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# Some evidence of the interests of eighth grade children in the materials of science.

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# SOME EVIDENCE OF THE INTERESTS OF EIGHTH GRADE CHILDREN IN THE MATERIALS OF SCIENCE

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C.B.B.

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# FOREWORD

## Foreword

The writer has undertaken this thesis because it seems that one of the first steps in the business of making better science textbooks and better courses of study should be the determination of the interests of children. It is not to be assumed, however, that these interests should be the sole criterion. Assuming for the moment that the science experiences offered children should be built of the things that, in the opinion of adults, they ought to know, it would appear, nevertheless, that a good approach could be made by way of their intense curiosities.

The extensive and painstaking researches in the psychology of learning demonstrate that children learn more readily about the things in which they are interested.[1] Economy in learning would then seem to imply that curricula should, to a considerable extent, center around the things in which the child has a vital interest.

Observing children's joyous play with animals, noting that they seemed to show more curiosity about animate than inanimate things and making a record of their protest against lack of information about pets or wild animals in their General Science textbooks contributed to the formation of an opinion on the part of the writer that the science interests of young children are mostly zoological.

It seems reasonable that they should be interested in living things. Every mother knows that moving things arrest the attention of infants. The outstanding characteristic of an animal is its disposition to move. In simple experiments with children of pre-school age, the writer found that children think things are alive because they move.

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1. Dunlap, J. W. "The Predictive Value of Interest Test Items for Achievement in Various School Subjects" Psychol. Bull., 1934, 31, 629-630 -- Abstract -- J. F. Dashiell (North Carolina).

These findings are similar to those of Jean Piaget as given in his writings of 1926 to 1930.[2] They think the moon is alive because it "sails" across the sky. Automobiles are alive because they run. But a tricycle is not alive because "I make it go".

A Canadian granite boulder lying on a meadow in Kentucky can be assumed to be less interesting to a child than the rabbit that hides behind it. The rabbit runs! The boulder is motionless. As far as the child is concerned the boulder never changes. The rabbit grows from a baby bunny to a full sized one. The stone needs not to be fed or housed. The stone never displays likes or dislikes. Apples are little, green, and sour. They grow big, red and are eaten. If one knew nothing of the interests of children one might still assume that living things, because they are neither fixed nor static, are more interesting to children than are the non-living.

Children still want to know about animals and plants but it seems to the writer that there is a decided drift of interest among the older ones towards astronomy and the earth sciences. The planetaria scattered about the country, publicity given such projects as the preparation and transfer of the 200-inch reflector from New York to California, astronomical and physiographic motion pictures, increased travel for children, may have stimulated interest in Mars and the Grand Canyon. However it has been done, desire to know about the earth and the sky appears to be here.

2. Piaget, J., The Child's Conception of Physical Causality. New York: Harcourt Brace & Co., 1930

--- The Child's Conception of the World New York: Harcourt Brace and Co., 1929

--- The Language and Thought of the Child New York: Harcourt Brace and Co., 1926

# CHAPTER I

# THE PROBLEM AND ITS BACKGROUND

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## THE PROBLEM AND ITS BACKGROUND

The problems on which it is hoped that this thesis will throw some light are (1) are children at the eighth grade level interested in any particular fields of science? (2) are the science interests of eighth grade boys and girls distinct? (3) are the science interests of these children affected by their I.Q.'s? (4) do their science interests show any definite trends? No satisfactory or generally accepted technique has been developed for answering these questions. Various methods were used in the research carried on in this subject between 1921-7.

In 1929 the writer was sponsor for an animal pet club in Highland Junior High School. These pets ranged all the way from a collection of spiders on up the animal scale, through hermit crabs, guppies, horned toads, alligators, and canaries to a pony.[1] The gift to the school of the Huchings-Bush Museum collection and the housing of this science exhibit in the Animal Pet Clubroom stimulated interest in other fields of science. Questions began to pour in not only at club period but at every class.

Books purchased by the club and those furnished by the school library provided an opportunity for the children to read about the things they wanted to know. However, except in the fields of astronomy and physiography, few of the answers to the spontaneous questions of the children were to be found in the textbooks. It would appear either that the writers of the textbooks in general science did not have available to them interest analyses of the children for whom they wrote or that they felt justified in ignoring these interests. This lack or this purposeful

1. The spider collection, including three Black Widows housed in small boxes made of wire from old window screens, were kept on a sitting room table of one of the pupils' homes.

omission seems to a considerable extent to be responsible for expressed dissatisfactions toward general science textbooks found in the current literature.

In W. J. Klopp's study of general science textbooks,[2] there is the statement: "The interests.......of many children are sacrificed because of the too limited a course of study offered in many modern texts: too much stress is laid on the particular material of special interest to the teacher: children in different schools cannot compete on the same basis because of the variable content to which they are exposed".

An analysis of general science textbooks was made by Elliott R. Downing.[3] Twelve books were examined in 1921 and an additional thirteen in 1927. "One cannot help concluding," Mr. Downing writes, "that there is no consensus of opinion as to what should be included in a textbook in General Science and there has been no improvement in the late books over the earlier ones." It was found that the aims of authors consulted indicated that "principles of science were not uppermost in the minds of the authors when the books were written. There is little unanimity among authors," states Mr. Downing, "as to what scientific principles are of the greatest importance at the general science level in the schools."

Hanor Webb made a quantitative analysis of general science textbooks in which it was discovered that, measured both by the number of pages devoted to the subject, and by the topics treated, physics ranked first in the majority of general science textbooks.[4] There was little

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2. Klopp, W. J., "Study of the Offerings of General Science Texts" General Science Quarterly, XL, (May, 1927), pp. 236-246.
3. Downing, Elliott R., "An Analysis of Text Books in General Science" General Science Journal, XII, (May, 1928), pp. 509-516.
4. Webb, Hanor, General Science Instruction in the Grades, Contributions to Education, No. 4, Nashville, Tennessee: Peabody College for Teachers, 1921. Parts II and V.

variation among the rankings given by the various texts to the different subjects. Even physiology which most greatly varied in the importance assigned to it showed a mean deviation in rank of only 1.5 points.

Table I, compiled by Mr. Webb, would be startling if the information it contains were not so familiar and if it did not illustrate the ever-present problem of general science teachers whose pupils are interested in animals.

Table I

Pages and Topics Devoted to Various Subjects in General Science Texts--expressed in percentages of Total Pages and Topics in The Texts.

| Subject | Per cent by pages | Per cent by topics |
|---|---|---|
| Physiography | 80.5 | 47.8 |
| Physics | 80.3 | 54.4 |
| Physiology | 72.6 | 33.3 |
| Astronomy | 70.2 | 40.4 |
| Chemistry | 64.5 | 34.2 |
| Botany | 63.1 | 43.5 |
| Household arts | 56.6 | 15.4 |
| Zoology | 00.0 | 00.0 |

That general science textbooks in general do not represent the science interests of the children is emphasized by C. A. Pollock.[5] He found that only 43 per cent of the 3500 questions asked over a period of time by his students in general science were answered or even touched on by the authors of the general science texts they used.

Even though L. E. Mau's study is not concerned directly with interests in general science at the junior high school level, it is discussed in this thesis because it shows where these interests appear and how they change with age. It seems to the writer also that to review all

5. Pollock, C. A., Children's Interest as a Basis of What to Teach in General Science, Ohio State University Educational Research Bulletin, III, No. 1, (January, 1924), pp. 3-6.

available studies of the science interest of children at whatever age, emphasizes the gaps in this field of research and might result in stimulating further research. Until the science interests of children at all levels of development are determined the maximum amount of assistance cannot be rendered curriculum makers and writers of textbooks.

Miss Mau tried to determine the relative interests of children of kindergarden and primary grades in physical and biological nature material. She wanted to know the different attitudes that boys and girls would take toward phases of nature material in plant life, animal life, and physical nature. The children were shown a pepper plant with red berries, a grey cat, and a toy steam engine. This investigation was combined with another covering the same school and grades. In the second piece of research the materials used were two bar magnets and iron filings, a sensitive plant, and two doves in a cage. The order of interest for the girls was animal life, plant life, and physical nature material: for the boys, animal life, physical nature material, and plant life. As the children grew older, the interest in motor activity lessened and the sensory response grew. The interest in animals was paramount in all ages and in both sexes as determined by their questions and by their answers to the query, "If you could own one of these things, which would you choose?"[6]

The writer's experience a number of years ago while teaching general science in a senior high school is relevant. The course of study and the textbook on which it had been founded were at one time merely a series of unrelated lessons on the chemistry and physics of the "four elements"--earth, air, fire, and water. The few plants studied were not treated as

6. Mau, Laura E., "Some Experiments with Regard to the Relative Interest of Children in Physical and Biological Material in the Kindergarden and Primary Grades," Nature Study Review, VII, (November, 1912), pp. 285-291.

living, breathing organisms with life histories. They were merely frames on which to mount the technical chemistry lessons. Of zoology there was nothing aside from a short lesson on flies and certain other unfriendly insects. There was no mention of any mammal.

The docile children accepted whatever was fed to them in the name of lessons. They were passive unless a demonstration involved an explosion accompanied by noise and disintegration. If any substance changed color or form, if it appeared mysteriously or disappeared unaccountably they acclaimed it an "experiment" and called for more of the same kind.

The percentage of failures in this so-called general science was halfway between those of the social science studies and mathematics. The principal of the school said: "General Science is unpopular. Fifty per cent of the children would drop it if we allowed them to do so." While discussing the case of a particular boy who was allowed to give up General Science, replacing it with Shop, she said, "If we could turn him loose in the woods with a teacher who would explain to him the things he saw he would learn and enjoy it. The science we teach takes no account of the interest of the boys of his type."

By practicing small economies of time the writer found that a part of each period could be saved each day for "free" time in which the children could ask questions on any kind of science they wished. Any child could bring to class during this period any kind of exhibit or give an account of any science experience. The first exhibits brought to class were pigeons and the first two free-time periods were taken up with discussions of how the difference between kinds of pigeons might be accounted for. The way in which mother pigeons fed their young was of interest to every child. Snake and frog eggs were brought in by the youngsters. The boys who lived near the river bank wanted to know if water dogs were poisonous. One little fellow insisted that there must be some foundation for the fear since all the fishermen were afraid of water dogs. The children wanted to know about mushrooms and poison ivy. They wanted to know about gypsies, why negroes are black, how mummies were made, and why we sneeze if we smell pepper.

Twelve different groups of junior high school children were taken to see a brook rising out of a spring in a shallow cave. Parts of the banks were bare and other parts protected by plants. And although the purpose of the visit was to observe the erosive effects of running water, in no single instance over a period of six years was there ever a spontaneous question about the ledges of rock in the cave, and the sand and the pebbles, or the stream. Insects and other animals that disappeared or moved away at their approach engaged the attention of the children to the exclusion of almost everything else. The girls were particularly interested in the wild iris, the marsh marigold, and the water cress that seemed to choke the stream in places. These experiences of the teacher were carefully recorded each visit over a period of six years, and in every instance bore out the principal's statement that the course of study made little allowance for what the children themselves wished to learn.

A study begun by E. Lawrence Palmer in 1921 and continued through 1925 contributes some evidence of the interest of children in science material. His work is entitled "Scientific Interests of Children Enrolled in Country Schools".[7] He limited his research to the study of children's interests as revealed by their questions. In order to collect the material, requests were made on the Cornell Rural School Leaflets that teachers send in the nature study questions asked by their pupils as a

7. Palmer, E. L. and Bump, N. Gardiner, Leaflet Correspondence for 1925, XX, (September, 1926), pp. 15-18.

result of the stimulation of each separate leaflet. During the succeeding five years many thousands of questions were submitted by 7,056 teachers. These questions were classified by years under various fields of science. Compilations were in terms of the percentages that the questions pertaining to each field were to the total number of questions submitted during that year. It was found that the most popular leaflets were those dealing with spring birds, land insects, spring flowers, pests, winter birds, winter mammals, and woody plants in autumn. This study constituted Unit I of the Palmer research.[8] The percentages of the children's questions dealing with the various fields of science were found to be as follows:

Table II

Classification of Children's Questions as Reported by 7,056 Teachers of General Science for the years 1921-1925 inclusive

| | 1921 | 1922 | 1923 | 1924 | 1925 |
|---|---|---|---|---|---|
| Zoology | 62.8 | 65.8 | 63.2 | 57.8 | 66.8 |
| Botany | 21.8 | 23.0 | 21.8 | 21.7 | 21.1 |
| Inorg. Nature | 5.2 | 6.2 | 6.4 | 7.1 | 5.8 |
| Agriculture | 4.2 | 1.8 | 6.6 | 11.7 | 4.0 |
| Pedagogy* | 3.4 | | | | |
| Ecology | 1.4 | .4 | 0.0 | 0.0 | 0.0 |
| Miscellaneous | 1.2 | 2.8 | 2.0 | 1.7 | 2.3 |

*Included only in 1921

Unit II of Mr. Palmer's study dealt with the problem of determining whether (1) among the country children of New York state scientific interest was predominant in any one grade, and (2) whether the nature of the questions varied in any regular manner in the different grades. It was found that: (1) The percentage of questions falling into the various classifications (See Table I) in any one grade was about the same as for

8. Palmer, E. L., & Bump, N. Gardiner, Leaflet Correspondence for 1925, XX, (September, 1926), pp. 15-18.

all the questions included in the report for the five-year period; (2) In no particular grade was any specific interest prominent.[9]

Elliott Rowland Downing also made a study of the interests of children in nature materials.[10] He wished to determine whether children were most interested in plants, animals, or physical material and in what phases of these materials they were most interested. He used as data for this study the questions and observations published in the Saint Nicholas magazine from November, 1899, to April, 1912. Sixty per cent of the questions asked concerned animals; twenty and six-tenths per cent were about plants; eleven and six-tenths about physical material. Downing concluded that the major interest of children in the field of nature study concerned animals.

Charles W. Finley did some research work in the same field, writing his master's thesis on the interests of children in science materials.[11] He secured data relating to children's interest in three phases of elementary science: plants, animals, and physical phenomena. The investigation involved eight hundred and twenty-seven children from grades one to eight in five schools. A live plant, a black skimmer, and a pendulum were presented to the class. Discussions about the plant, the bird, and the pendulum were presented in varying orders. Each was explained and discussed with free class participation for a period of eight to ten minutes. More questions were asked about the bird in all grades. Two tests of interest were given: (1) Each pupil was asked to write a short

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9. Palmer, E. L., & Gordon, Eva, Nature Interests by Grades as Shown by Leaflet Correspondence, XXIII, (September, 1929), pp. 107-108.
10. Downing, Elliott R., "Children's Interest in Nature Materials", Nature Study Review, VIII, (December, 1912), pp. 334-338.
11. Finley, Charles, "Some Studies of Children's Interest in Science Materials", School Science and Mathematics, XXI, (January, 1921), pp. 1-24.

theme on one of the three objects that interested him most; (2) The children in the 4th, 5th, 6th, 7th, and 8th grades were asked to write on a slip of paper which one of the objects previously demonstrated they would choose if they might have another discussion of only one of them. Interest in the bird was outstanding in all grades.

A study made of pupil interest in biology is reported by C. J. Peters. Questions based on laboratory and classroom work on the amoeba, fishes, grasshoppers, birds, and frogs were given to find out what phases of biology were considered most important by the ninety biology students questioned. Their rankings of the phases of biology in order of importance are given in Table III.[12]

Table III

Phases of biology ranked as to Importance
by 90 High School Students of Biology

1. Locomotion
2. Economic Importance
3. Respiration
4. Adaptation to Environment
5. Instinct
6. Food and Food Getting
7. Reproduction
8. Shape
9. Life History
10. External Structure
11. Relation to Other Animals
12. Function of Different Parts
13. Internal Structure
14. Elimination of Waste Material
15. Classification

This study indicates that the emphasis in biology teaching in many cases has been wrongly placed so far as the criterion of student

12. Peters, C. J., Objectives of Education, 2nd Yearbook of National Society for the Study of Educational Sociology, New York: Teachers College, Columbia University, 1929, pp. 118-128.

interest is concerned.[13]

An interest study was made by George W. Hunter, then head of the department of biology at Dewitt Clinton High School, New York City. A questionnaire was given to the pupils at the end of their first year of biological work with the results as given in Table IV.

Table IV

Numbers of Children Rating Topics in General Science as "Most Interesting"

| Topic | No. "most interesting" |
|---|---|
| Human physiology | 1291 |
| Bacteria and Disease | 539 |
| Animals | 529 |
| Plants | 334 |
| Experiments | 102 |
| Total | 2795 |

Nowhere in the account of the study does the writer indicate in what field or fields the "experiments" were conducted.[14]

Charles Finley's study of children's interests in science material also yields data indicating that the mental maturity of children affects their interests in science.[15] A live "mud-puppy" in a glass aquarium was taken into a classroom and viewed by small groups of children from thirteen schools in grades one to eight inclusive. It was found that: (1) the number of questions asked about the animal's environment amounted to less than one-fifth of the number of children in grade three and in all other grades to a still smaller percentage; (2) in the lower grades

13. It is customary to teach classification, internal structure, and function of different parts.
14. Hunter, George W., Science Teaching at Junior and Senior High School Levels, New York: American Book Company, 1934.
15. Finley, Charles, Loc. Cit. p. 3.

little interest was manifested in the kinds of foods eaten by animals; (3) in the upper grades much interest was shown in what animals eat; (4) interest in the life histories of animals was greater in the upper grades; (5) economic interest in animals began in about the fifth grade; (6) there was a considerable interest in animal structure above the fourth grade but not before; (7) in the upper grades there was definite falling off of teleological questions and a substitution of those indicating a desire for the reasons for structural characteristics.

What we know of the mental growth curve of children in relation to science interests was gained mostly from implications contained in early studies directed toward the grade placement of the various fields of science. For example, Mr. Webb, doubtless basing his recommendation on what he believed to be the mental growth curve of the normal child, recommended what field of science can be profitably presented at each grade level.[16] He concludes that about 98.2 per cent of the material found in science textbooks should not be taught to the children in grades below the sixth. In the sixth grade, he thinks that physiology and physiography alone seem to offer material suitable for instruction in science and that there is a reasonable amount of previous knowledge possessed by children on these subjects in this grade to enable them to gain experience in the characteristic and fundamental topics of these sciences. In the seventh grade, biology and a most elementary treatment of physics become appropriate according to a similar standard. In the eighth grade, physics is acceptable. Chemistry is of doubtful value in any of the grammar

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16. Webb, Hanor, General Science Instruction in the Grades, Contributions to Education, No. 4, Nashville, Tennessee: Peabody College for Teachers, 1921. Parts II and V.

grades since previously gained knowledge, direct assimilation, and power of application all fall below suggested standards easily attained by children in the same grade in other sciences.

Another carefully worked out thesis is based on an investigation of the science interests of 1,235 students of the eighth and ninth grades by R. H. Thompson.[17] The method was to give out mimeographed sheets of science topics covering the year's work. The children were asked to check the ten most interesting and the ten least interesting topics. The differences between the expressed interests of the boys and girls were shown. Interest differed considerably with age levels. There were no civic interests noticeable in the eighth grade but they began to appear in the ninth. Boys' interests centered about modern inventions, wonders of nature, and science materials that challenged the imagination. Girls' interests dealt more with the esthetic pleasures than with nature. Neither boys nor girls were interested in commonplace nor familiar things. Table V shows the rankings of topics in terms of expressed interest for both sexes.

Table V

Rankings of Topics as to Interest by Boys and Girls in General Science Classes

| Boys' Interests | Girls' Interests |
|---|---|
| 1. Airplanes | 1. Motion pictures |
| 2. Electricity | 2. Flowers |
| 3. Radio | 3. Stars |
| 4. Automobiles | 4. Musical instruments |
| 5. Submarines | 5. Planets |
| 6. Machinery | 6. Northern Lights |
| 7. Chemistry | 7. Earthquakes |
| 8. Motion pictures | 8. Piano |
| 9. Animals | 9. Birds |
| 10. Steam engine | 10. Radio |

17. Thompson, R. H., A Study of the Interests of Junior High School Students in Science, Unpublished Master's Thesis, University of Southern California, 1927.

Hunter reports a study made by one of his students, Miss Christine V. Inmann-Kane, in the Santa Monica, California, Schools. The subjects were fifth to seventh grade children who had had experience in nature studies. The frequency of expressed interest is shown in Table VI. Hunter's report as to what topics these children knew most about is given in Table VII.[18]

Table VI

Number of Students in 5-7 Grades, Santa Monica, California, Expressing "Most Interest" in General Science

| Boys | | Girls | |
|---|---|---|---|
| Birds | 128 | Flowers | 148 |
| Animals | 105 | Birds | 122 |
| Flowers | 72 | Animals | 63 |
| Stars | 49 | Stars | 45 |
| Rocks | 48 | Rocks | 28 |
| Trees | 30 | Sea life | 25 |
| Sea life | 22 | Trees | 23 |
| Fossils | 19 | Fossils | 12 |
| Reptiles | 14 | Insects | 11 |
| Insects | 10 | Reptiles | 2 |
| Total | 497 | Total | 479 |

Table VII

Number of Students in 5-7 Grades, Santa Monica, California, "Knowing Most" about Various Topics in General Science

| Boys | | Girls | |
|---|---|---|---|
| Birds | 110 | Flowers | 127 |
| Animals | 92 | Birds | 91 |
| Flowers | 60 | Animals | 70 |
| Stars | 45 | Stars | 43 |
| Trees | 37 | Trees | 38 |
| Rocks | 35 | Rocks | 20 |
| Sea life | 29 | Sea life | 17 |
| Fossils | 15 | Fossils | 16 |
| Reptiles | 15 | Insects | 10 |
| Insects | 12 | Reptiles | 4 |

18. Hunter, George W., Science Teaching at Junior and Senior High School Levels, New York: American Book Company, 1934, pp. 69-70.

Victor C. Smith found sex differences in difficulty in answering standardized tests in General Science based on material offered in ten of the most popular General Science texts.[19] These questions were presented to 300 girls and 300 boys chosen at random in a sample of schools covering farming communities with only one hundred pupils in the school to those in cities with populations of several thousand. It was found that typical questions on which girls excelled were: "Artificial silk made from wood pulp is called rayon. Iodine mixed with starch gives a dark blue color. A disk one-third red and two-thirds yellow appears to be orange when rotated rapidly." Boys were superior to girls when answering these: "Electric cords are insulated with cloth and rubber. A dry cell is contained in a zinc can. An airplane with two sets of wings is called a biplane."

A table worked out by Mr. Smith is given below. Of particular interest to the writer, because its general implication is in line with the findings of this thesis, is a statement, taken directly from Mr. Smith's study: "Although apparently a large part of the sex difference in difficulty in answering the general science questions can be explained by environmental factors and the differences affording different experiences to boys and girls, these factors may or may not explain the greater interest of boys in mechanics. At any rate, sitting in the same classes, reading the same textbooks and receiving the same instruction from the teacher do not affect seriously the elementary sex differences." His findings with respect to differences between sexes are given in Table VIII.

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19. Smith, Victor C., "Sex Differences in the Study of General Science", <u>Science</u>, LXXV, (January, 1932), pp. 55-57.

Table VIII

Differences Between Difficulty of Items for Boys and Girls
Chosen at Random from High Schools in
Rural and City Communities

| Type of Material | No. of Questions | Median Diff. | P. E. of Med. Diff. |
|---|---|---|---|
| Clothing | 12 | 3.3 | .5 |
| Foods | 27 | 2.8 | .9 |
| Earth, weather, geology | 29 | .1 | .4 |
| Human biology, health | 60 | .6 | .5 |
| Life processes and development | 20 | 1.9 | .7 |
| Plant and animal biology | 49 | 2.8 | .7 |
| Astronomy | 14 | 3.2 | .8 |
| Light | 51 | 4.0 | .8 |
| Chemistry, air, water, matter | 115 | 4.4 | .4 |
| Simple machines, laws of work, mechanics | 50 | 6.4 | .9 |
| Sound | 19 | 9.9 | 1.8 |
| Fluids, barometer pumps | 32 | 11.9 | 1.1 |
| Electricity | 68 | 12.0 | .9 |
| Engines, applied mechanics | 38 | 27.2 | 1.3 |

The general conclusions of Mr Smiths study, which, incidentally, throw some light on the interests of children in the materials of science, are that the topics generally covered in biology in the textbooks are not of marked difference in interest to boys and girls. Physiographic materials showed no differences. Physics and chemistry showed some sex differences, boys being more interested than girls in them, the median differences ranging from four to twenty-two per cent. The significance of these mean differences cannot be determined from the data presented.

A later study by Francis D. Curtis used a questionnaire with the results given in table IX.[20]

Table IX

Frequency of Expressed Interest in Topics in General Science

| | Interest | Frequency |
|---|---|---|
| 1. | Stars | 194 |

20. Curtis, Francis D., "Some Values Derived from Extensive Reading of General Science", Contributions to Education, No. 163, New York, Bureau of Publications, Teachers College, Columbia University, 1924.

| | Interest | Frequency |
|---|---|---|
| 2. | Electricity | 106 |
| 3. | Animals | 95 |
| 4. | Planets | 94 |
| 5. | Moon | 91 |
| 6. | Earth | 89 |
| 7. | Gravity | 81 |
| 8. | Earthquakes | 79 |
| 9. | Volcanoes | 75 |
| 10. | Sun | 69 |

This study, according to Hunter also, showed a difference of science interest between boys and girls and between those living in the city and those living in the country.[21]

The findings of the C. A. Pollock study[22] mentioned above were that the inorganic sciences ranked first in the interest of children. Table X shows a sampling of his findings.

Table X

Field of Science Ranked According to Interest as Determined by Number of Questions Asked by Students of General Science

| Field of Interest | Rank | No. of Questions |
|---|---|---|
| Electricity | 1 | 347 |
| Stars | 2 | 253 |
| Radio | 3 | 243 |
| Heat | 4 | 181 |
| Light | 16 | 157 |
| Rotation | 19 | 46 |
| Animals | 23 | 37 |

If the main interest of children in science were in the inorganic field, this would stand in shapp contrast to what seems to be the interest of adults as interpreted by editors of magazines and newspapers. L. Thomas Hopkins found that[23] "Biology is the most common branch of science

21. Hunter, George W. op. cit. p. 14.
22. Pollock, C. A., op. cit. p. 4.
23. Hopkins, L. T., "A Study of Magazine and Newspaper Science Articles with Relation to Courses in Science for High School", School Science and Mathematics, XXV, (November, 1925), pp. 794-800.

occurring in newspapers and magazines selected for examination. Omitting the two technical magazines, less than one-fourth as much space is given to the theoretical side of physics and chemistry combined as to biology." Mr. Hopkins' conclusion is: "Biology is the most important of all secondary school sciences from the standpoint of general educational values. Physics would follow next in order with chemistry third, geology fourth, and astronomy fifth." On the basis of interest, then, the sequence of sciences in secondary schools should be: Biology, Physics, and Chemistry. In a junior-senior high school plan the sequence would be General Science in the seventh and eighth grades, Biology in the ninth, Physics in the tenth, and Chemistry in the eleventh. The opinion of Mr. Hopkins is that since biology is the science making the greatest contact with life, it should be required of everyone and placed in that year where it can reach the largest number of pupils. In order to secure this data, analysis was made of all the daily issues, including Sunday editorials, of the four daily newspapers of Denver from February 12th to March 15th, 1924, and also of the February, April, June, August, and October issues of Popular Mechanics, Scientific American, Ladies' Home Journal, Good Housekeeping, Saturday Evening Post, Literary Digest, Country Gentleman, and Farm Journal.

"A Study of Science Articles in Magazines", by Searles and Ruch,[24] was made by an analysis of all the issues published during the ten-year period, January 1st, 1914, to December 31st, 1923, of the Literary Digest, the American, the Review of Reviews, Current Opinion, National Geographic, Scribners', and the World's Work. The study also considered issues of

24. Searles, Albert H., and Ruch, G. M., "A Study of Science Articles in Magazines", School Science and Mathematics, XXVI, (April, 1926), pp. 389-396.

the Saturday Evening Post for five years and six months. Articles were classified as "General" if they did not concern one science more than another. Their classification is given in Table XI.

Table XI

Per cent of Scientific Articles Published
Dealing with Various Fields

| Subjects of Articles | Per cent |
|---|---|
| Biology | 62.2 |
| Physics | 26.3 |
| Chemistry | 5.0 |
| General | 4.0 |
| Agriculture | 2.4 |

Francis D. Curtis made a study of the knowledge needed for an intelligent reading of the public press. His statement that, "The biological sciences, which are given little space in general science textbooks, are probably entitled to a greater proportionate representation insofar as the function of providing a serviceable foundation for an intelligent reading of the press is concerned,"[25] carries with it the implication that biological articles appear frequently in the newspapers.

Of the studies quoted above, only one is recent, that of Inmann-Kane (1932). The literature on the interest of children in science is meager. A search through the bibliographical resources of the University of Louisville and of the Louisville Free Public Library reveals no published integrative study of research into the science interest of children since Curtis' second digest in 1931 except the abbreviated presentation of such studies found in Hunter's book, which is two years old.

25. Curtis, F. D., "Some Values Derived from an Extensive Reading of General Science", Contributions to Education, No. 163, New York, Bureau of Publications, Teachers College, Columbia University, 1924.

The writer has checked the bibliography of science interest studies in Hunter and found that this thesis covers the science material that Hunter used[26], while all the pertinent studies abstracted by Curtis in his two Digests[27] have been discussed.

As far as consideration for student interest is concerned by writers of textbooks, the situation seems to remain very much as it was in 1928 when Downing reported that the late books were no better than the old[28]. Klopp's criticism[29] as to the meagerness of interests is partially met in the latest General Science texts by an almost encyclopedic multiplicity of detail on such topics as are offered. An examination of five textbooks,[30] published between the years 1932 and 1935, reveals practically the same organization of material as indicated by the Manor Webb table.[31]

In the majority of the urban centers in the United States two of which the writer has personal knowledge, St. Louis, Missouri,[32] and Louisville, Kentucky,[33] permanent committees are at work constantly revising science courses of study and worksheets. During the summer of

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26. Hunter, G. W., Science Teaching at Junior and Senior High School Levels.
27. Curtis, F. D., A digest of Investigations in the Teachings of Science in the Elementary and Secondary Schools, P. Blakeston Sons & Co., Philadelphia, 1926.
---- A Second Digest of Investigations in the Teaching of Science in the Elementary and Secondary Schools, P. Blakeston Sons & Co., Philadelphia, 1931.
28. See above, p. 4.
29. See above, p. 3.
30. Hunter, George W., & Whitman, Walter G., Problems in General Science; Powers, Samuel R., Neuner, Elsie F., & Bruner, Herbert B., The World Around Us and This Changing World; Watkins, Ralph K., & Bedell, Ralph C., General Science for Today; Weed, Henry T., Rexford, Frank A., & Carroll, Franklin B., Useful Science for High School.
31. See above, p. 5.
32. Personal letter from Mr. George Johnson, Director of Tests and Measurements, Board of Education, St. Louis, dated May 23, 1936.
33. Personal communication.

1935, Mr. Frederick Reed of the Winnetka, Illinois, schools made the statement to thw writer that both the administrators and the teachers of that system were dissatisfied with science taught in the elementary schools because it contained too little biology.

This statement is interesting because the textbook, Common Science, used in the Junior High School at Winnetka is, as far as the writer knows, the first book to recognize that the interests of children should form one of the criteria of a good curricula in science. A collection of two thousand questions asked during the school year, 1915, by the children in the San Francisco Normal and the San Francisco Public Schools forms the foundation on which Washburne's Common Science is built.[34] Mr. Washburne writes in the preface in explanation of the apparent total disregard of organic material: "The chapter headings of this book might indicate that it has to do with physics and chemistry only. This is because the general physical and chemical principles form a unifying and inclusive matrix for the mass of applications. But the examples and descriptions throughout the book include physical geography and the life sciences. Descriptive astronomy and geology have, however, been omitted. These two subjects can best be grasped in a reading course and field trips and have been incorporated in separate books." For four years a mimeograph edition of this book was used in the elementary department of the San Francisce State Normal School. In 1920, the World Book Company copyrighted it and offered it to the public.[35]

Mr. Washburne's text used in the Junior High Schools is supplemented

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34. Washburne, C. W., Common Science, Yonkers-on-Hudson, New York, World Book Company, 1920.
35. loc. cit. p. 22.

by a course in biology. Winnetka seems, however, to have come to the point of action in her unrest over her science curricula. During March of this year a circular letter, signed by Miss F. Presler, Chairman of the Winnetka Science Curriculum group, was received by the writer. Because of its thorough-going method of attack of the problem of making better science texts and courses of study, it is quoted in part:

"Are you interested in the place science should have in elementary education? Are you dissatisfied with existing courses of study and text books? Do you want to help and be helped to prepare some science experiences for children, on an activity basis, adjusted to their fundamental interests and abilities and needs?

"We are convinced that the growth curve of childhood is accompanied by a development not only in the amount but in the variety of science experience which a child should have. That is, that there are rather definite stages or levels in the growing up process to which education should be adjusted. There is, from time to time as the child matures, a period of readiness for certain conceptual experiences. This readiness seems to be conditioned by : the child's age, his mental ability (whatever that means), his previous experiences, and the interests of his associates (including the teacher especially). We feel that there are some science experiences which are so fundamentally satisfying and stimulating that every child should have them, and have them at the right time.

"BUT--we are not sure just what these experiences are, and just <u>when</u> they should be given. Our best chance of finding the answer is from the children themselves. The things which they really want to know and the time they want to know them indicate the best approach.

"Like many others we have been collecting children's questions--

hundreds of them--enough to indicate certain general trends from year to year. However, our children naturally reflect, to some extent, our own expectations and practices. Moreover, they are drawn from a limited social and physical environment. Neither have we yet been able sufficiently to differentiate between children within a grade group.

"Therefore we are making further efforts ourselves and inviting interested teachers to work with us. Do you want to be considered a member of a working group with these definite aims:

1. To determine whether there are any interests characteristic of specific age levels and if so what are they.

2. To determine whether there are other criteria for the building of a science curriculum in addition to the interests of children, and if so what these criteria should be.

3. To work out science units to satisfy the interests of children as determined by their questions and to fulfill any other criteria that may be determined upon.

"It is our hope to form a group which will be widespread and varied enough so that we can have confidence in the results we gather being typical and characteristic of American childhood. Rural, town, and city school situations of the various sections of the United States will be sought."

While this chapter was being written, there came from Winnetka the second step of an organized and carefully planned move to learn something about the interest of children in the material of science. Sets of try-out cards were sent to members of a science curriculum committee of wide geographical distribution of which the writer is a member. Six children, three boys and three girls, from each of the grade levels chosen, which were in the case of the writer a high, a low, and a medium group from the A and B classes of the seventh and eighth grades, selected according to the criteria laid down in the instructions given below have checked the tryout cards. These cards have been sent to Winnetka and shortly, enough cards will be provided to administer this questionnaire to the entire membership of the groups chosen. Both sides of this tryout card and the details of instructions to the teachers administering the questionnaire appear below:

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Question Card (1)

WHAT ARE YOU MOST INTERESTED IN KNOWING ABOUT? Please number 1st, 2nd, 3rd choices. If what you are interested in isn't here, write it at the end of the list.

| | | |
|---|---|---|
| machines ______ | stars & planets ______ | furry animals ______ |
| trees & plants ______ | sea life ______ | your own body ______ |
| volcanoes & earthquakes ______ | birds ______ | the earth ______ |
| space & time ______ | God ______ | weather & atmosphere ______ |
| bugs & insects ______ | rocks & mountains ______ | human beings ______ |
| ______ | ______ | babies ______ |

how things work ______

how things began ______

why things are the way they are ______

what things are made of ______

what makes things happen ______

---

(2)

I often wonder ______

______

I like stories about (1)____________________________

(2) ____________________ (3) ____________________

Name______________________________________________

Boy____________ Age____________ Date of Birth____________

Girl____________ Age____________ Date of Birth____________

Grade____________ Town____________ State____________

---

The explanation of the question card which is quoted immediately below adds illuminating sidelights to the Winnetka approach to the study of the interest of children in science.

"The problem of discovering what are a child's natural, real or appropriate interests is a delicate one and one for which no reliable technique has been developed.

"Many persons are convinced that there is no such group of interests, but that children regardless of their stage of development reflect the interests of adults or those related to their most recent experience and environment. On the other hand there is a growing body of opinion and considerable evidence that the experiences and interests which mean very much to children are those for which they are ready, and that this readiness consists, along with other things, of biological and mental maturity.

"In order to pursue this inquiry, it is important that we collect under uniform conditions the science questions of children of different ages and abilities and in various environments.

"Experience has shown that it is not sufficient abruptly to ask children "What are you interested in?" They must be aware at the time of the extent of the field of science, and be in a position to make an individual choice among possible and representative science interests. Hence the form of this card."

The old and extremely limited amount of literature on the science interest of children will have received a valuable addition when the new material growing out of the Winnetka research is collected and analyzed.

## Summary

The first chapter furnishes evidence that General Science textbooks and courses of study are not considered satisfactory. According to Klopp, Downing, Webb and Pollock they either offer too limited a range of topics or do not contain material in which children are vitally interested. It would also appear from these studies that the later books show no improvement on the earlier ones. That children do have decided preferences in the materials of science is indicated by the studies of Laura Emily Mau, by the researches of E. Lawrence Palmer and Elliott Downing, and by the experiments conducted over a period of six years by the writer.

There is evidence furnished by the studies of C. J. Peters and Charles Finley that the emphasis in the teaching of biology has been wrongly placed from the standpoint of the interest of children. The traditional course of study stresses classification, internal structure, and function of parts, in spite of the fact that children prefer the phases of locomotion, respiration and adaptation to environment.

Recommendations are made by Hanor Webb, based on what he believes to be the mental growth curve of children, for the grade placement of the various science subjects.

That there are slight but significant differences in the sex interests of children is indicated by the studies of R. H. Thompson, Christine V. Inmann-Kane and Victor Smith, girls being particularly less interested in physics than boys.

The studies of magazines and newspapers conducted by Searles and Ruch and by F. D. Curtis indicate that the science interest of adults is biological.

The study by Christine V. Inmann-Kane reported by Hunter is the only recent study of interests among those quoted above. However, the fact that a revival of the research in the interest of children in the material of science has taken place is indicated by the nation-wide study of this subject undertaken by the Winnetka Public School system through a committee in the membership of which Louisville is included.

Lack of data on the subject of the science interest of children and the recently renewed interest in this subject furnish justification for this present study.

# CHAPTER II

# THE METHOD

# CHAPTER II

## THE METHOD

The subjects of the present study were 300 girls and 300 boys in the eighth grades of Parkland Junior High School, Shawnee High School, and Western Junior High School, Louisville, Kentucky. The population of these schools are drawn from three adjacent neighborhoods covering approximately five square miles. The socio-economic backgrounds of the three schools are not significantly different, the territories from which the children are drawn overlapping in many cases. Owing, however, to the fact that many of the children of the Shawnee School come from better homes around Shawnee Park or from good gomes supported by well established old business firms on lower Broadway, the children of Shawnee High seemed the most privileged. Many of the Western Junior children come from the industrial sections on or near the Ohio River. Therefore, in some respects the population of that school is the least favored. These slight differences are roughly indicated by the average I. Q.'s of the children: 92.7 for the Western children, 93.45 for Parkland, and 98.09 for Shawnee, according to Table XII herewith presented:

Average I.Q.'s of the Twelve Groups of Children That Checked the Questionnaire

| Parkland | | Shawnee | | Western | |
|---|---|---|---|---|---|
| Group | I.Q. | Group | I.Q. | Group | I.Q. |
| 8B Boys | 90.2 | 8B Boys | 94.48 | 8B Boys | 87.24 |
| 8B Girls | 95.52 | 8B Girls | 100.76 | 8B Girls | 93.53 |
| 8A Boys | 93.44 | 8A Boys | 98.65 | 8A Boys | 93.2 |
| 8A Girls | 94.66 | 8A Girls | 98.48 | 8A Girls | 96.94 |

Basing calculations on the above figures it was found that the average I.Q. of the three schools is 95.003.

The average I.Q. for the high I.Q. groups is 110.6 and for the low groups, 80.006. The average for the Parkland high I.Q. groups is 111.55; for the Western high I.Q. groups 101.09; and for the Shawnee high groups 115.23. The average I.Q. for the Parkland low groups is 74.68; for the Western low groups 83.34; and for the Shawnee low groups 82.00.

The eighth grade children were chosen as subjects for this thesis because they ask more spontaneous questions than those either of the seventh or of the ninth grade as determined by actual count over a period of two years, and their questions contain a wider range of interest than those of the grades above or below them.

The data for this study were secured by the administration of a questionnaire of 150 items to approximately 900 eighth grade pupils. There was a short letter on the first page of the questionnaire asking the children to select out of the 150 items, the 75 most interesting to them. These they were to check. The teacher administering the questionnaires was asked to impress the children with the fact that they were to check the most interesting questions whether they knew anything about them or not. The teacher was also requested to see that the correct sex, grade, and the right number of checks were placed on each paper. Several devices were used by the pupils to determine when 75 questions had been checked. A great many numbered the questions as they checked them. One boy checked every other question. Since the fifty boys in the 8A grade were samples of a greater number of that group to which the questionnaire had been given, this boy's paper was rejected and another was chosen at random in place of it.

## EXHIBIT A

The Science Questionnaire as Submitted to the Children

Dear Girls and Boys:

You have had enough experience in science up to this time to know that there are good answers to most of the questions you would like to ask. Science is man's attempt to understand the universe and children as a rule are more eager to know about the things around them than grown-ups.

We should like to know in what field of science you are expecially interested. There is a space provided at the left of each question for a check mark. You will help us if you will check out of the 150 questions below, any 75 questions that you want most to have answered. Please read all the questions carefully before you begin to write.

Thank you for your co-operation.

Name ____________________ Age ____________________
Boy or girl ______________ Grade __________________
School __________________ Teacher ________________

Would you like to know:

__ 1. Why we eat sheep and do not eat cats?

__ 2. How Saturn got its ring?

__ 3. How to make a fire extinguisher?

__ 4. Why we have so many Canadian granite boulders strewn over Kentucky?

__ 5. What makes the rainbow?

__ 6. Why the rails of a railroad look as if they were coming together in the distance?

__ 7. In what ways scientists think thw world could come to an end?

__ 8. Why you go zigzag up a steep hill on your bicycle?

__ 9. Why mistletoe grows on trees?

__ 10. How snakes help farmers?

__ 11. What glass is made of?

___12. How cave men learned to talk?

___13. How to make a telescope?

___14. Why I have to brush my teeth and my dog does not have to brush his teeth?

___15. How an electric sweeper works?

___16. How to stuff a bird?

___17. How to make an electric magnet?

___18. What are the oldest living things?

___19. How savages know what man to make their chief?

___20. How to replace a fuse when the lights go out?

___21. Where diseases come from?

___22. What really happens when you press an electric doorbell button and you hear a ring?

___23. Why savages put war paint on their bodies before they go into battle?

___24. What change takes place in a needle when you rub it on a magnet and it becomes a temporary magnet?

___25. Why human beings something like ourselves can live probably in no other planets except Mars and Earth?

___26. What makes lightning?

___27. Why most of the Swedes and Norwegians are blondes.

___28. Why you use a transformer when you run a toy electric train?

___29. Why we paint wooden houses?

___30. Why America uses helium in her dirigibles?

___31. In what ways molds and bacteria are useful?

___32. How old the earth is?

___33. Why iron rusts?

___34. Where gypsies come from?

___35. How to test acids?

___36. How to grow a new kind of dahlia or iris?

___37. How plants scatter new seeds?

___38. How a burning glass works?

___39. Where icebergs come from?

___40. Why you put rosin on the fiddle-bow?

___41. Why it is easier to move a heavy piece of furniture after you get it started?

___42. Which are the friendly spiders?

___43. Why we make a radiator out of iron?

___44. How electricity is made?

___45. Why parents and teachers ask children to drink milk rather than coffee?

___46. How to make hydrogen?

___47. Where the planets get their names?

___48. What kinds of games savage children play?

___49. Why some things burn and others do not?

___50. What makes an eclipse of the sun?

___51. Why men trained dogs rather than bears or deer to live with them?

___52. How to make a hot-bed?

___53. How steel is made?

___54. How mountains are made?

___55. Where the earth came from?

___56. How to graft roses and fruit trees?

___57. Whether bats are covered with feathers or fur?

___58. Where we get radium?

___59. What is the name of the substance that weighs most?

___60. Where we get asbestos?

___61. How marble is made?

___62. How snapping off the switch turns out the light?

___63. Why farmers say a toad in the garden is worth twenty dollars?

___64. How an electric refrigerator makes ice?

___65. Where mercury comes from?

___66. What animals give us the most material for clothing?

___67. Where quinine comes from?

___68. What would happen if a comet should collide with our earth?

___69. Why you hear the sound of a steam engine's whistle after you see the vapor?

___70. How to take your own temperature?

___71. Of what use are reindeer?

___72. How taking "shots" keeps you from having diphtheria?

___73. How to repair a cord on an electric lamp?

___74. How can you know a poison snake?

___75. What plants give us material for clothing?

___76. What air is made of?

___77. What are the ways animals protect themselves from enemies?

___78. What would happen if flowers lost their perfume?

___79. How a radio works?

___80. How much radium is there in use?

___81. How to tan a muskrat's skin in the easiest way?

___82. How to make oxygen?

___83. What animals besides kangaroos carry their young in a pouch?

___84. Why North American Indians put feathers on their heads?

___85. Why the greater part of a fuse plug is made of glass or china?

___86. How fire was probably discovered?

___87. How plants make seeds?

___88. Why magnets pick up nails and do not pick up paper?

___89. What makes the crude oil that comes from the earth?

___90. What we call animals that feed their young with milk?

___91. How coal is made?

___92. How are precious stones, such as diamonds and emeralds, made in the earth?

___93. What makes the ring around the moon?

___94. How plants get their food?

___95. Why is it easier to lift a weight with pulleys?

___96. What makes quicksand?

___97. Why do you find yourself pitching forward if the car in which you are ridind stops suddenly?

___98. What makes natural gas?

___99. Where we find remains of cave men?

___100. What makes a sink-hole?

___101. In what ways are weeds useful?

___102. How to distill water?

___103. Why is rock in quarries in layers?

___104. Where scientists find drawings of deer and other animals made by cave men?

___105. What is at the center of the earth?

___106. How a telephone works?

___107. What musical instruments were first invented?

___108. What is the cause of geysers?

___109. How old are the oldest cave men?

___110. Why is radium so scarce?

___111. Where cannibals and headhunters are living now?

___112. How to know a fossil when you see one?

___113. Why is salt lake salty?

___114. Why is it better to go to bed early and get up early than go to bed late and get up late?

___115. What germs look like?

___116. How are tides made?

___117. What plants use animals for food?

___118. How getting your feet wet might give you a cold?

___119. What shooting stars are?

___120. Why you perspire?

___121. How big is the sun?

___122. Why is it better to breathe through your nose than through your mouth?

___123. How far away is the moon?

___124. Why savages left their caves and started to build?

___125. How were the stars made?

___126. Why most people get dizzy when they whirl around?

___127. What causes thunder?

___128. Why our worst storms come from south and west.

___129. Why the moon seems to change its shape?

___130. How the Grand Canyon was made?

___131. What is the difference between caterpillars and worms?

___132. How to read a gas meter?

___133. What is the name of the active volcano in the U.S.?

___134. Which are the poison snakes in Kentucky?

___135. What is the name of the highest mountains in the U.S.?

___136. If an ape, a dog and a horse were fastened in cages exactly alike and there was a way to get out, which animal would free himself first?

___137. Why one generally has fever when one is sick?

___138. Why Kentucky and Southern Indiana have so many caves?

___139. Why does it hail in warm weather but not in cold weather?

___140. What makes your pulse beat?

___141. What causes earthquakes?

___142. Why we should eat spinach and carrots?

___143. How Egyptians embalmed the bodies of the dead?

___144. How a periscope works?

___145. How was the first water on earth made?

___146. Why we take a shower after gym exercises?

___147. What star is nearest the sun?

___148. What made the cliff over which Niagara Falls pours?

___149. Why we have the shortest day of the year in December?

___150. What makes a desert?

The questions submitted to the children had been chosen from hundreds that had been asked spontaneously by pupils during the writer's seven years of teaching general science, one year in the senior high school, and the remainder at the junior high school level. The method of selection of the questions forming the questionnaire was as follows: All questions were studied and duplicates were eliminated. They were arranged in ten piles representing arbitrarily defined fields of science. A typist was asked to draw fifteen questions from each pile. In order to do something in the way of counteracting any personal preferences of the writer, Mr. Frederick Reed of the Winnetka School System, who was the writer's instructor at the University of Louisville during the summer of 1935 and who has studied children's interests over a period of years, was asked to contribute a number of questions in each field. His questions were substituted for five of the original lot in each field, the selection being made by chance in both the case of the questions eliminated and those substituted.

The questions finally chosen from each field were written on cards, the cards shuffled and the questions typed in this chance order so that a random sampling from the various fields should be presented to the child, thus eliminating the "halo" effect of questions from one field on others from that field. This made up the questionnaire, which is presented as Exhibit A in the thesis. The statement previously made that fifteen questions were chosen from each field of science presents a precision and an assurance not experienced by the writer. An adequate classification of children's questions is most difficult because a single question might spring with equal right out of several contexts. For example, the eating of horsemeat during the World War by the fathers of

## Table XIII

QUESTIONS FORMING THE QUESTIONNAIRE, INDICATED BY NUMBERS THEY BEAR ON THE QUESTIONNAIRE, GROUPED ACCORDING TO THE FIELDS OF SCIENCE TO WHICH THEY BELONG

| Astronomy | Physiography | Anthropology | Geology | Chemistry | Zoology | Physics | Electricity | Botany | Physiology |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 12 | 32 | 3 | 10 | 5 | 15 | 9 | 1 |
| 7 | 26 | 19 | 58 | 11 | 16 | 6 | 17 | 18 | 14 |
| 25 | 39 | 23 | 60 | 29 | 42 | 8 | 20 | 31 | 21 |
| 47 | 54 | 34 | 61 | 30 | 57 | 13 | 22 | 36 | 45 |
| 50 | 96 | 48 | 65 | 33 | 63 | 38 | 24 | 37 | 70 |
| 55 | 100 | 51 | 89 | 35 | 66 | 40 | 28 | 52 | 72 |
| 68 | 108 | 84 | 91 | 46 | 71 | 41 | 44 | 56 | 114 |
| 93 | 113 | 86 | 92 | 49 | 74 | 43 | 62 | 67 | 118 |
| 119 | 127 | 99 | 98 | 59 | 77 | 53 | 64 | 75 | 120 |
| 121 | 128 | 104 | 103 | 76 | 81 | 69 | 73 | 78 | 122 |
| 123 | 130 | 107 | 105 | 80 | 83 | 95 | 79 | 87 | 126 |
| 125 | 133 | 109 | 112 | 82 | 90 | 97 | 85 | 94 | 137 |
| 129 | 135 | 124 | 138 | 102 | 131 | 116 | 88 | 101 | 140 |
| 147 | 139 | 143 | 141 | 110 | 134 | 144 | 106 | 115 | 142 |
| 149 | 150 | 111 | 145 | 27 | 136 | 148 | 132 | 117 | 146 |

children now in the junior high school, and the sale of canned rattle-snake meat in some provision stores[36] set children to thinking about criteria for selection of meat foods. And interest represented by the question: "Why do we eat sheep and not cats?" bobbed up frequently. This question can be classified as physiological, hygienic or zoological. "What makes the tides?" may be thought of as astronomy or physiography. Coal occupies as much space on work sheets on combustion as on those on earth sciences. "What do germs look like?" is an oft-recurring question that belongs in the field of hygiene as much as in botany or biology. "What do diseases come from?" and "Can human beings like ourselves live on Mars?" are questions belonging to several fields of science. "What makes the crude oil that comes from the earth?" is a popular question hard to classify.

Accordingly, when it came to the determination of the children's preferences for any particular field of science, it seemed best to select out of the approximately fifteen questions in each field a number of questions that might strictly be said to belong to one particular field only. For purposes of comparison, this number was made the same for all fields considered. By narrowing the fields of astronomy, chemistry, zoology, etc., to their most formal limits, twelve questions were found that belonged to each definite field.

Table XIII facing this page and Exhibit B following this page are presented so that the reader by examination may be able readily to identify the specific questions of any science field. We will use those of physics and zoology to illustrate. By consulting the questionnaire and reading the questions according to the numbers listed under the headings of physics and zoology in Table XIII it will be found that fifteen

36. J. Kunz, Inc., Delicatessen, Louisville, Ky.

questions classified as questions in physics belong specifically to the material of science recognized as physics by the writers of high school and college textbooks. This sampling cannot be assumed legitimately to represent the entire field of physics.

Likewise, an examination of the questions listed as zoological concerned themselves with the adaptation to environment, the economic importance, and the peculiar traits of familiar animals, which material is included in the encyclopedic accounts of the animals in question. The sampling cannot be assumed legitimately to represent the field of zoology. However, Bar Graph Exhibit F does indicate that the questions asked by the children from this field differ in popularity as a whole from those asked in zoology.

## EXHIBIT B

### Fields of Science to Which Questions Belong

1. Physics *
2. Astronomy
3. Chemistry
4. Physiography
5. Physics *
6. Physics
7. Astronomy
8. Physics
9. Botany
10. Zoology
11. Chemistry
12. Anthropology
13. Physics
14. Physiology
15. Electricity *
16. Zoology
17. Electricity
18. Botany
19. Anthropology
20. Electricity
21. Physiology
22. Electricity
23. Anthropology
24. Electricity
25. Astronomy
26. Physiography
27. Chemistry *
28. Electricity
29. Chemistry
30. Chemistry
31. Botany
32. Geology
33. Chemistry
34. Anthropology
35. Chemistry
36. Botany
37. Botany
38. Physics
39. Physiography
40. Physics
41. Physics
42. Zoology
43. Physics
44. Electricity
45. Physiology
46. Chemistry
47. Astronomy
48. Anthropology
49. Chemistry
50. Astronomy
51. Anthropology
52. Botany
53. Physics *
54. Physiography
55. Astronomy
56. Botany
57. Zoology
58. Geology *
59. Chemistry
60. Geology *
61. Geology
62. Electricity
63. Zoology
64. Electricity
65. Geology *
66. Zoology
67. Botany
68. Astronomy
69. Physics
70. Physiology
71. Zoology
72. Physiology
73. Electricity
74. Zoology
75. Botany
76. Chemistry
77. Zoology
78. Botany
79. Electricity*
80. Chemistry
81. Zoology
82. Chemistry
83. Zoology
84. Anthropology
85. Electricity *
86. Anthropology
87. Botany
88. Electricity
89. Geology
90. Zoology
91. Geology
92. Geology
93. Astronomy
94. Botany
95. Physics
96. Physiography
97. Physics
98. Geology
99. Anthropology
100. Physiography
101. Botany
102. Chemistry
103. Geology
104. Anthropology
105. Geology
106. Electricity
107. Anthropology
108. Physiography
109. Anthropology
110. Chemistry
111. Anthropology
112. Geology
113. Physiography
114. Physiology
115. Botany
116. Physics *
117. Botany
118. Physiology
119. Astronomy *
120. Physiology
121. Astronomy
122. Physiology
123. Astronomy
124. Anthropology
125. Astronomy
126. Physiology
127. Physiography
128. Physiography
129. Astronomy
130. Physiography
131. Zoology
132. Electricity *
133. Physiography
134. Zoology
135. Physiography
136. Zoology *
137. Physiology
138. Geology
139. Physiography
140. Physiology
141. Geology
142. Physiology
143. Anthropology
144. Physics
145. Geology *
146. Physiology
147. Astronomy
148. Physics *
149. Astronomy
150. Physiography

* indicates that question could belong to more than one field given.

# CHAPTER III

# MATERIALS

# CHAPTER III

## MATERIALS

Degree of interest in the items of the questionnaire is shown by the Scattergram facing this page, marked Exhibit C. It is apparent that the lines bunch in the middle third of the space covered by the scattergram and that fewer lines extend into the upper third of the space than drop down into the lower. This can be interpreted to mean that there is a moderate amount of interest in the great majority of questions, extraordinary interest in twenty-four of them, and decided lack of interest in thirty-two of them.

### EXHIBIT D

A Portion[37] of Table XIV

NUMBER OF CHILDREN EXPRESSING AN INTEREST IN EACH OF THE 150 QUESTIONS ON THE QUESTIONNAIRE, CLASSIFIED BY SCHOOL AND BY SEX

(Each group contains 50 children so that these numbers may be read as per cents if they are multiplied by two.)

| | Parkland | | | | Shawnee | | | | Western | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. Girls | | No. Boys | | No. Girls | | No. Boys | | No. Girls | | No. Boys | | Total No. Girls | Total No. Boys |
| | 8A | 8B | 8A | 8B | 8A | 8B | 8A | 8B | 8A | 8B | 8A | 8B | | |
| 1 | 22 | 29 | 31 | 28 | 16 | 25 | 23 | 20 | 25 | 18 | 23 | 27 | 135 | 152 |
| 2 | 36 | 29 | 27 | 35 | 29 | 29 | 33 | 36 | 32 | 30 | 36 | 33 | 185 | 200 |
| 3 | 25 | 22 | 27 | 25 | 27 | 12 | 31 | 22 | 15 | 22 | 24 | 30 | 123 | 159 |
| 4 | 16 | 26 | 33 | 26 | 25 | 22 | 29 | 19 | 19 | 27 | 29 | 27 | 135 | 163 |
| 5 | 40 | 42 | 28 | 38 | 35 | 39 | 31 | 34 | 40 | 35 | 23 | 30 | 231 | 184 |

A portion of the children's interests in the individual questions are shown by Table XIV, which is to be interpreted in the following manner:

Question 1, "Why do we eat sheep and do not eat cats?", received

37. Complete table to be found in appendix.

check marks as being of interest to 22 8A and 29 8B Parkland girls, 31 8A and 28 8B Parkland boys; 16 8A and 25 8B Shawnee girls, 23 8A and 20 8B Shawnee boys; 25 8A and 18 8B Western girls, 23 8A and 27 8B Western boys; making a total of 135 for the girls and 152 for the boys. The fact that 27 more boys than girls checked this question constitutes a result in line with the general finding of this thesis that boys are more interested in zoological material than girls.

Question 2, "How Saturn got its ring", was checked by 36 8A and 29 8B Parkland girls, 27 8A and 35 8B Parkland boys; 29 8A and 29 8B Shawnee girls, 33 8A and 36 8B Shawnee boys; 32 8A and 30 8B Western girls, 36 8A and 33 8B Western boys; making a total of 185 for girls and 200 for the boys checking this question in astronomy, which result on question number 2 is not in line with the general finding of this thesis that girls are more interested in astronomy than boys.

Question 3, "How to make a fire extinguisher", was interesting to 25 8A and 22 8B Parkland girls; to 27 8A and 25 8B Parkland boys; 27 8A and 12 8B Shawnee girls, 31 8A and 22 8B Shawnee boys; 15 8A and 22 8B Western girls, 24 8A and 30 8B Western boys; making a total of 123 girls and 159 boys. The result on this particular question falls in line with the general finding of this thesis that boys are more interested in physics than girls.

Question 4, "Why there are so many Canadian granity boulders strewn over Kentucky", was checked by 16 8A and 26 8B Parkland girls, 33 8A and 36 8B Parkland boys; 25 8A and 22 8B Shawnee girls, 29 8A and 19 8B Shawnee boys; 19 8A and 27 8B Western girls, 29 8A and 27 8B Western boys; making a total of 135 for the girls and 165 for the boys. This result on question number 4 is contrary to the general finding of this thesis that girls are more interested in physiography than boys.

Question 5, "Why the rails of a railroad look as if they were coming together in the distance", was interesting to 40 8A and 42 8B Parkland girls, 28 8A and 38 8B Parkland boys; 35 8A and 39 8B Shawnee girls, 31 8A and 34 8B Shawnee boys; to 40 8A and 35 8B Western girls, to 23 8A and 30 8B Western boys; making a total of 231 girls and 184 boys. The result of this question is out of line with the general finding of the thesis that physics is more interesting to boys than to girls.

Exhibit E, facing this page, is a scattergram which on examination will show that though there are differences in the average intelligences of the children of the eighth grade of the three schools from which they were drawn for the purpose of this thesis, a scattergram with three colors representing precisely the interests of each school in each of the 150 questions coincided so nearly in its connecting lines as to be almost illegible. The inference from this fact that I.Q.'s appear not seriously to affect interest in science is further borne out by the statistics on this point appearing later in this thesis.

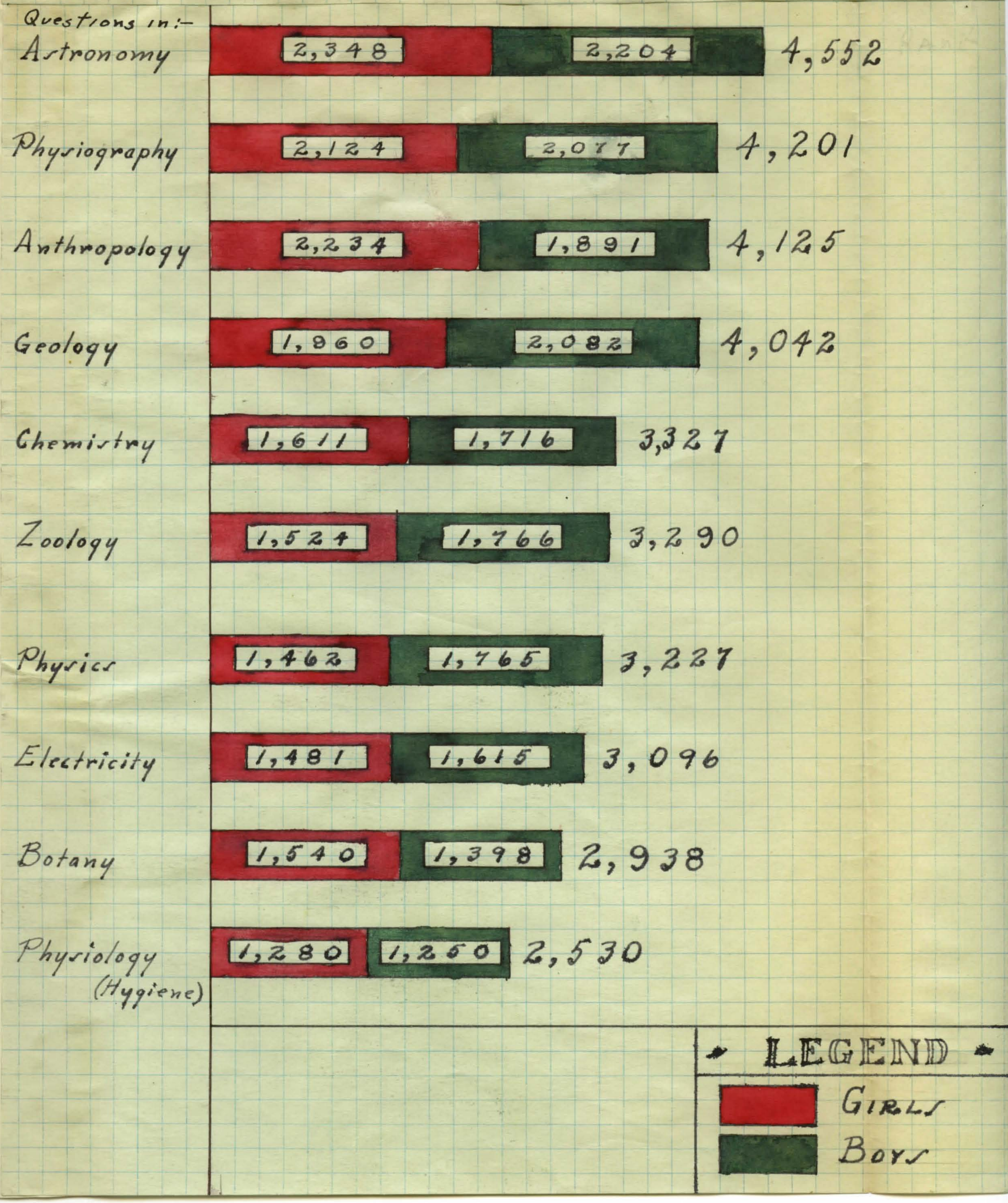
The children were allowed 55 minutes in which to check 75 of the most interesting questions out of the 150 on the questionnaire. They were urged to read the questionnaire through before they began to check. The checking proceeded in waves diminishing slightly toward the end. These curves can be measured as follows: 11,776 checks were made on the first 38 questions, which is approximately one-fourth of the number of questions; 10,004 checks were placed on questions 39-76 inclusive, which represents the second quarter of the questionnaire; 10,668 checks were placed on questions 77-113 inclusive, the third quarter, and 10,079 checks were placed on questions 114-150 inclusive, representing the last quarter. The drop at the second quarter cannot be ascribed to fatigue since 664 more questions were checked in the third quarter than in the second. The total number of checks made on questions in the first half of the questionnaire is 21,502, and that in the second half 21,025, showing a difference of 477 checks given to the first half of the questions more than to the last half. However, since a total of 42,527 checks were made on the entire questionnaire this slump of 477 in the latter half is not great enough to jeopardize the validity of the data. It could be assumed that the questions in the first and third quarters of the questionnaire were the more interesting than those in the secons and fourth quarters, the third quarter of the questions receiving from 600 pupils only 108 checks less than the first quarter.

The total checks on the first six questions are respectively 287, 385, 282, 298, 375, 230, and on the last six questions 375, 122, 339, 329, 313, and 414.

The difference in the number of checks on the first question and the last is 127 in favor of the last question. The difference between the 2nd question and the 149th is 72 in favor of the 2nd; between the 3rd and the 148th is 47 in favor of the 148th; between the 4th and the 147th is 41 in favor of the 147th. Difference between the 5th and 146th is 253 in favor of the 5th; difference between the 6th and 145th is 145 in favor of the 145th.

By examination of these figures, it is found that a comparison of the first six questions on the questionnaire with the last six that questions 2 and 5 in the first group of six received more checks than the corresponding numbers in the last group, namely 146 and 149, and that the other four questions in the block of six at the end of the questionnaire received more checks than questions 1, 3, 4, and 6 in the block of six at the beginning of the questionnaire. The total difference

Rank of Questions in the Fields of Science According to Interest. F



between the checks received on the first six questions of the questionnaire and the last six questions is 35 checks in favor of the block of six at the last of the questionnaire. From this we may assume that the difference between totals on the first six questions of the questionnaire and the last six questions, which is 477 out of 42,527 checks, is due to the fact that the questions in the first half of the questionnaire were more interesting to the children than those in the last half. This difference averaging .782 of a question per child is not significant. It is apparent from the above data that the time 55 minutes was sufficient for filling out the questionnaire, that there was no evidence of fatugue suffered by the children, and that the interest in the questions was sustained to the end.

Relative interest of children in the questions belonging to ten fields of science is shown by the bar graph facing this page, marked Exhibit F, which was constructed in the following manner. The check marks made by the 600 children on the questionnaire were counted for each question. These question checks were classified according to the ten fields of science as previously discussed.[38]

It was found that the questions classified as astronomical received the greatest total number of checks, those as physiographical the next highest number of checks, those classified as anthropological the next highest in number, etc. Therefore, the expressed interest of children is shown in the following table.

THE FIELDS OF SCIENCE RANKED WITH RESPECT TO EXPRESSED INTEREST OF THE 600 CHILDREN IN THE QUESTIONS BELONGING TO THEM

| | |
|---|---|
| 1. Astronomy | 6. Zoology |
| 2. Physiography | 7. Physics |
| 3. Anthropology | 8. Electricity |
| 4. Geology | 9. Botany |
| 5. Chemistry | 10. Physiology (Hygiene) |

38. p. 40.

Exhibit F on examination will reveal that the number of astronomy questions checked by girls exceeded that checked by boys by 144; the number of physiography questions checked by girls exceeded that checked by boys by 47; the number of chemistry questions checked by boys exceeded that checked by girls by 105; the number of zoology questions checked by boys exceeded that checked by girls by 242; the number of physics questions checked by boys exceeded that checked by girls by 303; the number of electricity questions checked by boys exceeded that checked by girls by 134.

Girls and boys differed most in expression of interest with respect to the question, "Which are the most poisonous snakes in Kentucky?". 103 more girls than boys checked that item. This result varies from the finding of this thesis that girls are less interested in zoological questions than boys. The fact that 103 more girls than boys checked this question about snakes could be accounted for on the grounds that danger and mystery provoke interest and that snakes possess these two attractions for girls to a greater degree than for boys. This may be due to environmental influences. Girls normally have no opportunity to loose their horror of snakes by learning the truth about them. Boys, on the other hand, tramp about places where snakes can be found, go on hikes, and live in camps where the study of economic value of snakes, avoidance of dangerous ones, and the fearless handling of the friendly varieties are encouraged. "What makes the rainbow?" showed the next greatest divergence in sex interest, the girls checking this question 87 more times than boys. It is possible that girls at the eighth grade level are more interested in rainbows than boys because their asthetic sensibilities are more mature at that level than those of the boys.

It is obvious, however, from the study of the figures quoted above

**H**

| BOYS \ GIRLS | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 | 100-109 | 110-119 | 120-129 | 130-139 | 140-149 | 150-159 | 160-169 | 170-179 | 180-189 | 190-199 | 200-209 | 210-219 | 220-229 | 230-239 | 240-249 | 250-259 | f 150 | d | Σfdy -80 | Σfd²y 2244 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250-259 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 240-249 | | | | | | | | | | | | | | | | | | | | | I 90 | 1 | 9 | 9 | 81 |
| 230-239 | | | | | | | | | | | | | | | | | | | | II 144 | | 2 | 8 | 16 | 128 |
| 220-229 | | | | | | | | | I -14 | | | | | I 21 | | I 35 | | | | | | 3 | 7 | 21 | 147 |
| 210-219 | | | | | | | | | | I -6 | | | | | | | | | I 48 | | | 2 | 6 | 12 | 72 |
| 200-209 | | | | | | | | | I -10 | | | | II 20 | I 15 | | II 50 | I 30 | II 70 | | | | 9 | 5 | 45 | 225 |
| 190-199 | | | | | | | | | | | | | I 8 | I 12 | I 16 | III 60 | | | | | | 6 | 4 | 24 | 96 |
| 180-189 | | | | | | | | II -18 | | II -6 | | I 3 | I 6 | III 27 | | I 15 | | | | | | 10 | 3 | 30 | 90 |
| 170-179 | | | | | | | | | | II -4 | II | II 4 | II 8 | II 12 | III 24 | | | | | | | 13 | 2 | 26 | 52 |
| 160-169 | | | | | | I -5 | | I -3 | III -6 | II -2 | I | II 2 | I 2 | I 3 | I 4 | I 5 | | | | | | 14 | 1 | 14 | 14 |
| 150-159 | | | | | | | | II | II | I | I 0 | I | II | II | | | | | I | | | 11 | 0 | 0 | 0 |
| 140-149 | | | | | | | I 4 | III 9 | II 4 | | I | II -2 | I -2 | IIII -12 | | | | | -8 | | | 15 | -1 | -15 | 15 |
| 130-139 | | | | | II 24 | | II 16 | IIII 24 | II 8 | I 2 | II | II -4 | I -4 | I -6 | I -8 | I -10 | | | | | | 19 | -2 | -38 | 76 |
| 120-129 | | | | I 21 | II 36 | I 15 | I 12 | 卌 45 | I 6 | I 3 | | | | I -9 | | | | | | | | 13 | -3 | -39 | 117 |
| 110-119 | | I 36 | I 32 | | II 48 | I 20 | | I 12 | | I 4 | I | | | | | | | | | | | 8 | -4 | -32 | 128 |
| 100-109 | | | | | II 60 | II 50 | | I 15 | | | | | | | | | | | | | | 5 | -5 | -25 | 125 |
| 90-99 | I 60 | | | | IIII 144 | III 90 | I 24 | | | I 6 | | | | | | | | | | | | 10 | -6 | -60 | 360 |
| 80-89 | | | II 112 | I 49 | | | I 28 | | | | | | | | I -28 | | | | | | | 5 | -7 | -35 | 245 |
| 70-79 | II 160 | | | | | I 40 | | | | | | | | | | | | | | | | 3 | -8 | -24 | 192 |
| 60-69 | I 90 | | | | | | | | | | | | | | | | | | | | | 1 | -9 | -9 | 81 |
| 50-59 | | | | | | | | | | | | | | | | | | | | | | | | | |
| f 150 | 4 | 1 | 3 | 2 | 12 | 9 | 6 | 19 | 12 | 12 | 8 | 10 | 11 | 17 | 7 | 9 | 1 | 2 | 2 | 2 | 1 | | | | |
| d | -10 | -9 | -8 | -7 | -6 | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | |
| Σfdx -101 | -40 | -9 | -24 | -14 | -72 | -45 | -24 | -57 | -24 | -12 | 0 | 10 | 22 | 51 | 28 | 45 | 6 | 14 | 16 | 18 | 10 | | | | |
| Σfd²x 2823 | 400 | 81 | 192 | 98 | 432 | 225 | 96 | 171 | 48 | 12 | 0 | 10 | 44 | 153 | 112 | 225 | 36 | 98 | 128 | 162 | 100 | | | | |

+2043
−177
1866
Σdxdy

SCATTER DIAGRAM OF NUMBERS OF GIRLS AND BOYS EVIDENCING INTEREST IN EACH OF THE 150 ITEMS ON THE TEST

$$r = \frac{\frac{\Sigma dxdy}{n} - c_x c_y}{\sigma_x \, \sigma_y} =$$

$$\frac{\frac{1866}{150} - \left(\frac{-101}{150} \times \frac{-80}{150}\right)}{\sqrt{\frac{2823}{150} - \left(\frac{-101}{150}\right)^2} \; \sqrt{\frac{2244}{150} - \left(\frac{-80}{150}\right)^2}} =$$

$$\frac{271820}{150 \times 150} \div \left[\sqrt{\frac{413249}{150^2}} \cdot \sqrt{\frac{330200}{150^2}}\right] =$$

$$\frac{271820}{150^2} \times \left(\frac{150^2}{64282 \times 575.06}\right) =$$

$$\frac{271820}{370060.0692} = .73$$

$$P.E. \; \frac{.6745(1-r^2)}{\sqrt{150}} = \frac{.6745 \times .994671}{12.24} = .0054$$

The correlation between the interests of girls and boys in the material of science is $.73 \pm .0054$

and from the position of the dots on the scattergram G that the sex differences in the interests of these children for the questions taken as a whole are too slight to be significant.

This general conclusion is strengthened by the fact that when numbers of girls and boys expressing interest in the 150 items on the questionnaire are correlated a coefficient of .73 .0054 is obtained. From the included scatter diagram, Exhibit E, it is apparent, by inspection, that the data are linear and consequently that the product-moment correlation technique of analysis is appropriate. While this value of .73 is considerably below 1.00, it is probably as high as would be reasonable to expect under any circumstances considering the nature of the data. Questionnaire data of this type are usually found to have reliability coefficients of not more than .64. If this figure is assumed as the reliability of the data for both boys and girls, by application of Spearman's formula for correction for attenuation we obtain a coefficient of .913 between the expressed interests of boys and girls on the 150 items of the questionnaire. The formula is:

$$r_{\infty\infty} = \frac{r_{12}}{\sqrt{r_{1I}}\sqrt{r_{2II}}}$$

, where $r_{12}$ refers to the zero order correlation between the two variables, $r_{1I}$, to the reliable coefficient for the first variable, $r_{2II}$, to the reliability coefficient for the second variable, and $r_{\infty\infty}$ to the maximum limit of the relationship that could exist if the measures were 100% accurate.[39]

These differences, slight as they are, in general do show certain

39. Dunlap, J. W. and Kurtz, A. L., Handbook of Statistical Nomographs, Tables and Formulas, World Book Co., 1932, Formula 280.

trends. The fact that the physics questions were checked 303 more times by the boys than by the girls substantiates the findings of Victor Smith that physics is harder for girls than for boys.[40] Whether this is due to the fact that the mental processes involved in solving the problems of physics are not pleasurable to girls or whether the materials of this science are not related directly enough to their biological or mental needs, constitute problems that cannot be answered, either from the findings of this study or from the literature examined.

The materials displayed in tables, scattergrams, and other exhibits of this thesis serve to give weight to a statement made in the preface of the "Story of the Earth and Sky", which follows:[41]

"Studies of the spontaneous questions show that beginning at about the age of nine and lasting at least until early adolescence, there was a keen interest...in the stars...in the story of the earth, its probable origin, its evolution, and its place in the solar system and in the imagination-stretching starry universe."

The popularity of the astronomic and physiographic questions in the prestnt study as indicated by rank on Exhibit F[42] could be accounted for by the fact that the questions on this subject dealt with features of natural grandeur or awe-inspiring phenomena. The botany questions might have been relatively unpopular because they dealt with familiar or commonplace things. Three children to whom the questionaire was presented were asked why they failed to check any of the questions in the field of physiology or hygiene. They gave as reasons that they knew the answerw and that the questions were not interesting, anyway. An informal test of their knowledge of the correct answers to these questions was

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40. cf., p. 15
41. Washburne, C. W., Washburne, Heluiz, with Reed, Frederick, <u>The Story of the Earth and Sky</u>, New York, D. Appleton-Century Co., 1935.
42. Facing p. 48.

EXHIBIT I

QUESTIONNAIRE ITEMS RANKED ACCORDING TO NUMBER OF THE SIX HUNDRED STUDENTS EXPRESSING INTEREST IN THEM

| Rank | Question No. | No. of Checks | Rank | Question No. | No. of Checks | Rank | Question No. | No. of Checks |
|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 493 | 51 | 78 | 330 | 101.5 | 69 | 262 |
| 2 | 32 | 480 | 52 | 148 | 329 | 101.5 | 132 | 262 |
| 3 | 96 | 472 | 53.5 | 119 | 328 | 103 | 36 | 259 |
| 4 | 55 | 452 | 53.5 | 34 | 328 | 104 | 135 | 257 |
| 5 | 18 | 436 | 55.5 | 136 | 327 | 105 | 52 | 256 |
| 6 | 105 | 434 | 55.5 | 85 | 327 | 106 | 9 | 255 |
| 7 | 141 | 421 | 58 | 133 | 325 | 107 | 111 | 254 |
| 8 | 92 | 415 | 58 | 128 | 325 | 108 | 49 | 252 |
| 9. | 150 | 414 | 58 | 100 | 325 | 110 | 103 | 251 |
| 10 | 68 | 405 | 60 | 21 | 324 | 110 | 41 | 251 |
| 11 | 125 | 404 | 61 | 51 | 318 | 110 | 40 | 251 |
| 12 | 42 | 400 | 62 | 50 | 316 | 112 | 82 | 248 |
| 13 | 47 | 398 | 63.5 | 89 | 314 | 113 | 106 | 247 |
| 14 | 93 | 396 | 63.5 | 99 | 314 | 114 | 91 | 246 |
| 15 | 26 | 395 | 65 | 149 | 313 | 115 | 31 | 244 |
| 16 | 74 | 387 | 67 | 8 | 312 | 116 | 75 | 240 |
| 17 | 2 | 385 | 67 | 48 | 312 | 117 | 116 | 233 |
| 18 | 65 | 380 | 67 | 129 | 312 | 118 | 101 | 231 |
| 19 | 25 | 379 | 69 | 24 | 311 | 119 | 6 | 230 |
| 20 | 107 | 378 | 70.5 | 16 | 307 | 120 | 60 | 229 |
| 21.5 | 5 | 375 | 70.5 | 88 | 307 | 121 | 57 | 227 |
| 21.5 | 145 | 375 | 72 | 115 | 305 | 122 | 56 | 226 |
| 23 | 109 | 374 | 73.5 | 126 | 303 | 123.5 | 144 | 212 |
| 24 | 38 | 371 | 73.5 | 110 | 303 | 123.5 | 108 | 212 |
| 25 | 143 | 367 | 75 | 80 | 301 | 125 | 102 | 211 |
| 27 | 121 | 364 | 76.5 | 4 | 298 | 126 | 66 | 210 |
| 27 | 23 | 364 | 76.5 | 67 | 298 | 128 | 131 | 205 |
| 27 | 11 | 364 | 78 | 79 | 297 | 128 | 94 | 205 |
| 29.5 | 130 | 361 | 79 | 98 | 296 | 128 | 71 | 205 |
| 29.5 | 12 | 361 | 81 | 46 | 293 | 130.5 | 43 | 203 |
| 31 | 63 | 357 | 81 | 70 | 293 | 130.5 | 14 | 203 |
| 32 | 13 | 356 | 81 | 137 | 293 | 132 | 97 | 201 |
| 33 | 139 | 356 | 83 | 64 | 291 | 133 | 20 | 198 |
| 34 | 138 | 356 | 84 | 83 | 290 | 134 | 112 | 198 |
| 35 | 61 | 355 | 85.5 | 1 | 287 | 135 | 122 | 197 |
| 37 | 59 | 353 | 85.5 | 35 | 287 | 136 | 15 | 196 |
| 37 | 120 | 353 | 87 | 3 | 282 | 137 | 62 | 194 |
| 37 | 84 | 353 | 88 | 117 | 281 | 138 | 90 | 192 |
| 39 | 86 | 349 | 89 | 17 | 280 | 139 | 81 | 190 |
| 40 | 54 | 347 | 90.5 | 134 | 279 | 140 | 114 | 184 |
| 41 | 27 | 344 | 90.5 | 33 | 279 | 141 | 29 | 183 |
| 42 | 147 | 339 | 92 | 76 | 278 | 142 | 87 | 177 |
| 43 | 22 | 338 | 93 | 30 | 276 | 143 | 28 | 172 |
| 44 | 127 | 337 | 94 | 104 | 274 | 144 | 73 | 165 |
| 45 | 19 | 335 | 95 | 77 | 272 | 145 | 118 | 164 |
| 47 | 113 | 333 | 96 | 140 | 271 | 146 | 37 | 159 |
| 47 | 123 | 333 | 97.5 | 124 | 268 | 147 | 95 | 151 |
| 47 | 58 | 333 | 97.5 | 53 | 268 | 148 | 45 | 127 |
| 49.5 | 44 | 332 | 99 | 72 | 266 | 149 | 146 | 122 |
| 49.5 | 10 | 332 | 100 | 39 | 265 | 150 | 142 | 114 |

made on the spot and it was found that they did not know the correct answers, though they gave in good faith explanations based on folkways of thinking about health matters.

The fact that the findings of this thesis vary from the findings of the studies discussed in Chapter I could be accounted for on the grounds that the former studies were carried on largely at the kindergarden and early primary grade level. It will be recalled that this study was made by using as subjects children at the eighth grade level with an average age 14.4. It is assumed tentatively that between the ages of 8 and 11 through experiences gained in the nature studies presented in public schools, children have found out some of the things they wanted to know about animals and plants.

That the interest of children of junior high school age appears to center around heavenly bodies and their movements, the structure of the earth and its changes, and about the story of mankind, could be accounted for partly by the stimulation afforded by such comic strips as Buck Rogers' adventures, the Tarzan series, motion pictures and newspaper articles featuring eclipses, sun-spots, etc. There might be indicated also in this apparent change of interest about the age of 9 a general tendency of all children's interests to broaden and deepen as the mental faculties of the child mature, in which interests in science might be expected to be effected.[43]

On Exhibit I, facing this page, in which the questions are ranked from one to one hundred and fifty, it will be noted that No. 7, a question in astronomy, ranks first, and that No. 142, a question in physiology, ranks last. As will be seen by an examination of Exhibit F, facing page 48,

43. Piaget, Jean, The Child's Conception of Physical Causality, New York, Harcourt Brace & Co., 1930, pp. 266-281.

the field of astronomy ranks first in point of pupil interest and the field of pysiology ranks last. A question in chemistry, on Exhibit I, No. 80, has the median rank of 75, and the field of chemistry on Exhibit F ranks five in point of pupil interest.

TABLE XV

ITEMS OF MOST INTEREST TO GIRLS

| Number of Girls who Checked | Item |
|---|---|
| 251 | The ways in which scientists think the world might come to an end. |
| 244 | How old is the earth. |
| 244 | Where the earth came from. |
| 242 | What makes quicksand. |
| 229 | What are the oldest living things. |
| 220 | What causes earthquakes. |

TABLE XVI

ITEMS OF MOST INTEREST TO BOYS

| Number of Boys who Checked | Item |
|---|---|
| 242 | The ways in which scientists think the world might come to an end. |
| 236 | How old is the earth. |
| 233 | What makes quicksand. |
| 218 | What is at the center of the earth. |
| 215 | How to make a telescope. |
| 207 | What is the oldest living thing. |

TABLE XVII

ITEMS OF LEAST INTEREST TO GIRLS

| Number of Girls who Checked | Item |
|---|---|
| 52 | Why is it easier to lift a weight with pulleys. |
| 52 | Why should we eat spinach and carrots. |
| 52 | Why do we take a shower after gym exercise. |
| 54 | Why parents and teachers ask children to drink milk rather than coffee. |
| 62 | Why do you use a transformer when you run a toy electric train. |
| 97 | Why the rails of a railroad look as if they were coming together in the distance. |

TABLE XVIII

ITEMS OF LEAST INTEREST TO BOYS

| Number of Boys who Checked | Item |
|---|---|
| 62 | Why we should eat spinach and carrots. |
| 70 | Why we take a shower after gym exercises. |
| 75 | How plants make seeds. |
| 80 | How to repair a cord on an electric lamp. |
| 82 | How snapping off a switch turns out the light. |
| 86 | How plants scatter seeds. |

An examination of Tables XV, XVI, XVII, and XVIII indicate that the items of most interest both to boys and girls are cultural and general rather than utilitarian and specific. They appeal to the imagination; they are dramatic in their human relations; have to do with cosmic conditions vital to the human race. The items of least interest to boys and girls are personal and functional in their nature; the range of application is narrow; they are commonplace, familiar and in detail.

Might not the preferences of the children for the larger aspects of science experiences indicate to science curriculum builders and science textbook writers that they should avoid offering to the children inert slices or chunks of factual matter, separated from their vital relationships with the entire field of phenomena? Might not these expressed interests in the fundamental and universal place on those that plan the science work for the children in our schools, an obligation to search until they find some way to present apparently trivial and local experiences in their dynamic relationships to the phenomena that appeal to the imagination of adolescence?

**Table XIX**

This table shows insignificant but interesting differences in the science interests of children, having different intelligence quotients, total average quotient at 95.003, average quotient of highs 110.6, average quotient of lows 80.006.

| | Astronomy I.Q. High | Astronomy I.Q. Low | Physiography I.Q. High | Physiography I.Q. Low | Anthropology I.Q. High | Anthropology I.Q. Low | Geology I.Q. High | Geology I.Q. Low | Chemistry I.Q. High | Chemistry I.Q. Low |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1,516 | 1,569 | 1,582 | 1,516 | 1,622 | 1,387 | 996 | 1,064 | 1,336 | 1,553 |
| Difference | | 53 | 66 | --- | 235 | --- | --- | 68 | --- | 217 |

| | Zoology I.Q. High | Zoology I.Q. Low | Physics I.Q. High | Physics I.Q. Low | Electricity I.Q. High | Electricity I.Q. Low | Botany I.Q. High | Botany I.Q. Low | Physiology I.Q. High | Physiology I.Q. Low |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1,319 | 1,288 | 1,111 | 1,253 | 719 | 829 | 1,033 | 1,097 | 841 | 892 |
| Difference | 27 | --- | --- | 142 | --- | 110 | --- | 64 | --- | 51 |

To arrive at the above figures the sample of 28 out of each group of 50 was selected as follows: the I.Q.'s of each group of 50 were listed from high to low. The 14 lowest of each group was chosen to represent the low I.Q.'s, the 14 highest of each group was chosen to represent the high I.Q.'s. This sample according to a study made by M. B. Jensen gives reliable data for measuring differences in education and interests based on differences in I.Q.'s.[44]

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44. Jensen, M.B., Objective Differentiation Between Three Groups in Education (Teachers, Research Workers and Administration), Genetic Psychology Monograph, Vol. III, No. 5, (May, 1928), p. 61.

It will be found by an examination of Table XIX, facing this page, that differences in intelligence in children do not significantly affect their interest in materials of science. It will be observed that there are slight differences in science interest between the children of low and high intelligence. These are to be discussed since it is possible they show trends.

Table XVIII is to be interpreted as follows; the sample of low I. Q. Children chosen to measure the difference in interest between those of low and high I. Q.'s placed 1,569 checks on the astronomy questions. Those of the high I. Q. form the same group placed 1,516 checks on the astronomy questions. Since the difference between these checks is 53 it means that out of 168 children 53 more of the low I. Q. group than of the high I. Q. group manifested interest in questions astronomy. Likewise, the high I. Q. group placed 66 more checks on the physiography questions that did the low I. Q. group; 235 more checks were placed by the high I. Q.'s on the anthropology questions than by the low I. Q.'s; 68 more checks were placed by the low I. Q,'s on the geology questions than by the high I. Q.'s; 217 more questions were checked by the low I. Q.'s On chemistry questions than by the high I. Q.'s; 27 more checks were placed on zoology questions by the high I. Q.'s than by the low I. Q.'s; 142 more checks were placed on physics questions by the low I. Q.'s than by the high I. Q.'s; 110 more checks were placed on questions on electricity by the low I. Q.'s than by the high I. Q.'s; 64 more botany questions were checked by the low I. Q.'s than by the high I.Q.'s.

If any meaning can be attached to these differences we shall have to look for them in the fields of anthropology, physics and electricity where the differences are the greatest. The questions on physics and electricity are specific, functional, and concrete in character. They do not appeal to the imagination and require no power of abstract thought. The questions of these two fields appeal to the low intelligence group more strongly than to the children in the high intelligence group. The greatest difference between interests of the two groups is found to be in the field of anthropology. The questions pertaining to the field are cultural in their nature and might be expected to appeal to children who would be interested in seeing the human race in perspective and in relation to its environment.

## Summary

The purpose of this study is to find some evidence of the interest in science of children at the eighth grade level of development. The findings are to be considered as a portion of the complete data to be found in the future on the science interest of school children of all ages. These findings are to be taken into consideration in the making of science curricula and textbooks. These textbooks and courses of study are considered to be unsatisfactory both on account of the value of the subject matter and the emphasis placed on phases of various fields of science.

A review was made of the available field of literature devoted to science interests of children in order to obtain background and perspective for a view of the interests of eight grade pupils. It was found that on the whole younger children were interested in the animals, older children in the inorganic fields. The data indicated that the phases of greatest interest of children in animals were locomotion, respiration, and adaptation to environment. Some sex differences also were indicated in studies made of children of kindergarden and primary and high school age.

A renewed interest in the study of children's science interests, which seems to have been fairly inactive [45] since 1928, is indicated

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45. This statement seems to be valid since the writer assisted by the library staffs of the University of Louisville library and the Louisville Free Public Library made a search through the Reader's Guide, Education Index, United States Catalogue, Accumulated Book Index and found no publication listed that would indicate that any study of children's interests had been printed since the Inman-Kane study of 1934.[2]
2 Loc. Cit. P.15

by the plans that the Winnetka School System have made to be carried on by a committee of wide geographical distribution, in which Louisville has membership.

The data for this study were obtained by employing as subjects six hundred children, three hundred boys and three hundred girls from the eighth grades of the junior department of three high schools of Louisville, Kentucky. Out of a hundred and fifty questions on a questionnaire, these children checked the seventy-five that were most interesting to them. The items on the questionnaire were selected from a collection of several hundred questions gathered by the writer over a period of seven years. These questions were asked spontaneously by the children. The method of selection was as follows: the several hundred questions were dropped into piles representing ten conventional fields of science. Fifteen questions were drawn from each field.

An analysis of the datd indicates that the major interest of the six hundred children was astronomy. The interest ranking second was physiogrphy, followed by anthropology, geology, chemistry, zoology, physics, electricity, botany, and physiology (hygiene.). There was a gigh positive correlation of interest between the sexes. The insignificant sex differences, however, fell in line with those of previous researches. The girls were less interested in physics and more interested in science fields relating directly to human concerns than boys. Both boys and girls showed a lack of interest in commonplace and familiar things and a high degree of interest in questions challenging the imagination.

It was found by comparing reliable per cents of the children having the lowest I.Q. with those having the highest I.Q. that there were no differences in science interests that were significant quantitatibely. What differences there were seemed to indicate that the children of low I.Q.'s were less interested in questions that demanded abstract thinking and for which there was a wide or a cultural background.

This study of the science interest of eight grade children has the following meanings for the teacher of science:

1. External motivation such as grades, rewards, and social pressure will be required in increasing measure for achievement of learning in the following fields of science: astronomy, physiography, anthropology, geology, chemistry, zoology, physics, electricity, botany, and physiology (hygiene).

2. Interest or lack of interest in any science field will be fairly constant among children of the same age and in the same socio-economic background, regardless of intelligence.

3. No sex difference in interest in General Science as a whole will be found significant enough to warrent making adjustments in the curriculum for boys and girls. It will be expected, however, that girls will show less spontaneous interest experiences in the fields of physics, zoology, and electricity than boys and that boys will show less interest in experiences in the field of anthropology, astronomy, and botany than girls.

4. It can be expected that children will show a spontaneous interest in any material of science that escapes the commonplace and the familiar, that challenges the imagination, that deals with cataclysmic changes and that possesses the qualities of mystery or of grandeur.

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# APPENDIX

NUMBER OF CHILDREN EXPRESSING AN INTEREST IN EACH OF THE 150 QUESTIONS ON THE QUESTIONNAIRE, CLASSIFIED BY SCHOOL AND BY SEX

(Each group contains 50 children so that these numbers may be read as per cents if they are multiplied by two.)

| | PARKLAND | | | | SHAWNEE | | | | WESTERN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. Girls | | No. Boys | | No. Girls | | No. Boys | | No. Girls | | No. Boys | | Total No. Girls | Total No. Boys |
| Item | 8A | 8B | 8A | 8B | 8A | 8B | 8A | 8B | 8A | 8B | 8A | 8B | | |
| 1 | 22 | 29 | 31 | 28 | 16 | 25 | 23 | 20 | 25 | 18 | 23 | 27 | 135 | 152 |
| 2 | 36 | 29 | 27 | 35 | 29 | 29 | 33 | 36 | 32 | 30 | 36 | 33 | 185 | 200 |
| 3 | 25 | 22 | 27 | 25 | 27 | 12 | 31 | 22 | 15 | 22 | 24 | 30 | 123 | 159 |
| 4 | 16 | 26 | 33 | 26 | 25 | 22 | 29 | 19 | 19 | 27 | 29 | 27 | 135 | 163 |
| 5 | 40 | 42 | 28 | 38 | 35 | 39 | 31 | 34 | 40 | 35 | 23 | 30 | 231 | 184 |
| 6 | 17 | 19 | 24 | 23 | 13 | 12 | 26 | 23 | 16 | 20 | 22 | 15 | 97 | 133 |
| 7 | 40 | 41 | 37 | 40 | 37 | 45 | 42 | 46 | 42 | 46 | 38 | 39 | 251 | 242 |
| 8 | 28 | 27 | 33 | 24 | 21 | 27 | 29 | 22 | 24 | 19 | 30 | 28 | 146 | 166 |
| 9 | 24 | 22 | 22 | 26 | 17 | 19 | 22 | 20 | 24 | 18 | 18 | 23 | 124 | 131 |
| 10 | 33 | 27 | 33 | 31 | 27 | 21 | 28 | 24 | 25 | 32 | 20 | 33 | 165 | 169 |
| 11 | 32 | 30 | 34 | 27 | 27 | 33 | 34 | 33 | 32 | 31 | 31 | 26 | 185 | 185 |
| 12 | 23 | 38 | 30 | 28 | 27 | 32 | 36 | 33 | 33 | 28 | 30 | 23 | 181 | 180 |
| 13 | 26 | 27 | 35 | 37 | 28 | 20 | 34 | 38 | 20 | 20 | 34 | 37 | 141 | 215 |
| 14 | 17 | 31 | 20 | 15 | 11 | 16 | 16 | 13 | 19 | 15 | 12 | 18 | 109 | 94 |
| 15 | 17 | 18 | 13 | 24 | 10 | 12 | 16 | 18 | 13 | 20 | 18 | 17 | 90 | 106 |
| 16 | 21 | 20 | 30 | 29 | 12 | 26 | 28 | 31 | 17 | 26 | 36 | 32 | 122 | 186 |
| 17 | 14 | 23 | 22 | 37 | 24 | 19 | 20 | 25 | 16 | 16 | 35 | 29 | 112 | 168 |
| 18 | 36 | 43 | 31 | 27 | 33 | 40 | 40 | 38 | 38 | 39 | 38 | 33 | 229 | 207 |
| 19 | 29 | 34 | 36 | 29 | 21 | 25 | 27 | 29 | 29 | 23 | 30 | 23 | 161 | 174 |
| 20 | 13 | 16 | 16 | 17 | 16 | 22 | 15 | 17 | 18 | 15 | 17 | 16 | 100 | 98 |
| 21 | 29 | 20 | 23 | 19 | 24 | 27 | 29 | 26 | 35 | 27 | 31 | 34 | 162 | 162 |
| 22 | 22 | 26 | 12 | 23 | 17 | 23 | 14 | 19 | 22 | 24 | 24 | 12 | 134 | 104 |
| 23 | 33 | 36 | 39 | 29 | 30 | 27 | 29 | 31 | 37 | 29 | 36 | 38 | 192 | 202 |
| 24 | 24 | 23 | 32 | 32 | 23 | 29 | 25 | 23 | 17 | 32 | 26 | 23 | 148 | 163 |
| 25 | 26 | 30 | 28 | 31 | 33 | 29 | 29 | 39 | 32 | 36 | 33 | 33 | 186 | 193 |
| 26 | 35 | 35 | 36 | 34 | 21 | 36 | 23 | 36 | 41 | 33 | 26 | 39 | 201 | 194 |
| 27 | 34 | 36 | 36 | 25 | 34 | 34 | 29 | 23 | 34 | 34 | 30 | 25 | 206 | 168 |
| 28 | 12 | 15 | 15 | 14 | 6 | 14 | 16 | 22 | 4 | 11 | 22 | 21 | 62 | 110 |
| 29 | 20 | 17 | 16 | 19 | 15 | 15 | 10 | 15 | 10 | 16 | 18 | 12 | 93 | 90 |
| 30 | 18 | 21 | 32 | 23 | 20 | 20 | 25 | 26 | 19 | 27 | 35 | 30 | 125 | 171 |
| 31 | 15 | 26 | 25 | 19 | 30 | 14 | 25 | 16 | 18 | 17 | 19 | 20 | 120 | 124 |
| 32 | 41 | 37 | 37 | 42 | 41 | 42 | 35 | 42 | 40 | 43 | 44 | 36 | 244 | 236 |
| 33 | 21 | 20 | 24 | 19 | 16 | 31 | 19 | 28 | 25 | 24 | 27 | 25 | 137 | 142 |
| 34 | 35 | 36 | 28 | 23 | 30 | 24 | 25 | 27 | 32 | 28 | 27 | 20 | 185 | 150 |
| 35 | 24 | 19 | 27 | 26 | 25 | 21 | 25 | 23 | 22 | 19 | 29 | 27 | 130 | 157 |
| 36 | 26 | 20 | 23 | 21 | 19 | 20 | 25 | 26 | 21 | 17 | 23 | 18 | 123 | 136 |
| 37 | 17 | 16 | 17 | 17 | 9 | 9 | 10 | 14 | 14 | 8 | 9 | 19 | 73 | 86 |
| 38 | 27 | 25 | 30 | 36 | 31 | 33 | 31 | 31 | 26 | 30 | 42 | 29 | 172 | 199 |
| 39 | 27 | 25 | 23 | 18 | 17 | 26 | 15 | 18 | 29 | 22 | 20 | 25 | 146 | 119 |
| 40 | 18 | 21 | 21 | 28 | 11 | 20 | 21 | 16 | 31 | 21 | 24 | 19 | 122 | 129 |
| 41 | 27 | 24 | 24 | 20 | 20 | 22 | 21 | 15 | 16 | 15 | 29 | 18 | 124 | 127 |
| 42 | 31 | 30 | 30 | 33 | 29 | 42 | 28 | 35 | 36 | 34 | 37 | 35 | 202 | 198 |
| 43 | 10 | 20 | 15 | 19 | 22 | 17 | 14 | 18 | 17 | 17 | 18 | 18 | 103 | 102 |
| 44 | 29 | 24 | 28 | 29 | 20 | 28 | 26 | 26 | 30 | 30 | 36 | 26 | 161 | 171 |

Table XII (Continued)

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | 12 | 13 | 14 | 16 | 4 | 6 | 13 | 39 | 10 | 9 | 10 | 11 | 54 | 73 |
| 46 | 24 | 19 | 28 | 29 | 21 | 18 | 26 | 28 | 19 | 24 | 29 | 28 | 125 | 168 |
| 47 | 34 | 37 | 36 | 32 | 30 | 32 | 25 | 31 | 38 | 37 | 37 | 29 | 208 | 190 |
| 48 | 30 | 31 | 23 | 30 | 21 | 23 | 27 | 26 | 26 | 24 | 23 | 28 | 155 | 157 |
| 49 | 19 | 21 | 24 | 18 | 20 | 22 | 17 | 22 | 21 | 22 | 24 | 22 | 125 | 127 |
| 50 | 16 | 38 | 20 | 34 | 18 | 30 | 15 | 29 | 33 | 37 | 24 | 22 | 172 | 144 |
| 51 | 24 | 29 | 25 | 32 | 21 | 25 | 25 | 28 | 28 | 20 | 35 | 26 | 147 | 171 |
| 52 | 28 | 22 | 26 | 22 | 14 | 21 | 28 | 23 | 19 | 25 | 26 | 21 | 129 | 146 |
| 53 | 22 | 22 | 25 | 28 | 17 | 16 | 23 | 30 | 18 | 18 | 22 | 17 | 113 | 145 |
| 54 | 38 | 29 | 29 | 33 | 27 | 32 | 28 | 33 | 34 | 29 | 33 | 32 | 189 | 188 |
| 55 | 40 | 39 | 29 | 40 | 34 | 43 | 36 | 36 | 43 | 35 | 36 | 41 | 234 | 218 |
| 56 | 21 | 14 | 25 | 22 | 22 | 17 | 19 | 37 | 15 | 15 | 20 | 19 | 104 | 142 |
| 57 | 21 | 22 | 13 | 26 | 22 | 20 | 19 | 22 | 19 | 16 | 14 | 13 | 120 | 107 |
| 58 | 21 | 24 | 36 | 30 | 30 | 25 | 33 | 38 | 16 | 21 | 28 | 31 | 137 | 196 |
| 59 | 31 | 31 | 20 | 25 | 35 | 35 | 33 | 31 | 26 | 31 | 28 | 27 | 189 | 164 |
| 60 | 11 | 10 | 22 | 23 | 19 | 21 | 26 | 26 | 11 | 19 | 17 | 24 | 91 | 138 |
| 61 | 32 | 24 | 30 | 35 | 27 | 32 | 33 | 27 | 29 | 23 | 31 | 32 | 167 | 188 |
| 62 | 20 | 20 | 11 | 15 | 13 | 18 | 10 | 14 | 26 | 15 | 12 | 20 | 112 | 82 |
| 63 | 28 | 35 | 30 | 33 | 30 | 32 | 26 | 24 | 28 | 33 | 29 | 29 | 186 | 171 |
| 64 | 35 | 19 | 26 | 22 | 17 | 23 | 20 | 17 | 33 | 28 | 24 | 27 | 155 | 136 |
| 65 | 20 | 28 | 38 | 25 | 37 | 39 | 35 | 39 | 28 | 22 | 36 | 33 | 174 | 206 |
| 66 | 24 | 13 | 20 | 22 | 16 | 19 | 15 | 15 | 18 | 18 | 13 | 17 | 108 | 102 |
| 67 | 21 | 24 | 14 | 25 | 28 | 29 | 26 | 31 | 24 | 21 | 28 | 27 | 147 | 151 |
| 68 | 27 | 28 | 33 | 35 | 27 | 37 | 28 | 30 | 30 | 36 | 34 | 30 | 185 | 190 |
| 69 | 23 | 19 | 22 | 26 | 17 | 20 | 16 | 19 | 19 | 18 | 24 | 29 | 116 | 136 |
| 70 | 28 | 24 | 20 | 22 | 24 | 21 | 23 | 18 | 35 | 28 | 27 | 23 | 160 | 133 |
| 71 | 14 | 17 | 18 | 20 | 12 | 21 | 21 | 18 | 16 | 13 | 13 | 22 | 93 | 112 |
| 72 | 31 | 17 | 19 | 16 | 19 | 25 | 17 | 21 | 28 | 32 | 17 | 24 | 152 | 114 |
| 73 | 14 | 18 | 12 | 19 | 11 | 13 | 9 | 16 | 17 | 12 | 13 | 11 | 85 | 80 |
| 74 | 40 | 33 | 40 | 35 | 16 | 29 | 21 | 32 | 36 | 37 | 40 | 38 | 191 | 206 |
| 75 | 24 | 19 | 15 | 24 | 23 | 22 | 22 | 19 | 20 | 21 | 11 | 20 | 129 | 111 |
| 76 | 23 | 18 | 16 | 17 | 18 | 27 | 11 | 26 | 24 | 27 | 26 | 25 | 137 | 121 |
| 77 | 21 | 27 | 37 | 25 | 19 | 19 | 23 | 24 | 16 | 23 | 15 | 24 | 125 | 148 |
| 78 | 40 | 30 | 17 | 25 | 30 | 34 | 22 | 20 | 34 | 31 | 22 | 25 | 199 | 131 |
| 79 | 34 | 20 | 29 | 29 | 18 | 18 | 23 | 19 | 23 | 23 | 30 | 31 | 136 | 161 |
| 80 | 12 | 25 | 33 | 25 | 25 | 22 | 28 | 26 | 14 | 23 | 31 | 27 | 121 | 170 |
| 81 | 11 | 11 | 19 | 22 | 13 | 15 | 19 | 20 | 10 | 15 | 19 | 16 | 75 | 115 |
| 82 | 19 | 18 | 25 | 18 | 20 | 15 | 30 | 24 | 23 | 22 | 20 | 24 | 117 | 141 |
| 83 | 28 | 31 | 29 | 30 | 24 | 22 | 24 | 26 | 22 | 28 | 26 | 30 | 155 | 165 |
| 84 | 33 | 34 | 30 | 34 | 25 | 31 | 30 | 29 | 27 | 28 | 29 | 23 | 178 | 175 |
| 85 | 24 | 33 | 25 | 28 | 25 | 31 | 19 | 24 | 26 | 32 | 31 | 29 | 171 | 156 |
| 86 | 30 | 29 | 27 | 29 | 29 | 30 | 29 | 28 | 31 | 26 | 33 | 28 | 175 | 174 |
| 87 | 21 | 17 | 13 | 10 | 14 | 24 | 11 | 18 | 13 | 13 | 10 | 13 | 102 | 75 |
| 88 | 29 | 27 | 21 | 29 | 21 | 28 | 24 | 20 | 28 | 28 | 27 | 25 | 161 | 146 |
| 89 | 20 | 30 | 29 | 28 | 28 | 23 | 27 | 26 | 18 | 25 | 30 | 30 | 144 | 170 |
| 90 | 16 | 16 | 21 | 19 | 15 | 21 | 14 | 15 | 13 | 13 | 12 | 17 | 94 | 98 |
| 91 | 25 | 20 | 29 | 26 | 19 | 16 | 13 | 17 | 22 | 14 | 21 | 24 | 116 | 130 |
| 92 | 26 | 33 | 35 | 34 | 37 | 40 | 34 | 30 | 35 | 37 | 38 | 36 | 208 | 207 |
| 93 | 32 | 39 | 29 | 31 | 27 | 36 | 27 | 37 | 33 | 40 | 31 | 34 | 207 | 189 |
| 94 | 20 | 37 | 15 | 19 | 30 | 19 | 14 | 12 | 13 | 14 | 19 | 13 | 133 | 92 |
| 95 | 5 | 14 | 25 | 17 | 4 | 11 | 17 | 12 | 6 | 12 | 15 | 13 | 52 | 99 |
| 96 | 43 | 37 | 41 | 37 | 38 | 37 | 38 | 33 | 44 | 43 | 40 | 41 | 242 | 234 |
| 97 | 15 | 23 | 19 | 19 | 14 | 19 | 18 | 15 | 15 | 16 | 15 | 13 | 102 | 99 |
| 98 | 21 | 25 | 30 | 29 | 25 | 19 | 31 | 22 | 20 | 24 | 19 | 31 | 134 | 162 |
| 99 | 22 | 25 | 31 | 33 | 22 | 25 | 24 | 24 | 30 | 28 | 29 | 21 | 152 | 162 |

Table XII (Concluded)

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 22 | 28 | 28 | 31 | 18 | 21 | 33 | 28 | 27 | 25 | 23 | 29 | 141 | 172 |
| 101 | 25 | 19 | 20 | 17 | 25 | 24 | 21 | 13 | 25 | 22 | 8 | 12 | 140 | 91 |
| 102 | 13 | 17 | 23 | 16 | 15 | 13 | 20 | 21 | 16 | 17 | 16 | 24 | 91 | 120 |
| 103 | 21 | 23 | 21 | 20 | 25 | 18 | 21 | 20 | 22 | 20 | 20 | 20 | 129 | 122 |
| 104 | 18 | 25 | 28 | 25 | 21 | 20 | 19 | 21 | 28 | 27 | 27 | 25 | 129 | 145 |
| 105 | 33 | 35 | 38 | 33 | 36 | 39 | 37 | 36 | 41 | 32 | 32 | 42 | 216 | 218 |
| 106 | 28 | 25 | 24 | 26 | 17 | 16 | 17 | 16 | 21 | 16 | 25 | 16 | 123 | 124 |
| 107 | 32 | 28 | 29 | 22 | 29 | 35 | 25 | 22 | 28 | 25 | 25 | 28 | 177 | 151 |
| 108 | 12 | 12 | 26 | 18 | 23 | 16 | 22 | 17 | 12 | 16 | 22 | 16 | 91 | 121 |
| 109 | 33 | 34 | 33 | 27 | 29 | 33 | 22 | 23 | 38 | 39 | 35 | 28 | 206 | 168 |
| 110 | 20 | 19 | 31 | 19 | 32 | 24 | 31 | 28 | 18 | 23 | 28 | 30 | 136 | 167 |
| 111 | 16 | 23 | 30 | 27 | 20 | 17 | 21 | 17 | 25 | 19 | 23 | 19 | 120 | 137 |
| 112 | 11 | 10 | 18 | 16 | 21 | 14 | 14 | 20 | 18 | 16 | 23 | 18 | 90 | 109 |
| 113 | 38 | 26 | 19 | 30 | 33 | 28 | 27 | 16 | 35 | 27 | 31 | 23 | 187 | 146 |
| 114. | 20 | 13 | 23 | 13 | 17 | 22 | 15 | 11 | 7 | 15 | 15 | 13 | 94 | 90 |
| 115 | 34 | 28 | 25 | 20 | 28 | 26 | 21 | 21 | 30 | 28 | 19 | 25 | 174 | 131 |
| 116 | 24 | 14 | 17 | 23 | 19 | 17 | 20 | 16 | 22 | 13 | 15 | 23 | 109 | 114 |
| 117 | 29 | 28 | 19 | 22 | 27 | 24 | 29 | 14 | 17 | 26 | 17 | 29 | 151 | 130 |
| 118 | 12 | 13 | 16 | 16 | 15 | 15 | 16 | 11 | 9 | 14 | 17 | 11 | 76 | 86 |
| 119 | 26 | 28 | 22 | 22 | 25 | 35 | 21 | 21 | 34 | 34 | 31 | 29 | 182 | 146 |
| 120 | 27 | 22 | 23 | 16 | 20 | 36 | 19 | 18 | 19 | 18 | 15 | 20 | 142 | 111 |
| 121 | 20 | 38 | 20 | 27 | 33 | 35 | 24 | 33 | 30 | 35 | 31 | 38 | 191 | 173 |
| 122 | 15 | 13 | 15 | 13 | 15 | 15 | 16 | 20 | 21 | 20 | 16 | 18 | 99 | 98 |
| 123 | 21 | 34 | 16 | 28 | 28 | 34 | 22 | 24 | 24 | 37 | 32 | 33 | 178 | 155 |
| 124 | 23 | 21 | 25 | 23 | 22 | 16 | 26 | 21 | 27 | 24 | 25 | 15 | 133 | 135 |
| 125 | 31 | 37 | 32 | 25 | 37 | 37 | 33 | 33 | 31 | 28 | 32 | 38 | 201 | 193 |
| 126 | 28 | 30 | 24 | 27 | 31 | 34 | 29 | 24 | 32 | 26 | 27 | 21 | 181 | 152 |
| 127 | 34 | 32 | 26 | 23 | 25 | 31 | 24 | 26 | 32 | 32 | 20 | 32 | 186 | 151 |
| 128 | 28 | 25 | 25 | 23 | 26 | 27 | 24 | 24 | 35 | 27 | 32 | 29 | 168 | 157 |
| 129 | 19 | 25 | 20 | 24 | 23 | 34 | 11 | 28 | 30 | 37 | 29 | 32 | 168 | 144 |
| 130 | 35 | 25 | 35 | 29 | 31 | 31 | 24 | 30 | 29 | 29 | 36 | 27 | 180 | 181 |
| 131 | 15 | 19 | 19 | 14 | 16 | 14 | 21 | 14 | 16 | 15 | 19 | 23 | 95 | 110 |
| 132 | 25 | 21 | 23 | 23 | 18 | 19 | 18 | 18 | 29 | 18 | 27 | 22 | 130 | 132 |
| 133 | 25 | 29 | 36 | 20 | 27 | 25 | 32 | 26 | 23 | 25 | 32 | 30 | 154 | 176 |
| 134 | 31 | 32 | 37 | 30 | 27 | 37 | 30 | 26 | 33 | 31 | 34 | 31 | 191 | 188 |
| 135 | 24 | 25 | 29 | 17 | 11 | 20 | 18 | 14 | 21 | 25 | 16 | 27 | 126 | 121 |
| 136 | 25 | 26 | 29 | 27 | 26 | 28 | 27 | 24 | 23 | 29 | 29 | 34 | 157 | 170 |
| 137 | 28 | 28 | 24 | 18 | 25 | 25 | 27 | 24 | 29 | 26 | 20 | 19 | 161 | 132 |
| 138 | 28 | 33 | 34 | 33 | 30 | 22 | 31 | 23 | 30 | 27 | 37 | 28 | 170 | 186 |
| 139 | 28 | 31 | 25 | 24 | 25 | 36 | 21 | 31 | 40 | 33 | 32 | 30 | 193 | 163 |
| 140 | 24 | 18 | 21 | 22 | 27 | 28 | 21 | 23 | 28 | 22 | 20 | 17 | 147 | 124 |
| 141 | 37 | 33 | 31 | 30 | 35 | 39 | 32 | 36 | 42 | 34 | 36 | 36 | 220 | 201 |
| 142 | 4 | 7 | 10 | 8 | 13 | 8 | 11 | 15 | 9 | 11 | 5 | 13 | 52 | 62 |
| 143 | 32 | 33 | 33 | 20 | 28 | 32 | 32 | 24 | 33 | 36 | 35 | 29 | 194 | 173 |
| 144 | 9 | 16 | 22 | 22 | 18 | 19 | 25 | 23 | 11 | 11 | 15 | 20 | 84 | 128 |
| 145 | 32 | 25 | 28 | 24 | 32 | 36 | 28 | 31 | 38 | 36 | 32 | 33 | 199 | 176 |
| 146 | 5 | 11 | 17 | 10 | 12 | 7 | 11 | 11 | 10 | 7 | 9 | 12 | 52 | 70 |
| 147 | 21 | 35 | 25 | 25 | 29 | 29 | 27 | 28 | 26 | 35 | 21 | 38 | 175 | 164 |
| 148 | 33 | 21 | 29 | 23 | 26 | 31 | 21 | 23 | 33 | 30 | 31 | 29 | 174 | 156 |
| 149 | 29 | 28 | 26 | 26 | 27 | 29 | 20 | 24 | 30 | 29 | 25 | 20 | 172 | 141 |
| 150 | 39 | 31 | 36 | 27 | 33 | 32 | 34 | 32 | 44 | 32 | 37 | 37 | 211 | 203 |

# VITA

Cora B. Burlingame (Mrs. Paul) was born 1872 Clark County, Indiana. Graduated from the Jeffersonville Public Schools June 1891. Graduated from De Pauw University with a Ph. B. degree June 1894. Taught Latin in the High School at Marion Indiana 1894-99. Taught science in the Normal Department of the University of Porto Rico, Rio Piedras, Porto Rico,1910-11. Principal Modern School, New York City 1912-14. Editorial and feature writer for the National Republican, a Washington, D. C. weekly, 1914-18. Head of the Department of Biology Louisville Girls' High School 1918-21. Rehabilitation Assistant for Federal Board for Vocational Education and U. S. Veterans' Bureau 1921-4. Taught General Science in Highland Junior High School, Louisville, Kentucky, 1929-35. Shawnee High School, Louisville, Kentucky, 1935-6. Publications: a novel "The Hand of God" Atlantic Publishing Company, Brooklyn, N. Y., 1909: The Libretto for Simon Buchalter's opera, "The Lovers' Knot", Schirmers, New York, 1915: short stories in Smart Set 1918-19: feature writer for the Louisville Courier Journal, 1929-33. Entered Graduate Department of U. of L. June, 1932, to work for Master's Degree in Education.