science teaching include "the development of scientific attitudes" or its equivalent. This study attempts to examine the relationship between science teaching and scientific attitudes in a selected sample of high school and college students in Lebanon who have been following science courses in English.

This investigation proposes to determine whether those students who have taken more science courses possess scientific attitudes to a greater degree than those who have taken fewer science courses. A test for the measurement of scientific attitudes was prepared with the help of available materials and suggestions from authorities in the fields of science, psychology and education. The test was pretested on a sample of ninety-three subjects. Item analysis techniques were utilized to make the test as reliable as possible. The reorganized test contained fifty items covering various aspects of scientific attitudes. Its corrected split-half reliability before revision, which involved the discarding of poorly discriminating items, was found to be greater than $+ .55$; and its validity is attested to by the judgments of experts.

The improved test was administered to a sample of two groups - a high school group of one hundred and twenty three subjects and a college group of eighty nine subjects.

For the college group, there was a significant positive correlation

between the amount of exposure to science courses and the possession of scientific attitudes as measured by the test of scientific attitudes used in this research.

For the high school group, no significant relationship was found to exist between the amount of science teaching the subjects had been exposed to and the degree to which they possessed scientific attitudes.

If it is granted that:

(1) The sample groups are both reasonably large and reasonably representative of high school and college youth in Lebanon, and

(2) The test used has met reasonable reliability and validity criteria, and

(3) Science teaching is likely to be one of the most potent forces in the development of scientific attitudes, it may be tentatively concluded that:

(A) Science study has been instrumental in the development of scientific attitudes at the college level, and

(B) The teaching of science to which the high school group has been exposed has not been effective in developing scientific attitudes to an appreciable extent.

Subsidiary questions to which the data were able to provide answers or suggestions of answers were also examined. It was found that:

(1) There was, in the high school group, a significant positive

correlation between the test score for scientific attitudes and the estimated qualifications of teachers under whom exposure to science had taken place. This association was not significant in the college group.

(2) There was no significant association found between expressed feelings about science and the measured scientific attitudes in either group of the sample.

(3) In the high school group the correlation between the felt influence of science study on attitudes and the measured scientific attitudes was positive and significant. This association was less certain for the college group.

(4) There was no apparent correlation between the expressed influence of science study on attitudes and the amount of exposure to science courses.

(5) There was no significant correlation between the expressed feelings about science and the amount of exposure to science courses.

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CHAPTER I

INTRODUCTION

Why a scientific attitude?

The rise of science is one of the most outstanding features of the modern world, and has led to the most far-reaching changes in human affairs. The kaleidoscopic nature of the environment in which we live is predominantly colored by science and will become more so in the years to come. Almost every aspect of life has been both enriched and complicated by the achievements of science. The need to make numerous appropriate adaptations has never before been of such pressing urgency. To make those adaptations successfully, nothing less than the spirit of science - the mature, sober, impartial, cautious and searching attitude of science - should be the mark of a successful citizen.

What is a scientific 'attitude'?

E.L. Thorndike, G. Allport and G. Hartmann agree that an attitude is a mental-motor set of an individual which is the chief determiner not only of what and how he thinks and does, but also what he will welcome or reject.¹ Attitudes help determine not only what the individual sees but how he sees it.² One's predispositions towards objects, persons,

¹Cole, Lawrence, E. and Bruce, William F., Educational Psychology, p. 668.

²Blair, Glenn M. et al., Educational Psychology, p. 193.

events, judgments and actions are to a great degree conditioned by his attitudes.

Attitudes are acquired through experiences which have a pronounced effect on one's feelings, mental or psychological. They may develop as a result of imitation, of teaching or of special environmental orientation early in life.

A scientific attitude of mind is especially characterized by a mood that is well sketched in Francis Bacon's words:

For my self I found that I was fitted for nothing so well as for the study of Truth; as having a mind nimble and versatile enough to catch the resemblance of things (which is the chief point) and at the same time steady enough to fix and distinguish their subtler differences; as being gifted by nature with desire to seek, patience to doubt, fondness to meditate, slowness to assert, readiness to reconsider, carefulness to dispose and set in order; and as being a man that neither affects what is new nor admires what is old, and that hates every kind of imposture. So I thought my nature had a kind of familiarity and relationship with Truth.³

Such an attitude puts in the hands of the possessor a new method - "a method so inclusive in range and so penetrating, so pervasive and so universal"⁴ that it is "applicable to the solution of many of life's problems".⁵

Science teaching and scientific attitudes

Science educators have for long both felt and claimed that scientific attitudes are and should be an outcome of science teaching. G.R. Twiss

³Thompson, Arthur J., Introduction to Science, p. 7.

⁴Dewey, John, Reconstruction in Philosophy, p. 22.

⁵Wells, Harrington, Secondary Science Education, p. 57.

argues that although only a few high school graduates may eventually become scientists by profession, scientific training is necessary for all students as it enables them to approach with the scientific attitude of mind those problems with which the experiences of their present and future lives must inevitably confront them.⁶ In another place the same author expresses the opinion that the development of scientific attitudes is among the results that should accrue to high school pupils, as the outcome of pursuing scientific studies.⁷

A.G. Hoff believes that the study of science can develop values that are transferable into the regular walks of life - namely scientific attitudes and the scientific method of attacking problems.⁸

E.D. Heiss also is of the opinion that scientific attitudes are among the most important outcomes which should result from science teaching.⁹ He enumerates many lists of objectives of science teaching as proposed by W. Croxton, G. Blough, R. Watkins and W. Perry, O. Caldwell, and F. Curtis; the objective of developing scientific attitudes occurs in every list.¹⁰ The same author quotes a bulletin prepared for the Bureau of Education of the Federal Security Agency¹¹ and a report of the Science Committee of the Colorado State Course of Study for Secondary Schools;¹² both of which consider the development of scientific attitudes as one of the main

⁶ Twiss, George R., Principles of Science Teaching, p. 19.

⁷ Ibid., p. 83.

⁸ Hoff, Arthur G., Science Teaching, p. 20.

⁹ Heiss, Elwood D., et al, Modern Science Teaching, p. 46.

¹⁰ Ibid., pp. 26-29.

¹¹ Ibid., p. 27.

¹² Ibid., p. 30.

aims of science teaching.

Authors of specific textbooks on the various branches of science are not less zealous about this issue. In a widely used physics source book, the authors recommend that the physics course should be the practice laboratory in which the attitudes of the scientific method are not merely recognized and recited, but are reinforced by use.¹³ A chemistry text argues that although only a few of the students may become chemists, the course, being also a study in the scientific method, cannot fail to be valuable in other walks of life.¹⁴ A zoology text, after giving "learning in the scientific method" as a second objective of the course, goes on to defend this learning as effectively assisting the student throughout his entire life, no matter in what field his labors fall.¹⁵ W. Beauchamp, J. Mayfield and J. West list the development of a scientific attitude of mind as one of the main objectives of courses in general science.¹⁶

Other works related to the psychology of thinking do not ignore the role of science training in developing better thinking. In a recent treatise, David Russell presents the claim that the teaching of science offers many opportunities for the development of critical thinking.¹⁷ When he defines critical thinking he includes the words "scientific attitude of mind."

¹³Bureau of Secondary Education - New York, Physics Handbook, p. 7.

¹⁴Partington, J.R., Everyday Chemistry, p. 10.

¹⁵Hegner, Robert W., College Zoology, p. 16.

¹⁶Heiss, op.cit., p. 28.

¹⁷Russell, David H., Children's Thinking, p. 300.

This wealth of "opinion" evidence associating the development of scientific attitudes with science teaching strongly suggests not only that science teaching can be instrumental in developing scientific attitudes, but that these attitudes are subsequently transferred to other life activities.

The present investigation attempts to explore the suggested relationship, seeking an answer from a sample which, though limited, represents to a reasonable degree the existing situation in Lebanon.

The main problem of the investigation becomes the finding of an answer to the following question:

Is there, in the studied groups, a relationship between the amount of science studied and the development of scientific attitudes?

On the answer to this question will depend several subsidiary questions which may be wholly or partly answered by means of the evidence gathered in this study, namely:

- A. If, in one or in both groups, no relationship between the amount of science studied and the development of scientific attitudes is found, what is likely to account for its absence?
- B. Are there other factors with which the amount of science studied is correlated?
- C. Are there other factors with which the measure of scientific attitudes is related?
- D. What are the implications of the findings in A, B and C above?

A REVIEW OF THE LITERATURE

Many attempts have been made to measure to what extent scientific attitudes ensue from science teaching; there is some conflict concerning the results observed. Sample studies with conflicting results will be given here.

In a study by G.M. Blair and M.R. Goodson measuring the contribution of the study of general science to the development of scientific attitudes, positive gains were found regarding the rejection of superstitions and unsupported statements.¹⁸

W.B. Reiner reported success in developing ability to recognize cause and effect relationship through teaching ninth grade general science classes.¹⁹

M.D. Solomon and G.E. Braunschneider worked with high school biology students and reported success in getting the students to apply the scientific method to problems of prejudice.²⁰

H.M. Hamlin studied the effects of a training in agriculture on the farming habits of students after they left school. There was not only transfer effect on the studied group, but the learned attitudes were also passed on to their neighbors.²¹

Ruth Scharff studied the effects of a course in health education

¹⁸Russell, op.cit., p. 356.

¹⁹Ibid.

²⁰Korf, F.R., Some Changes in Students... in Science Education, p. 8.

²¹Gray, Stanely J., Psychology Applied to Human Affairs, p. 118.

on the selection of food in a school cafeteria. Her results indicated that children selected food more intelligently after the health course than before.²²

J.W. Wrightstone in a study of relationships between natural science beliefs and attitudes found that natural science knowledge influenced positively the capacity to distinguish between proved generalizations and unfounded beliefs.²³

Studies by F.D. Curtis and C.U. Vicklund indicated that science teaching modified the attitudes of young people in a positive way.²⁴

On the other hand there have been many similar studies with contrasting results:

A study by E.B. More, attempting to correlate the amount of information possessed in several fields of science with the ability to pass accurate judgments on scientific problems of everyday life, came out with no significant correlation.²⁵

A.G. Hoff studied the extent to which scientific attitudes were achieved by high school seniors to see if those who had more science courses showed more scientific attitudes. He came out with no positive results.²⁶

Ira C. Davis studied the scientific attitudes of pupils and teachers

²²Ibid.

²³Hoff, Arthur G., Science Teaching, p. 28.

²⁴Heiss, Elwood, et al., Modern Science Teaching, p. 129.

²⁵Skinner, Charles, ed., Educational Psychology, p. 536.

²⁶Heff, op.cit., p. 21.

in Wisconsin, and found enough evidence to conclude that, where the students had the attitude, the science classroom could not have been the agent.²⁷

M.L. Alpern found no significant correlation between the ability of students to test hypotheses and the number of science courses they had taken.²⁸

G. Wessell, in a study to measure the effect of ninth grade general science on the development of scientific attitudes, found that direct teaching failed to produce important changes in pupils' attitudes.²⁹

Elliot R. Downing attempted to find out whether pupils acquired skill in scientific thinking as a by-product of science study. She found that students who had not had science courses secured similar and sometimes higher averages on a test of scientific thinking.³⁰

The present study does not claim to add weight to either side of the dispute, though an attempt is made in the conclusion to suggest a solution for the existing conflict. The purpose of this investigation is to study the relationship between science teaching and scientific attitudes, in a sample - though limited - of students from schools in Lebanon, to see how much such students are being helped, through their study of science, to develop scientific attitudes. Because all available

²⁷Ibid., p. 23.

²⁸Russell, David H., Children's Thinking, p. 276.

²⁹Heiss, op.cit., p. 129.

³⁰Hoff, op.cit., p. 24.

literature on this issue has originated abroad, a study of it in this part of the world cannot be without its contributions. Moreover, if this work manages to inspire relevant research or to challenge a similar study affirming or negating the present findings, its contribution will have been so much the greater.

CHAPTER II

THE TEST OF SCIENTIFIC ATTITUDES

The evidence for the measurability of attitudes

"Any thing that exists can be measured";³¹ but it is one thing to measure, say, the physical dimensions of an object and another to measure a person's scientific attitudes. An attitude is not a tangible something to measure, especially when the measurement is by means of paper and pencil tests; but this should not mean that attitudes are not measurable - the evidence suggests that at least their outcomes are measurable.

If real attitude differences can be determined, then, as Allport suggests, differences in behavioral outcomes are necessary concomitants.³² The commonest type of attitude study is made by analyzing the verbally expressed opinions of the examined group.³³ Verbal expression of opinions can be obtained through answering concrete questions, matching paired comparisons or using the cross-out response method.³⁴ It is widely accepted, as R. Stagner reports, that such opinion scales for measuring attitudes

³¹Elair, G.M. et al., Educational Psychology, p. 423.

³²Korf, F.R., Some Changes in Students... in Science Education, p. 10.

³³Kuhlen, R.G., The Psychology of Adolescent Development, p. 400.

³⁴Stagner, Ross, "Attitudes" - Encyclopedia of Educational Research, p. 72.

have considerable validity in practice.³⁵ G. Stouffer, for example, showed that a person's attitude as scored by an attitude scale was clearly similar to his attitude as revealed in a case history which was read and rated by competent judges.³⁶

Marburg observed that the validity of measurement of attitudes is greatly enhanced if the test is set up, in so far as possible, to present to the subjects real life problem situations.³⁷ This was constantly borne in mind in compiling items for the test of scientific attitudes used in this research.

Characteristics of a scientific attitude of mind

A measure of scientific attitudes should of necessity test for those functions, elements, aspects or behavioral outcomes of scientific attitudes on which broad agreement exists among educators and research workers.

E. Heiss includes the following elements in his list of scientific attitudes:

Freedom from bias, prejudice and superstitions

Open-mindedness

Critical mindedness

Intellectual honesty

³⁵Ibid., p. 74.

³⁶Stagner, op.cit., p. 74.

³⁷Korf, op.cit., p. 10.

Belief in cause and effect

Objectivity

Willingness to change beliefs when new evidence is found.³⁸

Victor H. Noll's attempt to measure scientific attitudes included items to test for:

Accuracy

Intellectual honesty

Open-mindedness

Suspended judgment

Criticalness - including self criticism.³⁹

Francis D. Curtis, with the help of fifty-eight high school and college teachers, prepared an outline of five areas covering the major elements of scientific attitudes. The major subdivisions of his outline are:

Conviction of universal basic cause and effect relations

Sensitive curiosity concerning reasons for happenings

Habits of delayed response

Habits of weighing evidence

Respect for another's point of view.⁴⁰

³⁸Heiss, Elwood D., Modern Science Teaching, p. 49.

³⁹Hoff, A.G., Science Teaching, p. 23.

⁴⁰Ibid., p. 20.

To give the test a local basis, several professors from the departments of Education, Psychology, Biology and Chemistry at the American University of Beirut were interviewed to discover their concepts concerning the elements of scientific attitudes. The final outline of the elements suggested includes the following items which were used as a guide in constructing the test:

An inquiring attitude

Intelligent seeing of cause and effect relationship

Ability to make sound reasoning and logical judgments

Judging on basis of factual knowledge possessed (hence a certain acquaintance with scientific facts is a prerequisite)

Ability to analyse and solve problems

Rejection of superstitions, old and modern

Faith in experimentation

Accuracy in observation, measurement and reporting

Ability to distinguish fact from theory.

The general agreement apparent in the various lists leaves little doubt as to what a test of scientific attitudes should attempt to test for.

The test under construction

The provision of items to match the various elements of scientific attitudes would have been a tedious job had it not been for the help received from authors, teachers, books, classes and many other sources. Worthy of mention is the generosity of Dr. Arthur G. Hoff of the University of Redlands, California, U.S.A., who availed the writer of a copy of his

unpublished test for scientific attitudes and some information regarding its use. Other contributions to the test will be acknowledged at appropriate points below.

When the pilot test was ready for pretesting, its front page gathered data on the amount of science teaching each subject had been exposed to. It also asked for opinions concerning the subject's feelings about his teachers of science and the study of science in general.

Part I of the test was made up of thirty items adapted for Lebanon from Dr. Hoff's test for scientific attitudes. A brief discussion of Dr. Hoff's work is appropriate here.

Dr. Hoff constructed two hundred items planned to reveal as many as possible of the major elements of scientific attitudes as outlined by Francis D. Curtis. These items were submitted to fifteen expert judges (who were either active in education or who served as science teachers and professors of education and psychology) for evaluation of their adequacy for measuring scientific attitudes. The items were further validated by means of trial performance on a group of about one hundred twenty high school and college students. Items which demonstrated a satisfactory distribution of responses and which were rated average or better by the judges were retained. In general the items are described situations to which the examinee is to choose one of four responses: 'true', 'false', 'insufficient data' or 'do not know'.⁴¹

⁴¹The complete test used in this study is reproduced in the appendix, and contains a number of items of this type adapted for Lebanon from Dr. Hoff's test.

Part II of the test was planned to measure certain specific aspects of scientific attitudes, thus complementing the first part of the test which is of a more comprehensive nature. When readied for pretesting, this part was made up of four sections.

Section A contained ten items, testing the subject's knowledge and understanding of the scientific principles involved in some everyday occurrences. Piaget's work 'The Child's Conception of Physical Causality' suggested at least six of the included concepts. These concepts were presented in the form of questions or statements to which the subject responded by checking one out of five listed alternatives. The alternatives were designed to include only one "best" response as the explanation of the concept in question.

Section B was constructed to explore the subject's ability to distinguish the difference between true and false cause and effect relationships in certain paired occurrences. The paired occurrences were stated and the subject was asked to indicate the true cause and effect relationship as well as the unfounded ones. The test items of this section were patterned on (and five of them actually came from) 'Cause and Effect Relationships Test in Science' prepared by the Science Committee of the Wisconsin Education Association.⁴² The other items in this section were formulated so as to present "might be" cause and effect relationships existing in the local culture. That is, the items expressed cause and

⁴²Heiss, Elwood D., Modern Science Teaching, p. 212.

effect relationships which, in the mind of the subject, might be the true ones.

Section C was an attempt to appraise the subject's ability to distinguish between statements of fact and theory. For each statement, the subject was asked to indicate whether it is:

- A. well established
- B. an accepted theory.
- C. a questioned theory
- D. definitely unacceptable

The items of this section were patterned on (and six of them actually came from) 'Fact-Theory Test in Science' prepared by the Science Committee of the Wisconsin Education Association.⁴³

Section D contained items on accuracy, perception and sound logical deduction. All items in Section D were constructed especially for this test.

The limited time in which this test could be administered allowed of no expansion in the number of items. The maximum time the schools normally allow for such purposes is not more than a class period of about fifty minutes. Even this was sometimes hard to secure. When readied for pretesting, the test included sixty four items - a number which proved to be over the optimum number for a fifty-minute test.

The pilot test

To match up the test with acceptable standards of psycho-educational

⁴³Ibid., p. 213.

measurements, a pilot test was deemed necessary. With the future sample in mind, the test was pretested on ninety-three subjects, forty-eight college students at various schools in the American University of Beirut, and forty-five high school students from various secondary schools in Lebanon offering science programs in English.

No attempt was made at timing individual subjects; but the students were told that beyond the assigned period, there would be no time extension. Nor was the aim of the test disclosed to the subjects lest they attempt to locate 'expected' responses. The subjects were told, however, that their 'natural' and cooperative efforts were essential to the success of the research.

Each paper was given a separate score for the odd and for the even items; the student's test score being the sum of both scores. To ascertain the reliability of the test each student's score on the odd items was paired with his score on the even items and the Pearson Product Moment Coefficient of Correlation between the halves was found to be $+ .38$. This figure is significantly different from zero at better than the .0001 level of significance,⁴⁴ and justifies the application of the Spearman-Brown correction. The Spearman-Brown correction formula was applied to this correlation, and the coefficient of reliability for the whole test was found to be $+ .55$.⁴⁵

⁴⁴In other words a correlation of this size would occur by chance sampling (in a population where the real correlation is zero) only once in ten thousand similar measurements.

⁴⁵Statistical information supplied by the advisor; and details from McNemar, Quinn, Psychological Statistics, p. 132.

Analysis of test items

To improve the reliability of the test, item analysis was employed. The twenty-seven percent scoring highest on the test as a whole were contrasted with the twenty-seven percent scoring lowest on it. To examine the correlation of each item with the test as a whole, the proportion of successes on it in the upper scoring group was compared with the proportion of successes on it in the lower scoring group. A discrimination coefficient is then obtained. This technique, worked out by John C. Flanagan, identifies items which fail to discriminate the high-scorers from the low-scorers.⁴⁶

For each item a difficulty coefficient was also determined. This is the ratio between the number of subjects getting the item correct and the number who attempted it.

Items that showed a negative discrimination were dropped. In fact, only items that had a discrimination coefficient of +0.12 or more were retained, and then only those resulting in a distribution of difficulty coefficients averaging near .50 were kept. This technique gives the test the greatest probability of making a large number of discriminations between individuals.⁴⁷

Fourteen items did not match up with the criteria used, and were thereupon dropped from the test. The item analysis was also of value in

⁴⁶Statistical information supplied by the advisor, and detailed from Walker, Helen and Lev, Joseph, Statistical Inference, pp. 472-475.

⁴⁷Statistical information supplied by Dr. Korf, the advisor.

setting up an acceptable scoring key for some of the items where a difficulty arose in determining the proper scoring to use.

The revised test

More reliable than the pretest value of $+ .55$,⁴⁸ the revised test contains fifty items. The previous divisions of the test were retained. The front page of the test was revised after the experience gained in the pilot test. Separate spaces were provided for reporting exposure to science courses at the college and high school levels. The check-list for the opinion inquiry replaced the 'grade in five-categories' system for ease of administration.

⁴⁸The revised test showed a split-half reliability of $+ .57$, or a net gain $+ .02$ in reliability. The gain through item selection was partly offset by the inevitable loss through curtailment.

CHAPTER III

ADMINISTRATION AND RESULTS OF TEST

The nature of the sample and the testing procedures

The tested sample comprised, like the pretest sample, two groups - a high school group of one hundred twenty three⁴⁹ subjects in the final grade in various secondary schools in Lebanon, and a college group of eighty nine subjects in the various schools and departments of the American University of Beirut. Whenever the investigator did not administer the test personally, he had earlier agreed with the administering teacher on the necessary proceedings. The test was untimed, but it was understood, that not more than one class period would be allowed. The aim of the test was not disclosed lest the subject be biased in favor of 'scientific' responses. This is the reason for the name "questionnaire" on the test. It was presented as a piece of research; the reaction of the subjects was both enthusiastic and cooperative.

Although the front page of the test makes reference to sex and age of subject, no attempt has been made to differentiate the tested sample

⁴⁹ Numbers here refer to accepted papers: Papers which were incomplete or showed obvious misunderstanding of the instructions were omitted.

as to age and sex; the only grouping used was that of level of study - secondary or college.

The relationship between test score and exposure score

Each paper was given a test score and a score indicating the respondent's total exposure to science courses. The test score indicated how many items had been checked correctly by the subject, and was, therefore, considered indicative of the extent of his scientific attitudes. The exposure score indicated the total number of hours of scheduled science study the subject had had in general science, physics, chemistry and biology.

For each group the two variables, test score and exposure score, were compared to discover any relationship between these two sets of measures. For this purpose the Pearson Product-Moment coefficient of correlation was computed. The results were as follows:

1. The coefficient of correlation between the test score and the hour exposure score in the high school group was +0.04, a correlation not significantly different from zero.
2. The coefficient of correlation between the test score and the exposure score in the college group was +0.24, a correlation significant at the .02 level.⁵⁰

⁵⁰This means that chance could have accounted for such results only twice in one hundred such samples, and the finding is therefore strong evidence for association.

The evidence from the present study therefore reveals that:

1. There is a significant positive correlation between the amount of science study and the test score for scientific attitudes in the college group.
2. In the high school group no significant relationship was found between the amount of exposure to science courses and the possession of scientific attitudes as measured by the instrument used.

Analysis of the opinion responses

The opinion responses, expressed on the front page of the test, were compared with both the test score and the exposure score. Both groups of the sample were studied separately, but were combined to give a wider picture whenever this seemed appropriate. The chi square technique⁵¹ was applied here to relate each opinion response with (a) the test score and (b) the exposure score.

There were four of these opinion responses; the results for each were as shown below:

1. (a) Expressed opinion on the qualification of one's teachers of science as related to the test score.

The frequencies of responses on this item for both groups were distributed as shown in Table I.

⁵¹McNemar Quinn, Psychological Statistics, pp. 186-194.

TABLE I

DISTRIBUTION OF FREQUENCIES OF RESPONSES CONCERNING
 THE QUALIFICATION OF TEACHERS AS ESTIMATED BY THOSE
 FALLING ABOVE AND BELOW THE TEST MEDIAN

My science teachers were:	High School Group		College Group	
	Upper half	Lower half	Upper half	Lower half
highly qualified or well qualified	59	51	38	35
slightly qualified, poorly qualified, or unqualified	3	10	6	5

This distribution was checked for its deviation from chance expectancy by the chi square technique.

For the high school group, a chi square of 6.11 was obtained. This is significant at the .07 level.⁵²

For the college group, a chi square of 1.48 was obtained. This is not significant.⁵³

The apparent association in the high school group between the expressed quality of teachers and the test score for scientific attitudes is of importance. It suggests that the high school boys who scored lower on the scientific attitudes test are likely to be those who believe they had less qualified science teachers. Assuming that both the schools and the colleges have their share of superior teachers, the apparent absence of this association for the college group may indicate that, at the high school level, superior teaching is more necessary for the development of scientific attitudes than it is at the college level. Further reference to this issue will be made later in the study.

(b) Expressed opinion on the qualification of one's teachers of science in relation to the exposure score.

There appears to be no logical basis for investigating the relationship between total amount of exposure to science courses and opinions on

⁵²That is, chance could not account for the observed disproportions more than seven times in one hundred such cases.

⁵³That is, the observed disproportion here may easily be accounted for by chance.

teachers' qualification, and this relationship was, therefore, not studied.

2. (a) Expressed opinion on one's 'feelings about science' in relation to the test score

The frequencies of responses on this item for the two groups were distributed as shown in Table II.

TABLE II

DISTRIBUTION OF FREQUENCIES OF RESPONSES CONCERNING FEELINGS ABOUT SCIENCE EXPRESSED BY THOSE FALLING ABOVE AND BELOW THE TEST MEDIAN

Expressed feelings about science:	High School Group		College Group		Combined Groups	
	Upper half	Lower half	Upper half	Lower half	Upper half	Lower half
I am very interested in science	39	37	25	20	64	57
I am somewhat interested in science	14	13	11	9	25	22
I am not keen about it	8	10	8	13	16	23
I dislike it or I dislike it very much	0	0	0	2	0	2

This distribution was checked for its deviation from chance expectancy by the chi square technique.

For the high school group, a chi square of 2.3 was obtained. This is not significant.

For the college group, a chi square of 1.44 was obtained. This is not significant.

For the combined groups, a chi square of 3.84 was obtained. This is not significant.

The data indicate that interest in science is not necessarily associated with the possession of scientific attitudes as measured in this study.

(b) Expressed opinion on one's feelings about science in relation to the exposure score

The frequencies of responses on this item for the two groups were distributed as shown in Table III.

TABLE III

DISTRIBUTION OF FREQUENCIES OF RESPONSES
 CONCERNING FEELINGS ABOUT SCIENCE EXPRESSED BY
 THOSE FALLING ABOVE AND BELOW THE EXPOSURE MEDIAN

Expressed feeling about science:	High School Group		College Group		Combined Groups	
	Upper half	Lower half	Upper half	Lower half	Upper half	Lower half
I am very in- terested in science	38	36	25	18	63	54
I am somewhat in- terested in science	13	12	7	11	11	20
I am not keen about it	8	11	6	9	14	20
I dislike it or I dislike it very much	1	1	0	0	1	1

This distribution was checked for its deviation from chance expectancy by the chi square technique.

For the high school group, a chi square of 2.56 was obtained. This is not significant.

For the college group, a chi square of 2.62 was obtained. This is significant at the .11 level only.⁵⁴

For the combined sample, a chi square of 3.96 was obtained. This is not significant.

The evidence seems to indicate that, in general the subjects' feelings about science are not related to the amount of exposure they had to science courses. The possible association reflected in the college group should not be misinterpreted. It may be due to the fact that students with more interest in science chose more exposure to it, under the elective system available at that level.

One more point is worth mentioning in regard to the expressed interest in science. The fact that this study was carried on at the time of highly publicized and popularized scientific achievements -- Sputniks and Explorers -- is to some extent responsible for the extensive interest in science that is presently in vogue. The results obtained in response to this item may have been influenced by this turn of current events.

3. (a) The expressed amount of spare time reading about science as

⁵⁴This means that chance could have accounted for such results as much as eleven times in one hundred such cases, and the result is therefore not very strong evidence for association.

related to the test score

The frequencies of responses on this item for the two groups were distributed as in Table IV.

TABLE IV
DISTRIBUTION OF FREQUENCIES OF RESPONSES ON
THE AMOUNT OF SPARE TIME READING ABOUT SCIENCE EX-
PRESSED BY THOSE FALLING ABOVE AND BELOW THE TEST
MEDIAN

In my spare time:	High School Group		College Group		Combined Groups	
	* Upper half	Lower half	Upper half	Lower half	Upper half	Lower half
I read a tremen- dous amount about science	2	3	1	2	3	5
I read much about science	16	11	15	9	31	20
I read little about science	27	36	25	25	52	61
I don't read science stuff	8	4	2	3	10	7
I hardly read any- thing in my spare time	8	7	1	2	9	9

This distribution was checked for its deviation from chance expectancy by the chi square technique.

For the high school group, a chi square of 3.80 was obtained. This is not significant.

For the college group, a chi square of 2.36 was obtained. This is not significant.

The data indicate that there is no significant association between the amount of spare time reading about science and the possession of scientific attitudes as measured in this investigation.

- (b) The expressed amount of spare time reading about science as related to the exposure score

The frequencies of responses on this relationship for the two groups were distributed as in Table V.

TABLE V

DISTRIBUTION OF FREQUENCIES OF RESPONSES ON
THE AMOUNT OF SPARE TIME READING ABOUT SCIENCE
EXPRESSED BY THOSE FALLING ABOVE AND BELOW THE
EXPOSURE MEDIAN

In my spare time:	High School Group		College Group		Combined Groups	
	Upper half	Lower half	Upper half	Lower half	Upper half	Lower half
I read a tremen- dous amount about science	1	4	2	0	3	4
I read much about science	11	14	15	7	26	21
I read little about science	36	27	18	26	24	53
I don't read science stuff	5	7	1	3	6	10
I hardly read anything in my spare time	7	8	2	2	9	10

This distribution was checked for its deviation from chance expectancy by the chi square technique.

For the high school group a chi square of 3.82 was obtained. This is not significant.

For the college group a chi square of 10.33 was obtained. This is significant at the .04 level.

For the combined sample a chi square of 1.73 was obtained. This is not significant.

The association between the amount of spare time reading about science and the amount of exposure to science courses at the college level is not surprising. Those students with the higher exposure scores are the students majoring in the various fields of science, and their spare time readings about science are quite likely to be expanding in direct proportion with the amount of science to which they have been exposed. The absence of the association at the high school level may be due to the fact that the total exposure to science and science related motivations is not as great among the high school students; not to mention that at this stage one's spare time reading interests are rarely academic.

4. (a) The expressed effect of science study on attitudes and behavior as related to the test score.

The frequencies of responses on this relationship for the two groups were distributed as in Table VI.

TABLE VI

DISTRIBUTION OF FREQUENCIES OF RESPONSES
 CONCERNING THE EFFECTIVENESS OF SCIENCE STUDY ON
 ATTITUDES AND BEHAVIOR EXPRESSED BY THOSE FALLING
 ABOVE AND BELOW THE TEST

MEDIAN

My study of science has affected my behavior and at- titudes:	High School Group		College Group		Combined Groups	
	Upper half	Lower half	Upper half	Lower half	Upper half	Lower half
Completely	4	1	1	1	5	2
In many aspects	25	23	26	17	51	40
In few aspects	29	25	13	18	42	43
Hardly at all	0	6	3	2	3	8
Definitely not at all	3	5	0	3	3	8

This distribution was checked for its deviation from chance expectancy by the chi square technique.

For the high school group, a chi square of 8.77 was obtained. This is significant at the .07 level.

For the college group, a chi square of 5.88 was obtained. This is not significant.

For the combined sample, a chi square of 7.61 was obtained. This is significant at the .13 level only.

The bias in the direction of an association between the expressed effect of science study on one's attitudes and the extent of his scientific attitudes, as measured by the test score, is worthy of notice. Those who scored highest on the scientific attitudes test are in general those who expressed the greatest effect of science study on their attitudes. This evidence may be considered as helping to demonstrate, at least subjectively, the validity of the instrument of measurement used in this study.

(b) The expressed effect of science study on attitudes and behavior as related to the exposure score

The frequencies of responses on this relationship for the two groups were distributed as in Table VII.

TABLE VII

DISTRIBUTION OF FREQUENCIES OF RESPONSES
 CONCERNING THE EFFECTIVENESS OF SCIENCE STUDY ON
 ATTITUDES AND BEHAVIOR EXPRESSED BY THOSE FALLING
 ABOVE AND BELOW THE EXPOSURE MEDIAN

My study of science has affected my behavior and attitudes	High School Group		College Group		Combined Groups	
	Upper half	Lower half	Upper half	Lower half	Upper half	Lower half
Completely	4	1	= 2	0	6	1
In many aspects	20	26	20	20	40	46
In few aspects	29	26	14	14	43	40
Hardly at all	2	4	1	3	3	7
Definitely not at all	5	3	1	1	6	4

This distribution was checked for its deviation from chance expectancy by the chi square technique.

For the high school group, a chi square of 3.92 was obtained. This is not significant.

For the college group, a chi square of 3.00 was obtained. This is not significant.

For the combined sample, a chi square of 6.1 was obtained. This is not significant.

Thus no association was demonstrated between the expressed effectiveness of science study on attitudes and the amount of exposure to science study. The responses to the preceding comparison suggest that perhaps this effectiveness is proportional to the quality rather than to the quantity of the exposure to science.

A summary of results

A. The relation between the measured extent of scientific attitudes and the total exposure to science courses

1. There was in the college group a significant positive correlation between the amount of exposure to science courses and the measurement of scientific attitudes.
2. In the high school group, no significant correlation was found between the amount of exposure to science courses and the measurement of scientific attitudes.

B. The relation between the measured extent of scientific attitudes

and the opinion responses

1. There was, in the high school group, a significant positive correlation between the test score for scientific attitudes and the estimated qualifications of teachers under whom exposure to science had taken place. In the college group this correlation was not significant.
2. In the sample studied there was no association found between expressed feelings about science and the measured scientific attitudes.
3. There was no significant correlation found between the amount of spare time reading about science and the measurement of scientific attitudes.
4. In the high school group, the correlation between the felt influence of science study on attitudes and the test score for scientific attitudes was positive and significant. The existence of this association was less certain for the college group.

C. The relation between the amount of exposure to science courses and the opinion responses

1. No significant correlation was found between the expressed feelings about science and the amount of exposure to science courses.
2. The amount of spare time reading about science showed an association with the amount of exposure to science courses

only at the college level.

3. There was no apparent correlation between the expressed influence of science study on attitudes and the amount of exposure to science courses.

CHAPTER IV

CONCLUSIONS AND IMPLICATIONS OF THE STUDY

The answer to the issue raised in this study seems to contribute evidence to either side of the conflict concerning the development of scientific attitudes through science teaching.

In the college group a significant positive correlation was found between the amount of exposure to science courses and the test score for scientific attitudes. This evidence tends to substantiate the hypothesis that science teaching is instrumental in the development of scientific attitudes.

On the other hand the evidence from the high school group tends to reject the same hypothesis. For this group there was no apparent association between the amount of exposure to science courses and the test score for scientific attitudes.

Similar studies of this issue have come out with positive or negative answers concerning the development of scientific attitudes through science teaching, and have tended merely to endorse or reject the usefulness of formal science study in the development of scientific attitudes.

The present study is somewhat different. It contributes evidence to either side of the issue and must therefore attempt a compromise - a synthesis that may be nearer to the truth than either of the conflicting extremes.

In proper context, the whole issue is one of transfer of training, a question that has long been settled decidedly in favor of the possibility of transfer. Reference to the voluminous works of P.T. Orata⁵⁵ and Peter Sandiford⁵⁶ on hundreds of investigations of the transfer problem, indicates that experimental evidence is entirely in favor of the transfer theory.

Reference has already been made to the strong claims for the instrumentality of science study in developing values that are transferable to other walks of life, namely scientific attitudes and the scientific method of attacking problematic, daily-life situations. The evidence from the college group of the sample studied in the present investigation shows an association between the amount of exposure to science courses and the test score for scientific attitudes, and thus endorses these claims.

The failure to find an association between the amount of exposure to science courses and the possession of scientific attitudes in the high school group suggests that these claims are however, conditional. The study of science per se is not necessarily conducive to the development of scientific attitudes; there is enough evidence in the negative outcome studies, referred to earlier, to warrant such a conclusion.

In fact, if science study is isolated from experience and learnt as a "science" instead of the scientific way of treating the familiar

⁵⁵Garret, Henry, E., Great Experiments in Psychology, p. 97.

⁵⁶Sandiford, Peter, "Transfer of Training" Encyclopedia of Educational Research, pp. 1309-1312.

material of everyday experience, the inevitable outcome, then, as Dewey sees it, is "the learning of symbols without the key to their meaning. The pupil may acquire a technical body of information without ability to trace its connections with the objects and operations with which he is familiar - often he acquires simply a peculiar vocabulary."⁵⁷

The claims for an inherent superior transfer value attributable to any of the 'rigorous' subjects, including science, have never been substantiated by experimental evidence. The works of E.L. Thorndike⁵⁸ and A.G. Wesman⁵⁹ leave little place for such claims. Science as rote memorization of facts is unlikely to result in the acquisition of scientific attitudes, no matter how technical and peculiar its vocabulary and phraseology may be. But science that emphasizes typical life situations and life problems both in content and approach, and which is stressed as "first and foremost an attitude",⁶⁰ "an effective application of the scientific method",⁶¹ and "a useful agency through which young people may be helped to solve their problems"⁶² - this science is capable of achieving those outcomes which educators claim for it, foremost among them being the development of scientific attitudes.

⁵⁷Dewey, John, Democracy and Education, p. 257.

⁵⁸Gates, A.I. et al, Educational Psychology, p. 513.

⁵⁹Woodworth, Robert and Schlosberg, Harold, Experimental Psychology, p. 830.

⁶⁰Stephenson, J.P., Suggestions for Science Teachers, p. 7.

⁶¹Wells, Harrington, Secondary Science Education, p. 34.

⁶²Heiss, Elwood D., et al, Modern Science Teaching, p. 29.

By virtue of its universal method and the relevancy of its content to almost all aspects of everyday life, science lends itself, probably more successfully than other subjects, to the development of a methodology that will be of great value to the possessor in analysing, judging and acting upon future life situations.

The devices and instruments normally associated with science courses put valuable aids in the hands of the science teacher and learner, and these can stimulate a carry-over of the materials and methods of science to the solution of a great number of the problems that arise in everyday life.

The strong interest in science expressed by students everywhere, and for which there is evidence in the present study, can and should be utilized to contribute favorably to the appreciation and acceptance of the techniques and methods of science. Educational psychologists agree that subjects in which the pupil is interested offer the greatest opportunities for transfer.⁶³

If, therefore, evidence should arise, as is the case in the high school group of the present investigation, that those who have studied more science do not possess scientific attitudes to a greater degree than those who have received less of such training, the reason most probably lies in the quality of experiences constituting the science exposure. That is, we should look to the teacher and the science teaching situation

⁶³ Pintner, Rudolf, et al, Educational Psychology, p. 100.

for clues to the mystery of the expected but nonexistent development of scientific attitudes.

Arthur G. Hoff, after reviewing some studies in which science teaching failed to develop scientific attitudes, expressed a similar view and blamed 'inefficient teaching' for the negative outcomes.⁶⁴

It was pointed out by one reviewer of the literature that in instances where attitudes were influenced by courses of study, special materials, techniques or influences had been introduced to accomplish these ends.⁶⁵ Especially at the high school level the material learnt in the sciences cannot become part of the usable mental equipment of the learners unless assimilated with their own concrete and experiential knowledge. This process of assimilation requires aids and teaching techniques that can only be offered through superior teaching. Such techniques and aids seem to be lacking in the present science teaching situation in our secondary schools in Lebanon.

The positive correlation found between the measured scientific attitudes and the higher estimated qualifications of the teachers under whom the exposure to science took place is an indirect endorsement of what has been implied above. As if reflecting the greater need of younger pupils for qualified teachers, this correlation was significant and positive in the high school group and did not approach significance for the

⁶⁴Hoff, Arthur G., Science Teaching, p. 28.

⁶⁵Kuhlen, Raymond G., The Psychology of Adolescent Development, p. 492.

college sample. This finding suggests the greater need for superior teaching at lower levels, and may be interpreted as evidence against the present familiar practice in many of our schools of assigning teachers of low qualifications to the lower grades.

Three hypotheses may be offered to account for the absence of association between the estimated qualification of science teachers and the development of scientific attitudes at the college level:

(a) At the college level the students with their large stock of meanings, their rich experience and their mature apperception can 'see' for themselves the interrelations of the methods and content of science to life situations and life problems to such a degree that transfer of content and methods of science is not necessarily as much a function of teacher qualification as it is in the younger group.

(b) At the college level the students represent a selection - an intellectual elite, who because of the 'tincture of iron in them' to use W.C. Bagley's phrase, may be capable of wider transfer possibilities.⁶⁶

(c) The college group may actually have been enjoying the privilege of superior teaching, but because of their increased aspiration levels they may have tended to underrate the qualifications of their teachers and thus to hide whatever association may exist between superior teaching and the development of scientific attitudes.

A further finding of the present study showing a significant

⁶⁶Sandiford, Peter, 'Transfer of Training' Encyclopedia of Educational Research, p. 1312.

correlation between the felt influence of science study on attitudes and the possession of scientific attitudes implies that the teaching which produces a felt change in attitudes is in fact the best producer of scientific attitudes. Such an implication fits in well with W.C. Bagley's Ideals of Procedure Theory which suggests that to insure transfer, the attitude in question must be raised to the plane of an ideal and given an emotional tone.⁶⁷

This evidence associating both an effective science teaching situation and superior teaching with the development of scientific attitudes gives a valuable hint as to the direction of reform required in our secondary science teaching system - a system which apparently is failing to develop what is widely considered as a major objective of science teaching.

It is small consolation to find a positive association between science study and scientific attitudes at the college level. A very small proportion of the population have the material and intellectual resources to enter colleges. If scientific attitudes should be the mark of a successful citizen in this age of science, then the responsibility for re-shaping our present science teaching enterprise into an efficient system at all levels cannot be over-emphasized. Possibly no greater responsibility rests upon our science teachers and educational leaders than that of making science perform for the average student - the future citizen - what it has performed on the material level, which, in the words of Dewey is

⁶⁷Pintner, Rudolf, et al, Educational Psychology, p. 98.

"the emancipation from local and temporary incidents of experience and the opening of intellectual new vistas unobscured by the accidents of personal habit and predeliction".⁶⁸

The present investigation does not claim to have diagnosed the present science teaching situation in Lebanon and prescribed the remedy for it; that would require time and effort far beyond the limitations of a study of this kind.

Subjective indictment of the present secondary science teaching situation has not been lacking. A fellow teacher spoke for many when he wrote in a recent issue of Al'ulum - a monthly scientific review - an article entitled "The Deformation and Petrification of Students' Minds in our Schools", in which he blamed existing conditions not only on the teachers but also on the whole educational system.⁶⁹

The objective evidence presented in this investigation should not be taken as merely endorsing the existing subjective criticisms of the present secondary science teaching situation. It is hoped, rather, that this study may help to raise the whole issue to the level of experimentation, whereby the weaknesses and the possible improvements may be studied in a spirit of scientific endeavor.

It is with hope and encouragement, therefore, that we look to fellow graduates in science and education - our potential educational leaders - for further studies in this valuable and rewarding field.

⁶⁸Dewey, John, Democracy and Education, p. 269.

⁶⁹Kamaleddin, Jalil, Al'ulum, Vol., 3, No. 4 (April 1958) pp. 33-36.

APPENDIX

QUESTIONNAIRE

Name:

Age:

Class

Now remembering accurately please state how much study in the following you have had starting from your 8th Grade.

A. Secondary Study

	Years	Hrs/week	Any lab?	Hrs/week
Physics				
Chemistry				
Biology				
General Science				

B. University Study

	Years	Hrs/week	Any lab?	Hrs/week
Physics				
Chemistry				
Biology				

In the following items please check the one that best agrees with your opinion:

1. My teachers of science were:

- a. highly qualified.
- b. well qualified.
- c. slightly qualified.
- d. poorly qualified.
- e. unqualified.

2. As to how I feel about science:

- a. I am very interested in science and would like to study more of it.
- b. I am somewhat interested but I have had enough of it.
- c. I am not keen about it - in fact I prefer to think of and study other subject.
- d. I dislike science.
- e. I dislike science very much.

3. In my spare time:

- a. I read a tremendous amount about science.
- b. I read much about science.
- c. I read little about science.
- d. I don't read science stuff.
- e. I hardly read anything in my spare time.

4. My study of science has affected my behavior and attitudes:

- a. completely.
- b. in many aspects.
- c. in few aspects.
- d. hardly at all.
- e. definitely not at all.

Part I

Please read every question carefully and answer all questions.

Place a circle around the symbol representing the answer you think is right.

The symbols represent the following answers:

T: True

F: False

ID: Insufficient data to answer the question intelligently

DK: I do not know

- T - F - ID - DK 1: Company A of the Lebanese army is composed of men averaging 178 cms in height; company B of the Egyptian army is composed of men 170 cms in height. From this data it may be concluded that Lebanese are on the average taller than Egyptians.
- T - F - ID - DK 2: Samira had a pain in her right side. The doctor diagnosed the trouble and performed the necessary operation and she got well. Salwa, a friend of Samira, has developed a pain also in her right side. She should have an operation performed similar to Samira's.
- T - F - ID - DK 3: Jamil weighs eight kilograms more than George. Jamil is in better health than George.

- T - F - ID - DK 4: In studying the marks of 10,000 boys and girls in the Lebanese certificate exams, the average mark for the girls was considerably more than for the boys. This shows the girls are capable of acquiring better marks than boys in the elementary school.
- T - F - ID - DK 5: An evil man robbed a holy place. Almost a week later he was found dead. His death must have been a compensation for his wrong doing.
- T - F - ID - DK 6: Salim and Ramzi each bought a stove. Salim bought four tons of coal and Ramzi bought six tons of coal for their stoves. Ramzi must have a better stove than Salim.
- T - F - ID - DK 7: Mary complains of a pain in her abdomen. Her mother is right in saying that she will grow out of it because she herself used to have the same type of pain at this age.
- T - F - ID - DK 8: It will cost less money to attend college B than college C, therefore it is advisable for Henry to attend college B.
- T - F - ID - DK 9: Mr. Smith was a participant in an automobile accident. A bottle of whisky - almost empty - was found in the

car. Mr. Smith can be convicted for driving his car while drunk.

- T - F - ID - DK 10: A study of over 3,000 tubercular patients at Bhinis showed that 90% of them were underweight during childhood. This shows that in order to reduce the mortality from this disease the parents should try to keep the children normal or overweight.
- T - F - ID - DK 11: During the 2nd World War a certain mother was impressed by a terrific "nightmare" during a certain night. A week later she received news that her son had been killed at the exact date and time of her unusual experience. The nightmare was an indication of what befell her son.
- T - F - ID - DK 12: A study of tubercular patients at Bhinis showed that a high percentage of the patients are Saudi Arabians. This shows that the people of Saudi Arabia are more susceptible to the disease than other peoples.
- T - F - ID - DK 13: Apple trees will not thrive in our garden, in spite of the fact that they thrive in the neighbor's garden. It must be due to the climate.
- T - F - ID - DK 14: I have talked to almost all the pupils who took

Chemistry from Mr. A last year. They like him very much. I ought to sign up for chemistry under him because I'll most likely like him also.

- T - F - ID - DK 15: Mr. Khalil has a good reason for spraying his trees with bordeaux mixture because his father has done so for the last twenty years.
- T - F - ID - DK 16: In winter time, if a rainbow appears in the morning, it will be a clear day; but if a rainbow appears in the evening, heavy rains are to be expected that night.
- T - F - ID - DK 17: Mr. Fuleihan lost the key of his book case. He gave his secretary a bunch of about 100 keys which she proceeded immediately to try one key at a time till she found the suitable key. Though it took her a long time she employed the most economical method possible.
- T - F - ID - DK 18: My two uncles, who were quite fat, died before they reached the age of 40. Fat men, I conclude, are less liable to live to a ripe old age.
- T - F - ID - DK 19: A friend of mine told me that Mr. B is a poor teacher of history, so I ought not take history from him.

- T - F - ID - DK 20: Two endurance flyers A & B started on their respective endurance flights at the same time. A landed ten hours before B did. This proves that B had a better motor than A.
- T - F - ID - DK 21: A pole driven 3 feet into the bottom of a pond projects 5 feet above the surface of the water. A second pole projects 6 feet above the water, therefore the second pole is longer than the first pole.
- T - F - ID - DK 22: George Washington, Lincoln, Hitler, Bevin, Churchill, Abdul-Naser and many other great men were raised in the country. This shows that people raised in the country are apt to be more successful than people raised in the city.
- T - F - ID - DK 23: In a study of about four thousand fat men, it was found that 75% of them were considered by their associates as lazy. This shows that most fat men are lazy.

Part II

A. Please check the right answer or what you think is nearest to the right answer.

1. Two wet glass pieces cling together due to:
 - a. gravitation.
 - b. stickiness.
 - c. cohesion.
 - d. cohesion and adhesion.
 - e. pressure

2. We cannot make a hole in water because
 - a. we just can't.
 - b. it is viscous.
 - c. water wets our hands.
 - d. of surface tension.
 - e. fluids flow from high to low pressure.

3. Where does the wind come from?
 - a. the sky.
 - b. the movement of the trees.
 - c. the waves.
 - d. unequal heating of parts of the earth.
 - e. the revolving of the earth.

4. What are clouds?
 - a. smoke mixed with water.
 - b. dust particles carrying water vapor.
 - c. water droplets condensed on dust.
 - d. water droplets and fine salt particles.
 - e. water dissolved in the carbon dioxide of the air.

5. What makes shadows?

- a. light rays.
- b. darkness
- c. both light and darkness.
- d. opacity to light
- e. absorption of light by an object

6. What causes thunder?

- a. clouds striking against each other
- b. air striking against air
- c. the explosion of the clouds
- d. the sound of lightning
- e. electricity

7. Are all salts "salty"?

- a. yes
- b. no
- c. only salts that come from the ground are salty
- d. only salts that come from the sea are salty
- e. yes and no

B. In the following paired sentences, put (True) in the space if the paired sentences are true cause and effect relationships; put (False) if the relationship is otherwise:

1. () An electric current circuit was closed; lights on the circuit lighted.

2. () The branches of a tree wave to and fro; a near by windmill turns.
3. () A woman found a horseshoe; next day she won first prize in the national lottery.
4. () The weather suddenly became colder; moisture collected on the insides of windows.
5. () A tire blew out; the car went into the ditch.
6. () He looked at the moon too much; a few days later the poor boy became cross-eyed.

C. In the following sentences

Put A in the space if the statement is well established.

Put B in the space if the statement is an accepted theory.

Put C in the space if the statement is a questioned theory.

Put D in the space if the statement is definitely unacceptable.

1. _____ The pressure of water varies with the depth.
2. _____ The moon has no atmosphere.
3. _____ Fish is better brain food than meat.
4. _____ Flat, blunt fingers indicate a tendency to steal.
5. _____ Cold air is heavier than warm air.
6. _____ Dry air is heavier than humid air.
7. _____ In a bar magnet each molecule is a magnet.
8. _____ All life comes from pre-existing life.

KEY TO THE QUESTIONNAIRE

Part I

1: F	7: F	13: F	19: F, ID
2: F, ID	8: F	14: T	20: F
3: F, ID	9: F	15: F	21: F, ID
4: T	10: T	16: F	22: F
5: F	11: F	17: F	23: T
6: F	12: F, ID	18: F	

Part II

A. 1: d	3: d	5: d	7: b
2: c	4: c	6: b	
B. 1: True	3: False	5: True	
2: False	4: True	6: False	
C. 1: A	4: D	7: B	
2: B	5: A	8: B	
3: C	6: A	9: B	
D. 1: 1.875	3: 108	5: Yes	
2: No	4: 473		

DISTRIBUTION OF TEST SCORES OF THE SAMPLE STUDIED

Range of Score	High School Group	College Group
37-38	3	0
35-36	2	3
33-34	6	6
31-32	13	9
29-30	15	11
27-28	24	26
25-26	27	11
23-24	12	13
21-22	12	5
19-20	7	1
17-18	1	2
15-16	<u>1</u>	<u>2</u>
	N = 123	N = 89
Mean	26.6	26.8
Median	27.5	27.5
Standard Deviation	4.5	3.92

DISTRIBUTION OF EXPOSURE SCORES OF THE SAMPLES STUDIED

Range of Hour Exposure	High School Group	College Group
2800-3000	0	1
2600-2799	0	1
2400-2599	0	2
2200-2399	0	2
2000-2199	0	3
1800-1999	0	4
1600-1799	0	7
1400-1599	0	11
1200-1399	2	8
1000-1199	5	13
800-999	10	4
600-799	34	10
400-599	57	6
200-399	13	5
0-199	<u>1</u>	<u>12</u>
	N = 122	N = 89
Mean	601.1	1095.8
Median	360.5	1140.5
Standard Deviation	232	680

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