THE RELATIONSHIP BETWEEN PARENTAL OCCUPATIONAL CLASS AND SUCCESS IN SCIENCE FAIR COMPETITION

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FAIR COMPETITION

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PREFACE AND ACKNOWLEDGEMENTS

The purpose of the study was to investigate the relationship between finalists to the National Science Fair-International and the occupational class of the parent, and to examine selected facets in the finalists' background that might influence achievement in science project activity.

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THE PROBLEM AND ITS SCOPE

Introduction

The geometric accumulation of scientific knowledge and the resulting dependence of civilization on scientific technology and creativity during the past decade has been of major interest to those associated with science education and to the citizenry in general. In recent years there has been growing concern over the type and quality of education in science that secondary school students have been receiving.

This concern was given impetus by Sputnik and the following Russian accomplishments in space technology, and also by the realization that with each new generation the fund of scientific knowledge increases approximately fivefold (1). A good example of the snowballing effect of of the accumulation of scientific information is Drummond's (2) statement that science research papers are being published at the rate of 67,000 words a minute. These events have led to a continuing critical reexamination and reevaluation in science education programs, and to one of the largest scale curriculum improvement programs in the history of secondary school science education.

A philosophy that is common to all the new science curricular and extra-curricular programs states that students at all grade levels should be exposed to scientific processes based on inquiry and the laboratory method of investigation. This is in direct contrast with merely being exposed to small fragmented bits of the facts of science, and being led, step by step, through the structured demonstration and confirmational types of laboratory exercises often found in the traditional science curricula.

There are many major science curriculum examination and revision groups in existence at the present time operating on a national basis, including the Biological Sciences Curriculum Study, The Chemical Bond Approach Committee, The Chemical Education Materials Study, and the Physical Science Study Committee (3,4). There are also over fifty extra-curricular science programs supported by various public and private organizations interested in scientific achievement and growth in secondary school students (5).

The exhibition of individual student-constructed science research projects is among the fastest growing extra-curricular activities, and has evolved from a modest beginning in 1928 in New York City to what is commonly known today as a science fair. The "Olympics" of the science fairs is the National Science Fair-International, the culmination of a vast hierarchy of subordinate fairs including thousands of school and local fairs, hundreds of regional and area fairs, and scores of state fairs. Also represented in the National Science Fair-International are the students chosen as winners in various foreign countries. Affiliated state and regional fairs are authorized to send no more than two students with their winning projects to the National Science Fair-International.

Need for the Study

An extremely high percentage of the finalists to the National Science Fair-International attend college and eventually enter science-related occupations. This fact, coupled with the assumption that native intelligence is more or less evenly distributed among all social and economic groups in the population, presents an interesting question: are all occupational classes more or less equally represented at the National Science Fair-International? This study was designed to determine the relationship between the father's occupational class and success in science fair competition, this success being judged by being selected as a finalist to the National Science Fair-International.

The theory behind the research design of this study was that if the results indicated a disproportionate number of finalists from a particular occupational class, then a further evaluation of the methods of identifying and encouraging individuals with high native intelligence and science potential might be in order. No detailed study of this nature had been conducted regarding the National Science Fair-International, and while this activity serves an extremely commendable and worthwhile function in our society, potential scientists with certain socioeconomic backgrounds might in fact be overlooked by this particular program, and other potential scientists with different socioeconomic backgrounds may be identified in high proportions. If this is in fact the case, additional studies may identify the numerous elusive, interdependent factors in the environment of the groups often identified and of the groups seldom identified, and appropriate actions could perhaps then be initiated to identify and motivate a greater percentage of the set number of potential scientists available to our country.

Statement of the Problem

It was the purpose of this study (1) to determine the relative productivity of finalists to the National Science Fair-International by each major occupational class designated by the U. S. Census; (2) to compare selected specific occupations in regard to representation by finalists at the National Science Fair-International; (3) to examine selected background characteristics of finalists qualifying to the National Science Fair-International two or three times; (4) to examine selected characteristics concerning the children of groups found to be of special interest, such as children of military personnel, children of immigrant parents, and the finalists with a deceased parent; (5) to develop an index of productivity for each year and each major occupational class under consideration, indicating the ratio of representation of each class for each of the four years considered.

Hypothesis

The null hypothesis tested for in this investigation is as follows: The success in science fair competition as judged by the student qualifying for the National Science Fair-International is essentially unrelated to the parental occupational class. It is therefore expected that each occupational class will be represented by a number of finalists approximately proportional to the size of the occupational class as compared to the labor force for the years under consideration.

Clarification of Terms

Science Project: An investigatory activity conducted by a high school student in some area of scientific endeavor. Science projects, as considered in this study, refer to those investigations that are subsequently entered in science fair competitions affiliated with the

National Science Fair-International, and usually consist of both a physical exhibit of the student's research and a written report.

Science Fair: Regional, State, and National: The exhibition and judging of science projects is considered in this study as a science fair. Science fairs may be on a classroom, school, local, regional, state, and national-international basis. Classroom and school fairs generally qualify projects to local or area fairs. Local or area fairs normally qualify certain winning projects to the regional fairs. Regional fairs are formed by subdividing the particular state into a number of geographic regions or areas, and accepting winning and qualifying projects from subordinate fairs. The state science fair is then a competition for those science projects in regional fairs judged as having merit for further evaluation in the competition leading toward the national fair. The two projects judged as outstanding in each of the regional fairs may be qualified directly to the national fair from the regional fair, with provisions being made for alternates if either should also be selected as one of the two participants qualifying to the national from the state fair. The national science fair is then the final exhibit of the projects qualifying from regional fairs, state fairs, and the affiliated fairs of foreign countries.

National Science Fair-International: The final science fair for those projects each year judged as outstanding from affiliated regional and state fairs in the United States, and the winners from participating foreign countries. Originally named the National Science Fair, the name was changed to the National Science Fair-International with the inclusion of projects from foreign countries. The name has once again undergone a change; as of May, 1966, the National Science Fair-International will be known as the International Science Fair. The term National Science Fair-International will be used in the text of this study for any science fair held in the United States on a national or national-international basis during the years under consideration.

Finalist: A student whose science project qualified for exhibition at the National Science Fair-International from some subordinate fair. Each student receives an all-expenses paid round trip to the city in which the National Science Fair-International is located, and is accompanied by an adult, usually his project sponsor, his teacher, or his parent.

Biographies of the Finalists: Pages published by Science Service bearing data obtained from the official registration papers required of each finalist for each National Science Fair-International. These pages contain pertinent data concerning the finalist and his science project.

Occupational Class: The United States Bureau of the Census categorizes all occupations into large groups or classes having similar characteristics and degrees of specialization. These occupational classes are then given descriptive names by the United States Bureau of the Census. The following occupational classes are considered in the study. Selected specific occupations are listed after each occupational class for further clarification. For more complete information, the reader is referred to the 1960 Census of Population, Alphabetical Index of Occupations and Industries (6).

Occupational Classes:

1. Professional, Technical and Kindred Workers: Accountants, Clergymen, Engineers, Lawyers, Physicians, Teachers.

2. Farmers and Farm Managers: Farmers, Ranchers, Foreman, Dairymen, Farm laborers.

3. Managers, Officials and Proprietors: (except farm) Owners and managers of businesses, Superintendents, Postmasters, Purchasing Agents.

4. Clerical and Kindred Workers: Bank tellers, Cashiers, File clerks, Secretaries, Telegraph operators, Typists.

5. Sales Workers: Advertising agents, Insurance agents, Real estate agents, Salesmen.

6. Craftsmen, Foremen and Kindred Workers: Bakers, Carpenters, Electricians, Machinists, Plumbers.

7. Operatives and Kindred Workers: Apprentices in various trades such as: Apprentice bricklayers, Apprentice mechanics, Appren-plumbers; also Deliverymen, truck drivers.

8. Service Workers: (public and private-household) Butlers, Barbers, Bartenders, Janitors, Waiters.

9. Laborers, Except Farm and Mine: Construction workers, Road workers, Loaders, Machine cleaners, Odd-job men.

10. Unemployed: In the civilian male labor force, either short or long term unemployed persons.

11. Military Service: Males on active duty in any of the military branches of service.

12. Deceased, Unknown, Retired: This group is not included in the labor force; fathers of some finalists must be considered in this special group.

Specific Occupation: The general term commonly used to designate some person's occupation. Examples of this could be truck driver, automobile mechanic, pharmacist, mortician, carpenter.

Index of Productivity: The ratio between finalists from particular occupational class backgrounds and adult males employed in that particular occupational class for the year under consideration. The index of productivity then gives a rough comparison of the representation of the various occupation classes in the National Science Fair-International.

Limitations of the Study

The study will include only those finalists qualifying to the National Science Fair-International from the United States of America. The study will exclude all foreign students participating and will only be concerned with the years 1955, 1956, 1965, and 1966. Inferences regarding the results of the study may be applied only to those years and students involved in the study.

CHAPTER II

REVIEW OF THE LITERATURE

Historical Development of Science Fairs

The science fair movement was not a reaction to Russian space technology and missile potential. Organized science fairs have existed since 1928, and the foundation for fair activity was being laid as early as 1910 by project teaching.

Laying a firm foundation for the development of the science fair movement were a number of research reports concerning the use of student projects in science classes Early investigators (7,8) reported that extra-curricular activities in science, such as scientific explorations through activities leading to research papers, collections, science club participation, projects, and exhibits provide for almost as good a knowledge of environmental phenomenon as did curricular activities. Graber (9) and Watkins (10) found that students taught by the project method made scores as high or higher on subject matter tests based upon textbooks as students taught in the traditional manner, despite the fact that those taught by the project method were of lower I. Q. Graber also states that nearly three-fourths of the number of pupils surveyed expressed a preference for the project method (9).

A further step toward the development of the science fair is competition between high school science students in prize essay contests. Howe (11) records the first of these competitions in 1923, sponsored by the American Chemical Society. Similarities in present day science fairs and the early fairs with respect to the methods of displaying the projects can be seen in photographs of an exhibit held in 1930 (8).

Kraus (12) states that the first organized science fair was sponsored by the American Institute of the City of New York in 1928. This fair was open to children of all ages, and projects entered were judged according to a set of predetermined criteria. The sphere of operation included the schools in a fifty-mile radius of Times Square. Another evolutionary step toward the larger fairs was evidenced in 1939-1940 when winning projects were displayed at the New York World's Fair. Attempts were made during this time to encourage science fairs in other areas, mainly in the New England States.

In 1941 Dr. Watson Davis, Director of Science Service, took over the responsibility for direction of the national phase of the science fair program. The first National Science Fair was held in Philadelphia in 1950, attracting thirty student finalists. Since that first fair in 1950, the National Science Fair has taken on an international flavor, with student exhibitors from foreign countries included as finalists. The growth of the science fair activity is evidenced by the following: (12)

Year	Place	Finalists
1950	Philadelphia, Pa.	30
1951	St. Louis, Mo.	30
1952	Washington, D. C.	42
1953	Oak Ridge, Tenn.	71
1954	Lafayette, Ind.	95
1955	Cleveland, Ohio	136
1956	Oklahoma City, Okla.	213
1957	Los Angeles, Calif.	231
1958	Flint, Mich.	281
1959	Hartford, Conn.	320
1960	Indianapolis, Ind.	356
1961	Kansas City, Mo.	385
1962	Seattle, Wash.	387

1963	Albuquerque, N. M.	411
1964	Baltimore, Md.	419
1965	St. Louis, Mo.	418
1966	Dallas, Tex.	419

The 1950 National Science Fair admitted not more than four students from each affiliated subordinate fair, in 1953 an advisory coucil decided that the limit that any affiliated fair could sponsor at the National Science Fair would be not more than two. This system of representation has been in effect to the present time.

Projects at local, regional, state, and national fairs are judged according to the criteria and point values used by the National Science Fair-International (13). All projects are subject to rules regarding size and personal construction and research by the participant. The point system used in judging is weighted toward sound scientific thought and creativity, with sixty points divided between these categories, the remaining forty points are applied to the manner in which the project is developed and exhibited. Specifically, thirty points are allocated as the maximum possible for creative ability, which includes originality of ideas and ingenious uses of materials. Scientific thought, as evidenced by organized procedures, accurate observations, controlled experiments, and methods leading to a better understanding of scientific facts or theories make up a second criterion, and is awarded a maximum of thirty points. Ten points are allowed for skill, which includes workmanship and preparation. Ten additional points may be awarded for clarity, the ability to express ideas and concepts clearly and accurately to scientists and to the public. Thoroughness in research and reporting is allowed a ten point maximum. Also given a minor rating of ten possible points, the final criterion is reserved for dramatic value, the attractiveness and effectiveness of the exhibit. Judges are warned not to be influenced by extraneous flashing lights, switches, or gadgets which contribute nothing to the actual exhibit.

Judges at local and regional levels include science teachers from public schools and from colleges and universities, plus practicing scientists and professional personnel in their particular area of specialization. Judges at the National Science Fair-International are again highly qualified individuals from industry, education and various fields of scientific research. The categories in which a project may be entered for judging include Botany, Medicine and Health, Zoology, Chemistry and Biochemistry, Earth and Space Sciences, Physics, and Mathematics and Computers. Two separate competitions are conducted at the national-international level, girl finalists compete against girls, boys compete against boys (14).

Related Research-Fairs and Finalists

The science fair movement is now definitely of age, and the influence of fairs is a great factor in the encouragement of students with scientific talent. Kraus (12) makes the following statement expressing their effect:

> Doubtless the greatest innovation in science education during the present generation resulted not from the new advanced high school courses in biology, chemistry, physics, mathematics and the like, but rather through the spectacular development of science fairs.

Welt (15) concludes that science fairs identify and encourage the scientifically gifted child and stimulates the interest of students who have a special scientific talent. The project activities leading to and including the National Science Fair-International definitely seem to accomplish one of the major goals now associated with them: the identification and stimulation of potential scientists. The 419 finalists in

1964 represented nearly one million student exhibitors at the nation-wide school, local, regional, and state fairs feeding the National Science Fair-International, as statistics show that each finalist represented 2,285 exhibitors in supplementary fairs (16). Science fairs also serve such functions as providing teachers and students an opportunity to see what others are doing in science, to aid interested persons in their guidance of science students, and to arouse the interest of the public in the scientific ability of young people.

Shelburne (17) reports that many science oriented organizations, concerned over the tremendous shortage of skilled scientists and technicians, are encouraging science fair programs for the purpose of recognizing and motivating students with high science potential. Harris (18) in the Encyclopedia of Educational Research states that:

> There can be little doubt that the extensive scholarship programs, science club movements, science camps and other similar programs have been established in the hope of providing more attractive incentives for gifted students to enter the study of science.

The same author also states (18):

> Research directed toward identifying specific curriculum procedures, materials and processes which nuture and develop new and enriched interests of children, especially in the science areas, is badly needed.

One follow-up study of previous National Science Fair-International finalists reveals that over 90 percent of the finalists go on to make science or engineering their careers (16). Daniels (19), in another study, reports that 60 percent of all finalists surveyed were influenced in choice of career by science fair activities. In the same study it was revealed that 96.6 percent of the male and 91.5 percent of the female finalists attended college.

Studies have been made dealing with the source of first science interest (20, 21). These studies reveal that potential scientists are developing their initial interest in science as early as eight or ten years of age, and are initially stimulated mainly at school (31.6 percent) and at home (26.2 percent). A peculiar drop in interest at ages 9 and 11 suggests the need for a study to determine this cause.

Bowles (22), in a survey of the finalists in the 16th National Science Fair-International in St. Louis, Missouri, reports that 41 of the finalists indicated the origin of interest in science prior to their school years, and that about three-fourths of all the participants indicated that their interest in science had started during the elementary school. The author then suggests that scientists may be made in the grades rather than in the university laboratories.

Bethune (23), in a study of National Science Fair-International participants, reported that a large percentage of the finalists spent less than $40 on their project, implying that science fairs are not a competition for the wealthy only. Influence of parents and teachers upon the physical aspects of project development was considered to be slight, and direct intervention in project work, as opposed to moral support by the parent, was shown to have a statistically significant correlation with unsuccessful projects (24).

Science projects are required of all students by a small percentage of science teachers (25,26). This procedure, often required for a grade, or even resulting in failure of the course, regardless of the academic average, if not completed, does not go unchallenged. Investigators find a definite correlation between unsuccessful science projects and compulsory project participation (24). The widely accepted attitude concerning required projects among leading educators is effectively illustrated by

Hammond (27) when he states that many students do not wish to work on a project at all, and should not be forced to waste their time, and the time of others forced to work with them in some supportive manner.

Effect of Socioeconomic Background

Sebastian (28) summarizes impressive results at one school from a program in science fair competition specifically designed for culturally disadvantaged students with moderate scholastic achievement; however, no finalists to the National Science Fair-International were mentioned for the intensive six year program. One point of formidable importance was mentioned in the article, that the culturally disadvantaged students received "no parental incentives for scholastic success."

Stalnaker's (29) assumption that native intelligence is evenly distributed among all social and economic groups in the population gives emphasis to Conant's (30) charge that one of the tasks of the schools in slum areas is to encourage those who have academic talent to aim at a profession through higher education.

Some characteristics listed by Havinghurst (31) of the lower class could shed light on the reason for the lack of adequate representation of certain occupational groups, if this trend is in fact general. These include: (1) Placing little value on school performance or on conforming to school expectations. (2) Feeling that academic excellence is "queer" and will aleniate the child from his family and friends, (3) Often expressing dissatisfaction with schools, and (4) (the lower-lower class)--Tending to regard education with skepticism and to view the school and its methods as being either contrary to its own values or of little worth.

Quality of schooling definitely has an effect on the effective intelligence of an individual; however, money alone will not alleviate the situation, as Jencks (32) reports "The schools in Harlem spend almost twice as much per pupil as those in Milwaukee, and the results are nothing like twice as impressive." The slum children of the Banneker Elementary School District were raised from only 7 percent in the Track I academic division (as ascertained by the Iowa Basic Skills tests) to 22 percent in Track I academic division in a six year period through an intensive program that relied mainly on changing the attitudes of the parents concerning homework and attendance.

An indication that socioeconomic origin may influence success in the activity considered in this study is supplied by Porter (33), as many studies are cited that quite consistently report a strong tendency for the individual to gravitate toward his father's socioeconomic level. Altus (34), in considering motivation and achievement, reports that strong, positive parental attitudes toward education, training in independence and mastery, stress on meeting certain achievement standards at an early age (6 to 8 years old), and being held in warm regard by both parents are all optimal home influence.

Duncan (35) reports that in a Junior High School serving children of the lower socioeconomic groups, the experimental group, whose parents attended a course designed to acquaint them with SMSG math, scored much higher than the control group. In cases such as this, the interest of the parent and positive reinforcement and encouragement given to the student might well be as important as the actual background in subject matter in stimulating the student.

The National Achievement Scholarship program was reported by

Steiner (36) to be a counterpart of the National Merit Scholarship competition, designed to compensate for deserving youth who are handicapped due to a slum environement and schools of a substandard nature, in competing for college scholarships. Through this program, 200 negro high school seniors were chosen in the initial year for financial assistance through four years of college. The National Merit Scholarship program winner must take specific exams and come out with top grades, the National Achievement Scholarship program will only consider the school records and the recommendation of school officials, precluding competitive examinations. These students have exhibited a degree of success in college that is highly encouraging to the program officials. The Harvard Gamble Fund is a program designed along similar lines, and again has produced positive results. This program is not for drop-outs, juvenile delinquents, or the low in ability or initiative, but for conscientious highly talented students from an underprivileged school and economic background that sets certain limits on the academic achievement of those with highly promising potential (37).

Occupational Class Background and Accomplishment

Bond (38), in his study of National Merit scholars, tabulates results from one National Merit competition and challenges America's concept of social mobility, indicating that certain occupational classes are disproportionately represented, according to their corresponding size in the population.

Data from other investigators indicate a distinct shift in the proportions of natural scientists representing various occupational group backgrounds when different years are compared. The occupational group designated as Professional was responsible for the production of 45.5 percent of Visher's (39) "starred men of science," while one and one-half generations later, Strauss (40) shows, the Professional group fathered only 28.4 percent of the natural scientists included in his study. Further investigation of Strauss' data reveals that the Business group had an increased representation from Visher's Business group of 23 percent to 31.6 percent. The Skilled Laborers had shifted from the earlier representation of 8 percent to 21.5 percent representation in production from the population, and Unskilled Labor was represented by a change from one percent representation in the early study to a representation of 4.6 percent in the later study. These increases in representation are not associated with a corresponding increase in the labor force for the groups considered.

Strauss' study also indicates that parental possession of the doctoral degree or its equivalent, and the fact that the family resided in a college town, did not produce the high proportion of scientists that one might expect, as fathers not possessing the doctorate produced scholars at a ratio of almost five times that of the forementioned group in the same occupational class (40).

I. Q. Versus Creativity

Koelsche (41) reports I. Q. ranges from 100 to 148 with a median of 119.5 in a group of state science fair award winners over a period of three years. This compares with the six middle categories of 1,986 natural scientists in a study by Strauss (40), where the range was from categories 70-79 through 170 plus, with a mean I. Q. rating of 130.6 points.

One investigator found that of the 20 percent most creative school students over 70 percent would have been excluded from the "gifted" group if traditional I. Q. measures had been used as the method of identification (42). The traditional I. Q. measures are often a major factor in scholarship awards, college admissions practices, and advanced placement.

It seems obvious that lack of extremely high I. Q. scores should not preclude students from certain scholastic pursuits, and emphasizes once again Getzels and Jackson's (43) findings that creative ability and high I. Q. are not necessarily common to the same children. Wolfe (44) states that "half of the people who receive Ph.D. degrees come from the top 7 percent of the total population." The preceding studies indicate that the remaining 93 percent of the total population may produce 50 percent of our social and scientific leaders, if they are identified and encouraged before their potential is lost.

Upper and Lower Class Gifted Children

Syed (45), in a study of parent behavior influencing academic achievement of academically superior normal achievers and academically superior under achievers, found that the parents of the normal achieving group structure the environment for their children, define expectations regarding scholastic efforts, and provide help, guidance, encouragement, and approval. The parents of the under achieving group were found to be much less likely to exhibit the attitudes and characteristics demonstrated by the parents of the more successful group of children.

In his study of differences between gifted children from upper and lower status communities, Frierson (46) found in groups matched according to age, sex, race, grade, and I. Q., that nearly 40 percent of the children of the lower status group had hobbies involving building and scientific activities. The same hobbies made up only 13 percent of the upper status group's hobby choices. The results of Frierson's research carries implications that are important to the present study, and could suggest that the gifted child from the lower status with a high interest in scientific hobbies and activities should be adequately represented in the National Science Fair-International group of finalists, barring intangible selective or environmental processes that lie outside the scope of the present study.

CHAPTER III

METHOD AND PROCEDURE

Materials

Data concerning each finalist was taken from the *Biographies of Finalists and Pertinent Data About Their Exhibits* (14, 47, 48, 49), a collection of information-bearing sheets accumulated by Science Service from standardized entrance forms required of all finalists each year.

In many studies a sampling return to a questionnaire of 50 to 85 percent is considered as an acceptable return. By utilizing the information required of all National Science Fair-International participants, the desired facts concerning all participants was virtually assured. In a few isolated instances (twenty-one of the 1,150 participants over the four years) certain information concerning a finalist was not included in the biography. A follow-up letter was mailed to the principal of the school involved, and twenty of the twenty-one queries were answered. The one letter remaining unanswered was completed by contacting the student involved.

The information taken from the biography sheets was then coded for key-punching on IBM data cards for further processing. The occupational class and the specific occupation of each father was then assigned U. S. Census Bureau numberical codes, as designated in the *1960 Census of Population Alphabetical Index of Occupations and Industries* (6). The index lists occupation and industry titles as they appear on the census and survey schedules, together with a numerical or letter code indicating the appropriate category or class in which each title is to be classified. A new index is prepared for each Decennial Census of Population. The current edition replaces the 1950 edition.

Selection of the Subjects

All United States finalists to the National Science Fair-International for the years 1955, 1956, 1965, and 1966 included in the official Biographies of the Finalists sheets for each mentioned year are included in the study. Participants from Alaska and Hawaii are not included in the 1955 and 1956 data, they are included in the 1965 and 1966 data.

The research project of each participant under consideration has been judged as the best from the affiliated state or regional fair from which they were qualified to the National Science Fair-International through a selective process encompassing the school, local and area fairs. Finalists from these competitions are representative of the judges opinions of the best science projects in the particular hierarchy of science fair activity. Typically, no more than two projects are qualified from a regional or a state fair to the National Science Fair-International. As mentioned earlier in this paper, each finalist may represent over 2,000 exhibitors in subordinate fairs, indicating a high degree of success in science fair activity.

Treatment of the Data

The main objective of this study was to examine the relationship between parental occupational class and success in science fair competition, this success evidenced as being qualified through progressive competitions as a finalist to the National Science Fair-International. Occupational class of the father has been determined from the specific occupation listed in the official <u>Biographies of the Finalists</u>.

The relative number of finalists from each occupational class was then determined for each year. This number was then compared to the total number of participants for that particular year, and a chi-square analysis was performed utilizing a 1620 International Business Machine Model I computer, by instructing the machine to perform the following operation as presented by Garrett (50):

$$X^2 = \Sigma \left[\frac{(fo - fe)^2}{fe} \right]$$

where fo = the frequency of the occurence of the observed, and
fe = the frequency of the occurence of the expected.

The percentage of the occupational class in the labor force for a particular year, as recorded in various U. S. Census Bureau publications (51,52,53), was used as the observed, and the percentage of the finalists representing these occupational classes was considered as the expected.

An index of productivity was also prepared for each year included in the study, providing the ratio between finalists and fathers for each occupational class. The machine was instructed to prepare the index of productivity by dividing the number of adult males in each occupational class by the number of finalists representing that occupational class for the year under consideration.

Selected specific occupations were also compared in a similar manner, to more completely examine the relative representation to the National Science Fair-International. Attention was also given to the percentage of finalists with parents who were immigrants to the United

States for the years 1955 and 1956, to the percentage of finalists with a deceased parent for all years involved in this study, and to the number of participants in 1965 and 1966 with fathers in the military service, with special attention being directed to the military rank of the father. A survey was also conducted for all years regarding individuals who had qualified to the National Science Fair-International two or more years, in an attempt to determine similarities in background among this group that could distinguish them from finalists qualifying to the National Science Fair-International a single time.

CHAPTER IV

RESULTS OF THE STUDY

Representation of Occupational Classes

One of the major objectives of the study was to test the null hypothesis which stated that success in science fair competition is essentially unrelated to the occupational class of the parent. If the postulated null form of the hypothesis were accurate, finalists from all occupational classes would be expected to qualify to the National Science Fair-International in proportions approximately equal to the percentage of the fathers' occupational class in relation to the labor force. For example, in 1966 the occupational class identified in Table I as Class 5 (Sales Workers), with 2,944,000 adult males, comprised 6.345 percent of the adult civilian labor force. In the same year, finalists with fathers in the above-mentioned occupational class numbered 23, for a percentage of 6.301 of the 1966 finalist population.

If all occupational classes were represented in proportions approximating the example cited above, the null form of the hypothesis would indeed be correct, and the finalists would be expected to qualify, percentage-wise, in numbers roughly proportional to the percentage of the fathers' occupational class in the labor force.

An examination of the data contained in Table I, which deals with the major occupational classes in the civilian labor force and the finalists representing fathers in the respective occupational classes, reveals data that indicate the finalists are not always qualified to the National Science Fair-International in the proportions as dictated by the null form of the hypothesis.

The data recorded for Class I (Professional, Technical, and Kindred Workers) in 1956 may be used to further illustrate this point. The 3,928,000 males in this particular occupational class formed 8.985 percent of the male civilian labor force. The finalists with fathers from this occupational class numbered 73, and made up 36.318 percent of the 1956 National Science Fair-International population. The finalist-father percentage ratio in this particular class for the year considered is then slightly over 4 : 1, whereas the percentage ratio for Class 5, which was introduced in the first paragraph of this chapter, was slightly less than 1 : 1. Laborers, except farm and mine, designated as Class 9, with 3,255,000 adult males in the labor force represented by one finalist, had a finalist-father percentage ratio in 1966 of approximately 1 : 26.

Graphical presentations of these data by year and percentage are contained in Figure 1, Figure 2, Figure 3, and Figure 4. Consult Table II and Table III for raw data concerning males in the various occupational classes and the finalists for each of the years considered in this study.

All of the Professional and Managerial class fathers, who together made up 25.85 percent of the 1966 labor force, produced 60.82 percent of the finalists. Craftsmen and Foremen were represented by a 19.02 to 14.24 father - finalist ratio. Farmers, with 6.458 percent of the labor force, fathered 4.93 percent of the finalists. The group composed of Machine Operatives, Service Workers, and Laborers comprised 35.16 percent of the labor force, but produced only 7.66 percent of the finalists. When Service Workers and Laborers are considered collectively, 14.20 percent of the labor force produced only 2.73 percent of the finalists in 1966, when the nine occupations classified in the Census Bureau categories are considered.

A chi-square analysis was performed for each year to test the null hypothesis of equal probability of representation. Using the formula previously stated in Chapter III, and calculating the degrees of freedom as df = (r-1) (c-1), where r is the number of rows and c is the number of columns in the tabulated data, the chi-square values recorded in Table I were obtained.

The chi-square values were then entered in a chi-square table at the appropriate level for the degrees of freedom. Garrett (50) states:

> The more closely the observed results approximate to the expected, the smaller the chi square and the closer the agreement between the observed data and the hypothesis being tested. Contrariwise, the larger the chi square the greater the probability of a real divergence of experimentally observed expected results.

The chi-square values are so large that they lie beyond the limits of the chi-square table at the 0.01 level of probability for all years, as evidenced by the largest chi-square value being 117.370 in 1956 and the smallest chi-square value being 76.869 in 1965. The chi-square value at the 0.01 level of probability for eight degrees of freedom is 20.090. The discrepancy between the expected and observed values is so great that the hypothesis of proportional distribution of finalists to the National Science Fair-International in relation to the occupational class of the fathers may be rejected. These data strongly indicate that the representation of occupational classes by the finalists is probably directly related to the occupational class of the parent, and that certain occupational classes will send a larger proportional number to this activity than other occupational classes.

Table IV shows the percentages of the adult males and of the finalists representing eleven occupational groups, including the nine considered in Table I, plus the addition of the men on active duty in the military services (Class 11), and the men classified as unemployed (Class 10). These two groups, while not in the working civilian labor force, do form definite bodies represented in the potential labor force, and finalists are recorded as having their origin from each group. Since information was available regarding their numbers for the years under study, it was decided that they would be included in a chi-square test that would parallel the test reported in Table I.

No percentages were drastically changed by the addition of the Military and Unemployed classes to the civilian occupational classes, and the chi-square values ranged from a high of 132.945 in 1955 to a low of 82.496 in 1965. These values, when entered into the chi-square table for ten degrees of freedom, again show that the probability of random representation of occupational classes is much less than 0.01, as the chi-square value for 0.01 probability is 23.209 for ten degrees of freedom. The results of the chi-square tests again emphasize the fact that the probability of random representation of occupational classes is much less than 0.01, and that the hypothesis of unrelatedness may be rejected, as the data strongly suggest that there is a definite relationship between the fathers' occupational class and the finalists being qualified as participants to the National Science Fair-International.

Classes 1 (Professional, Technical, and Kindred Workers), 3 (Managers, Officials, and Proprietors), and 5 (Sales Workers) are represented in all years by a higher number of finalists than would be expected if one were to assume that the occupational class of the parent played no great role in the student being qualified, with the exception of Class 5 in 1966, when the representation approaches the expected.

Classes 6 (Craftsmen, Foremen, and Kindred Workers), 7 (Operatives and Kindred Workers), 8 (Service Workers), 9 (Laborers, Except Farm and Mine), 10 (Unemployed), and 11 (Military Service) were represented by a number of finalists in each year that was smaller than the expected, with Class 6 being only moderately lower in representation than expected.

The distribution of the 1150 finalists within the four years of the study and among the occupational class of origin is presented in Table III. Table II deals with similar data designating the number of males in the occupational classes of the labor force. Both tables contain primary data relating to the study, and are included for reference. Table III was compiled from the biographical information published by Science Service (14,47,48,49), after this information was classified and coded for further processing. Table II presents data pertaining to the adult male population in the labor force for each of the various occupational classes included in the study, and was compiled from information contained in various U. S. Census Bureau publications (52,53,54,55,56).

Consistency of Class Representation

The consistent manner in which the various occupational classes were represented at the National Science Fair-International throughout the years included in this study is graphically illustrated in Figure 5. It will be noted that all classes are rather stationary in regard to mobility of representation, with no large yearly fluctuations.

TABLE I

CHI-SQUARE ANALYSIS OF RELATIONSHIP BETWEEN OCCUPATIONAL CLASS OF THE FATHER AND REPRESENTATION AT THE NATIONAL SCIENCE FAIR-INTERNATIONAL--9 CLASSES

Class		1955		1956		1965		1966	
Name	Number	Exp %	Obs %	Exp %	Obs %	Exp %	Obs %	Exp %	Obs%
Professional	1	8.230	33.606	8.985	36.318	12.229	34.986	12.446	37.260
Farmers	2	11.957	6.557	11.967	5.472	6.996	7.438	6.458	4.931
Managers	3	12.197	22.131	12.267	19.900	13.969	25.344	13.413	23.561
Clerks	4	6.447	.819	6.752	7.462	7.125	5.234	7.147	6.027
Sales	5	5.853	10.655	5.768	6.467	6.086	7.713	6.345	6.301
Craftsmen	6	18.886	15.573	18.841	15.422	18.514	11.845	19.024	14.246
Operatives	7	21.671	8.196	21.302	6.467	20.537	4.683	20.962	4.931
Services	8	6.280	2.459	6.274	.995	7.001	1.928	7.184	2.465
Laborers	9	8.473		7.839	1.492	7.539	.826	7.016	.273
Chi-Square		117.370		112.116		76.869		80.724	

Key:
Exp % = The percentage of males from the class in the labor force.
Obs % = The percentage of finalists at the National Science Fair-International.

TABLE II

MALE POPULATION OF THE U.S. IN SELECTED OCCUPATIONAL CLASSES
(IN THOUSANDS)

Class		Year			
Name	Number	1955	1956	1965	1966
Professional	1	3,490	3,928	5,586	5,774
Farmers	2	5,070	5,232	3,196	2,996
Managers	3	5,172	5,363	6,381	6,223
Clerks	4	2,734	2,952	3,255	3,316
Sales	5	2,482	2,522	2,780	2,944
Craftsmen	6	8,008	8,237	8,457	8,826
Operatives	7	9,189	9,313	9,381	9,725
Services	8	2,663	2,743	3,198	3,333
Laborers	9	3,593	3,427	3,444	3,255
Unemployed	10	2,093	2,091	2,283	1,847
Military	11	3,097	2,859	2,671	2,940

TABLE III

FINALISTS TO THE NATIONAL SCIENCE FAIR-INTERNATIONAL

Class		Year				Class Totals
Name	Number	1955	1956	1965	1966	
Professional	1	41	73	127	136	377
Farmers	2	8	11	27	18	64
Managers	3	27	40	92	86	245
Clerks	4	1	15	19	22	57
Sales	5	13	13	28	23	77
Craftsmen	6	19	31	43	52	145
Operatives	7	10	13	17	18	58
Services	8	3	2	7	9	21
Laborers	9		3	3	1	7
Unemployed	10	1		2		3
Military	11	2	3	14	9	28
Deceased,etc.	12	11	9	21	27	68
Yearly Totals		136	213	400	401	1,150

TABLE IV

CHI-SQUARE ANALYSIS OF RELATIONSHIP BETWEEN OCCUPATIONAL CLASS OF FATHER AND THE REPRESENTATION AT THE NATIONAL SCIENCE FAIR-INTERNATIONAL--11 CLASSES

Class		Year							
		1955		1956		1965		1966	
Name	Number	Exp %	Obs %	Exp %	Obs%	Exp %	Obs %	Exp %	Obs %
Professional	1	7.333	32.800	8.071	35.784	11.032	33.509	11.281	36.363
Farmers	2	10.653	6.400	10.750	5.392	6.312	7.124	5.853	4.812
Managers	3	10.867	21.600	11.019	19.607	12.602	24.274	12.159	22.994
Clerks	4	5.744	.800	6.065	7.352	6.428	5.013	6.479	5.882
Sales	5	5.215	10.400	5.182	6.372	5.490	7.387	5.752	6.149
Craftsmen	6	16.826	15.200	16.925	15.196	16.702	11.345	17.245	13.903
Operatives	7	19.308	8.000	19.136	6.372	18.527	4.485	19.001	4.812
Services	8	5.595	2.400	5.636	.980	6.316	1.846	6.512	2.406
Laborers	9	7.549		7.041	1.470	6.802	.791	6.360	.267
Unemployed	10	4.397	.800	4.296		4.509	.527	3.608	
Military	11	6.507	1.600	5.874	1.470	5.275	3.693	5.744	2.406
	Chi-Square	132.945		129.607		82.496		90.900	

Key:
Exp % = The percentage of males from the class in the labor force.
Obs % = The percentage of finalists at the National Science Fair-International.

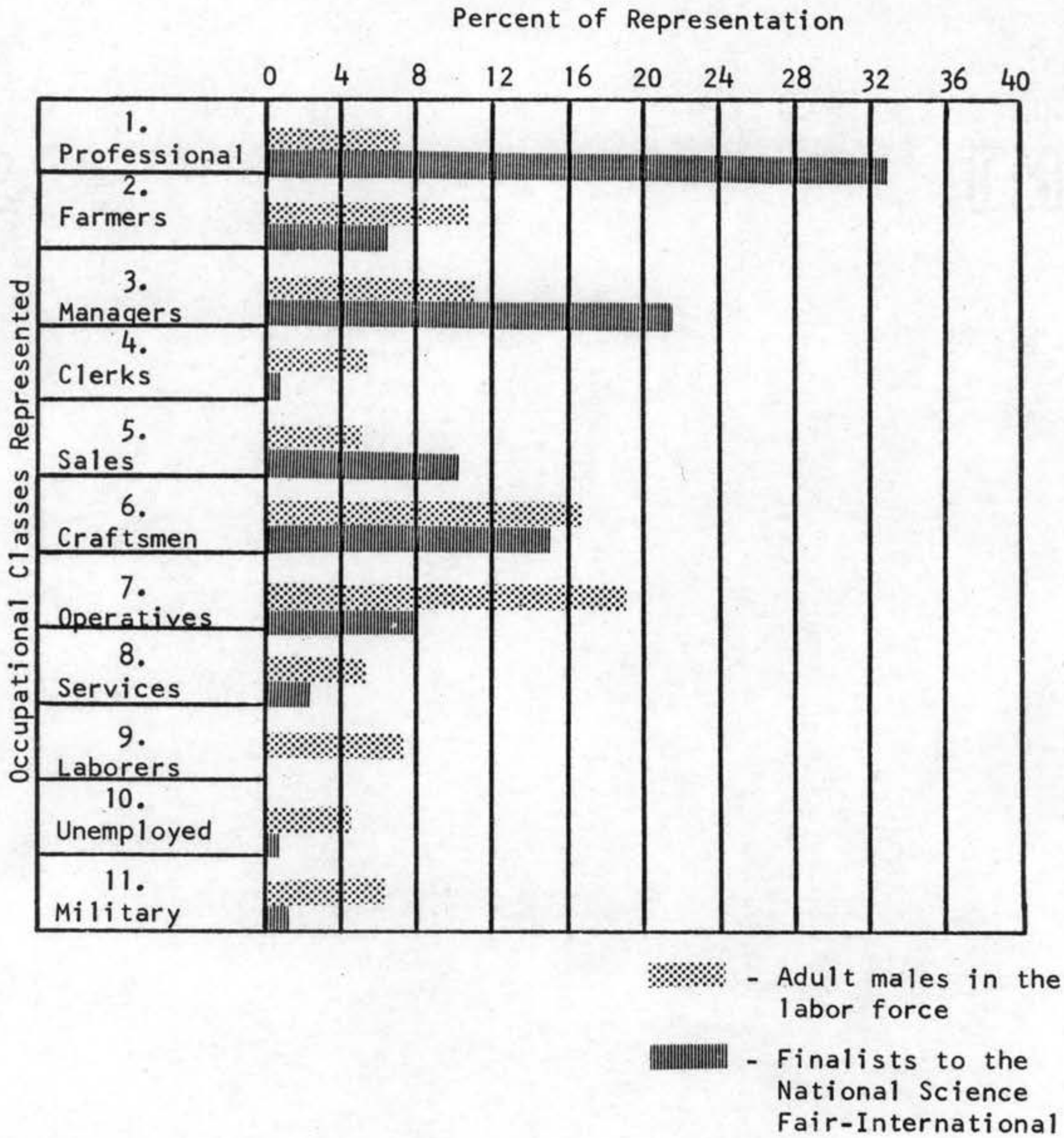

Figure 1. Percentages of Males in the Labor Force and Finalists to the National Science Fair-International -- 1955

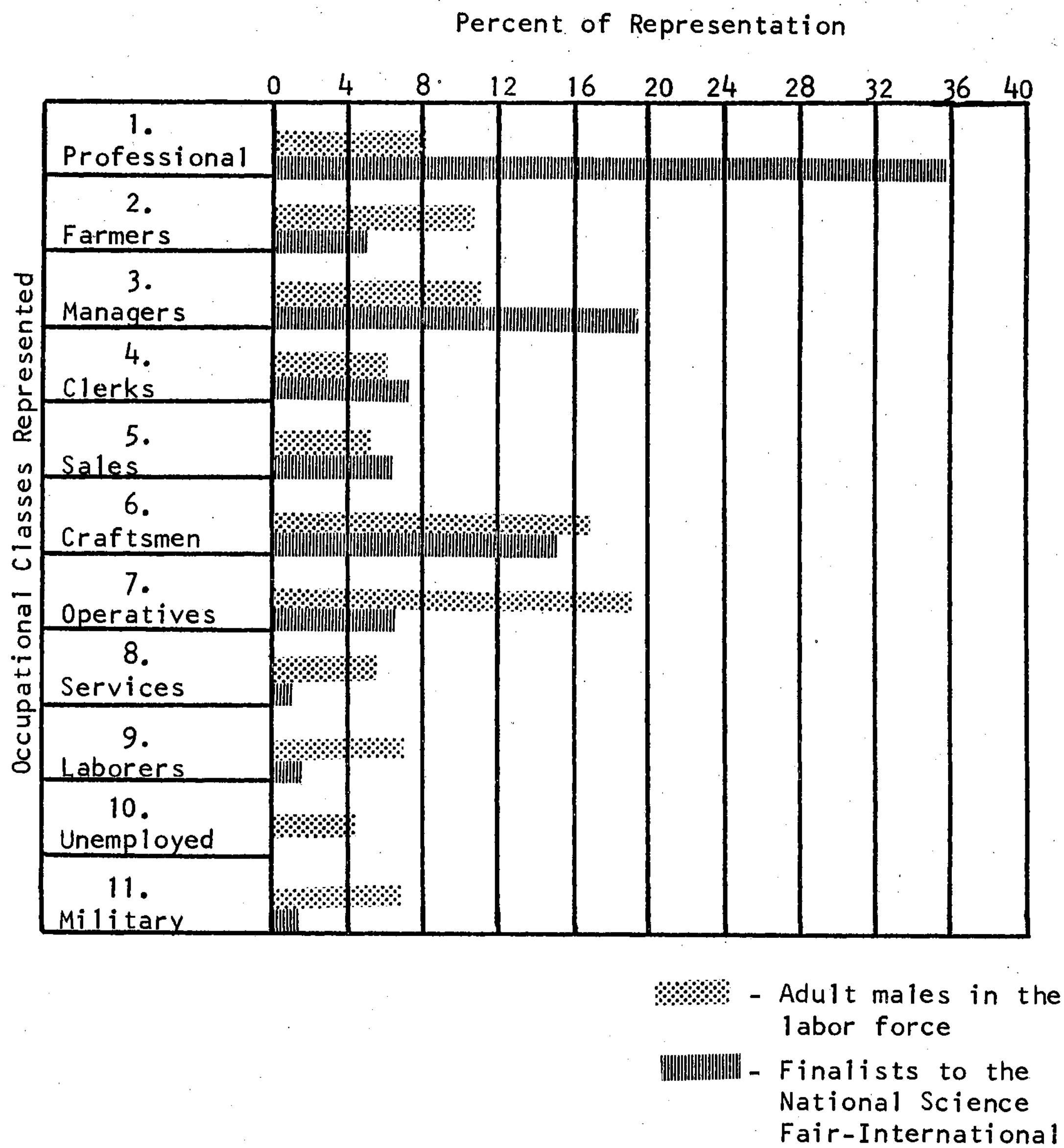

Figure 2. Percentages of Males in the Labor Force and Finalists to the National Science Fair-International -- 1956

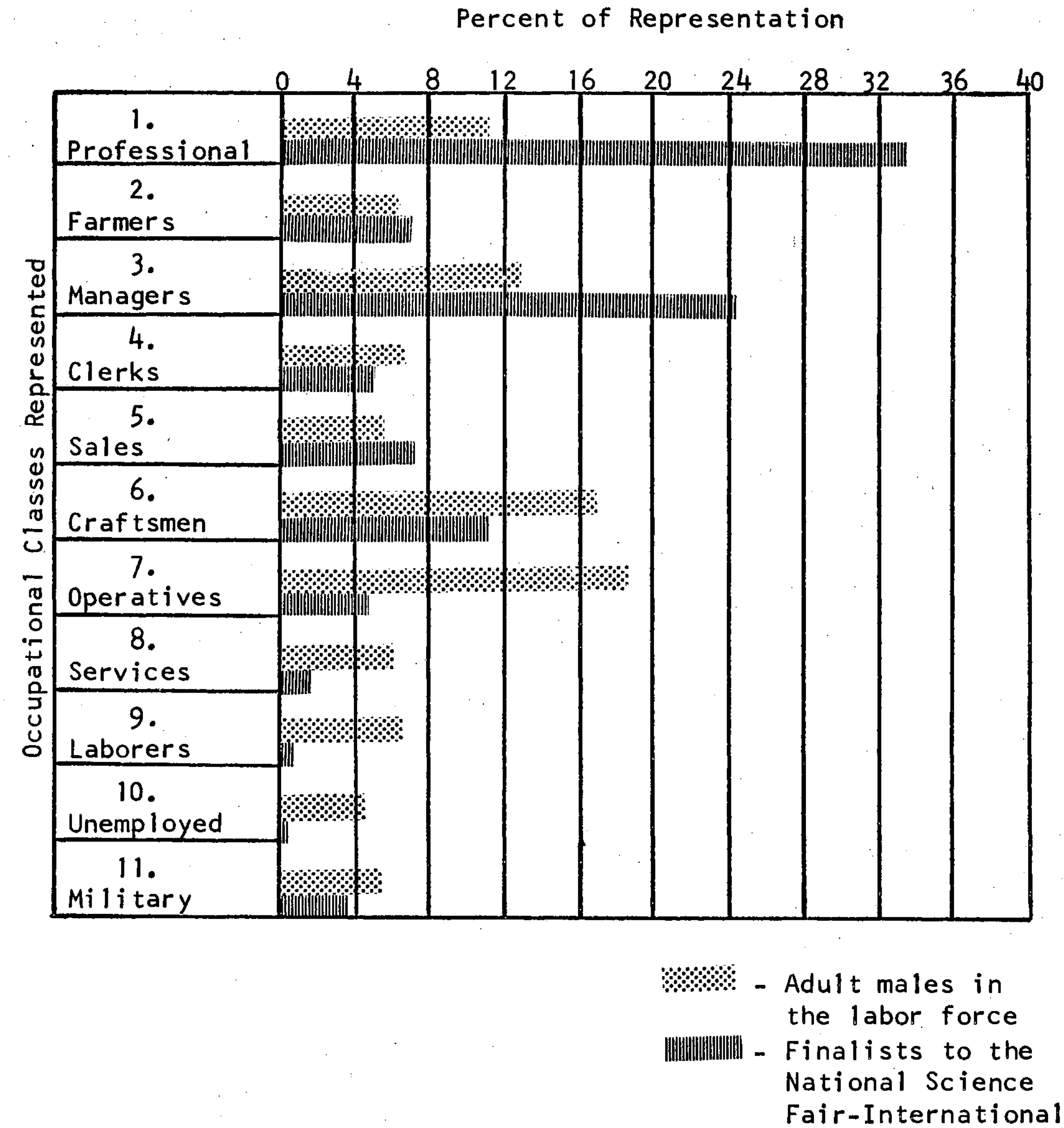

Figure 3. Percentages of Males in the Labor Force and Finalists to the National Science Fair-International -- 1965

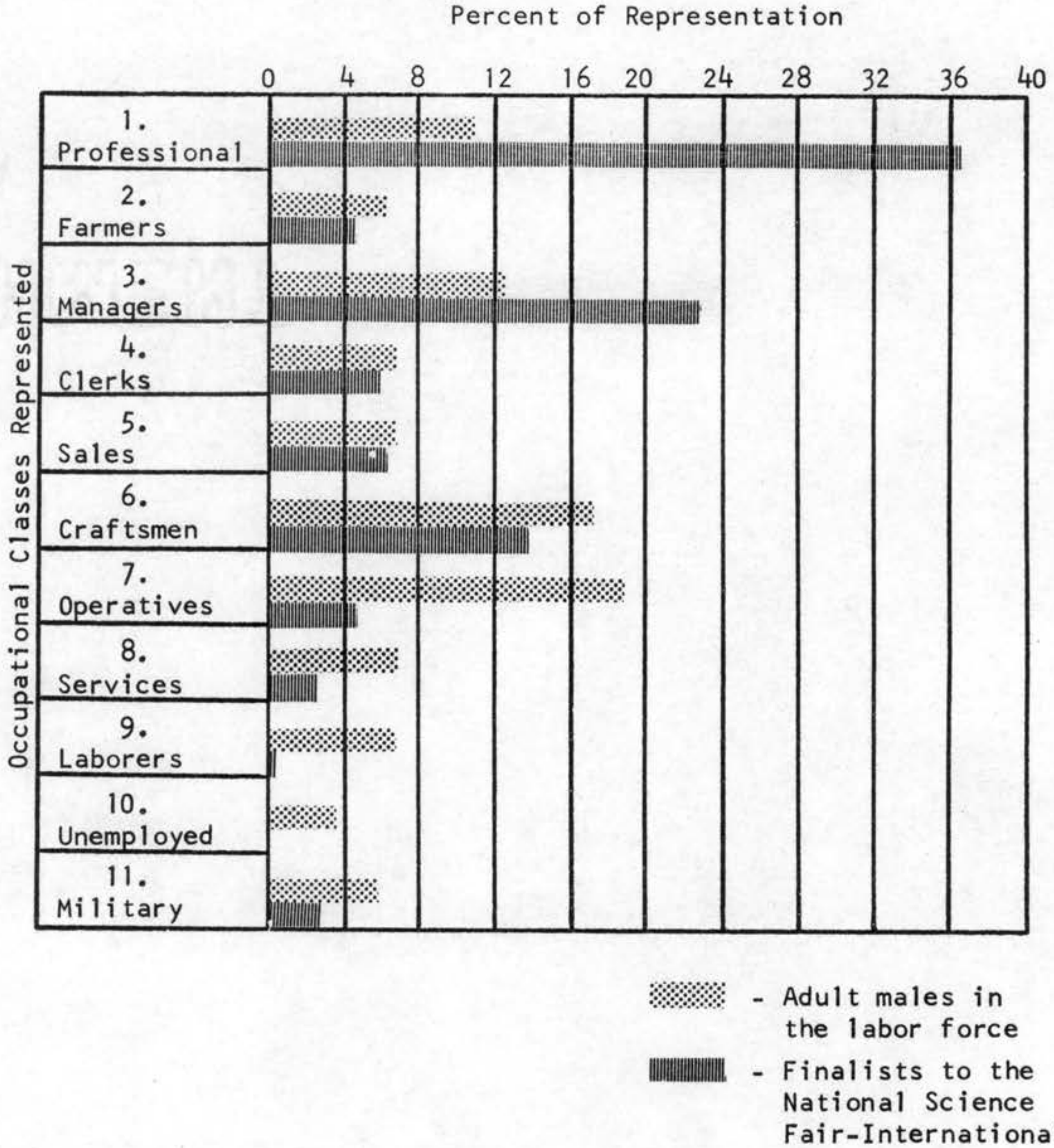

Figure 4. Percentages of Males in the Labor Force and Finalists to the National Science Fair-International -- 1966

Classes 1 (Professional, Technical, and Kindred Workers), 3 (Managers, Officials, and Proprietors), and 6 (Craftsmen, Foremen, and Kindred Workers), in the above stated order, are the groups represented by the largest percentages for each year of the study. No great tendency toward class mobility through the years is indicated by the data in Table V and Figure 5; in fact, examination of the data suggests that the classes have approached a state of homeostasis, with no class varying from its four year average by more than 3.8 percentage points in any given year. It may also be observed from the data that three classes, these being Class 8 (Service Workers), Class 9 (Laborers, Except Farm and Mine), and 10 (Unemployed), vary from their four year averages by less than one percentage point for any year.

Classes 1, 3, and 6, the leaders in the percentage of representation for each year, as indicated above, had a deviation from the average of not more than 2.4 percentage points for the four years under study. Examination of these data again suggests that an overall stability exists in the representation by finalists of the major occupational classes for the years included in the study.

Occupational Class Index of Productivity

The index of productivity shown in Table VI indicates the number of adult males in the labor force represented at the National Science Fair-International by each finalist from that particular class. Class 1 is represented by the greatest number of finalists each year. The finalists representing this group are also present in the greatest numbers in proportion to the total number of adult males from that class in the labor force.

TABLE V

FINALIST REPRESENTATION PERCENTAGES OF ALL CLASSES
TO THE NATIONAL SCIENCE FAIR-INTERNATIONAL

Class Name	Class Number	Year 1955	1956	1965	1966	Average Percentage	Maximum Deviation From Average
Professional	1	30.1	34.2	31.7	33.9	32.5	2.4
Farmers	2	5.8	5.1	6.7	4.4	5.5	1.2
Managers	3	19.8	18.7	23.0	21.4	20.7	2.3
Clerks	4	.7	7.0	4.7	5.4	4.5	3.8
Sales	5	9.5	6.1	7.0	5.7	7.1	2.4
Craftsmen	6	13.9	14.5	10.7	12.9	13.0	2.3
Operatives	7	7.3	6.1	4.2	4.4	5.5	1.8
Services	8	2.2	.9	1.7	2.2	1.8	.9
Laborers	9		1.4	.7	.2	.6	.8
Unemployed	10	.7		.5		.3	.4
Military	11	1.4	1.4	3.5	.2	1.6	1.9
Deceased,etc.	12	8.0	4.2	5.2	6.7	6.0	2.0

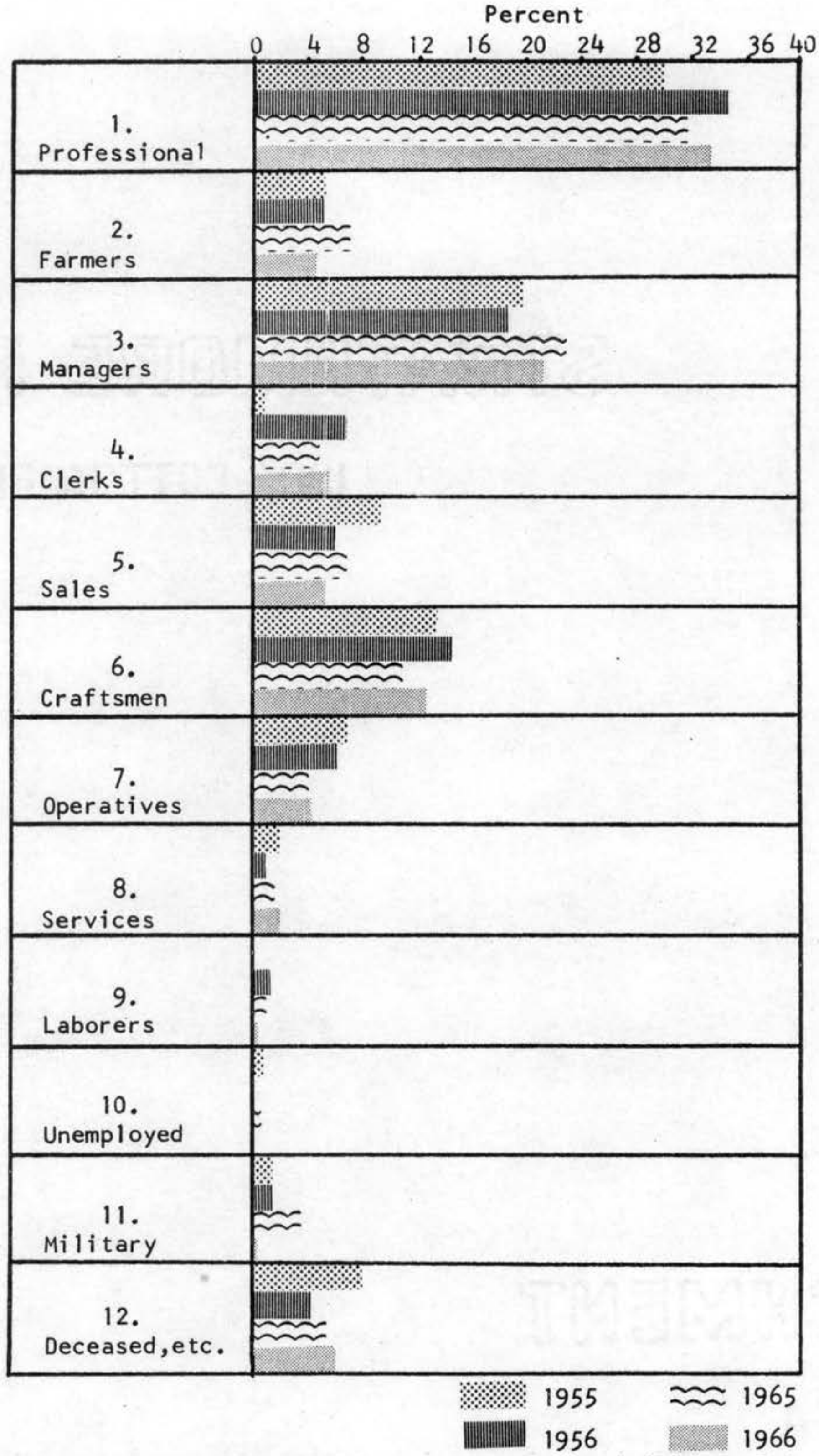

Figure 5. Percentage of Finalists to the National Science Fair-International Representing Each Occupational Class

In 1966 one finalist represented 42,455 Class 1 adult males in the labor force. This is contrasted by one finalist representing 72,360 Class 3 males, which was the second ranking class. Class 5, with an index of 128,000; Class 4, with an index of 150,727; Class 2, with an index of 166,444; and Class 6, with an index of 169,730, consitute an intermediate group with the third highest representation.

Class 11 (Military Service), Class 8 (Service Workers), and Class 7 (Operatives and Kindred Workers), constitute a fourth group, with a much higher ratio of production than the preceding groups. Classes 9 (Laborers, Except Farm and Mine), and 10 (Unemployed), are placed in the group with the highest production index, indicating a very low proportional representation at the National Science Fair-International, as shown by each finalist from Class 9 in 1966 representing over three million adult workers in that particular occupational class.

The data contained in Table VI once again indicate that there is a definite correlation between the occupational class of the father and the student being qualified as a finalist to the National Science Fair-International. It is of interest to note that Classes 1, 3, and 5 have the lowest finalist : adult-male-in-the-labor-force ratio, indicating that a smaller number of males are required to produce one finalist from each of these classes. Although Class 6 is represented by a higher total percentage of finalists in each year of the study than Class 5, (see Figure 5), Class 5 has a lower index of productivity for each year; the males in this occupational class therefore produce a higher proportion of finalists than the males of Class 6.

It should also be noted that although Class 7 (Operatives and

Kindred Workers) is improving as far as the index of productivity is concerned, with 1955 - 1966 indices of 918,900; 716,384; 551,823; and 540,277, the rank of the class for these years, according to representation, is better in 1955 and 1956, when the rank was 7th, than in 1965 and 1966, when the class ranked 9th among the other classes. This casts doubts on the suggestion of upward mobility of representation of this particular class.

Class 9 (Laborers, Except Farm and Mine), from 1956 to 1966, has suffered a reversal of the index ratio displayed by other classes, with one finalist representing an increasing number of the labor force. This is the only class showing a decreasing trend in class representation. Figure 6 presents a graphical illustration of a generalized trend observed in certain occupational classes toward a lowering of the index of productivity through the four years under consideration

Science Project Category and Class Distribution

The data contained in Tables VII and VIII deal with 1965 and 1966, the only years included in the study when projects were entered in seven categories, rather than two. In 1955 and 1956 the two categories were physical sciences and biological sciences. A general trend may be noted upon examination of these data, this being the large number of projects through all occupational classes entered in four of the seven categories. These favored categories are: Medicine, Chemistry, Physics, and Zoology, with 93, 78, 71, and 64 finalists, respectively in 1965 and 87, 51, 70, and 69 finalists, respectively in 1966. Earth Science, Math, and Botany, with 35, 30, and 29 finalists, respectively in 1965, and with 50, 36, and 38 finalists in 1966, ranked as the last three categories.

TABLE VI

INDEX OF PRODUCTIVITY--NUMBER OF ADULT MALES IN OCCUPATIONAL CLASS REPRESENTED BY EACH FINALIST

Class		Year			
Name	Number	1955	1956	1965	1966
Professional	1	85,121	53,808	43,984	42,455
Farmers	2	633,750	475,636	118,370	166,444
Managers	3	191,555	134,075	63,958	72,360
Clerks	4	2,734,000	196,800	171,315	150,727
Sales	5	190,923	194,000	99,285	128,000
Craftsmen	6	421,473	265,709	196,674	169,730
Operatives	7	918,900	716,384	551,823	540,277
Services	8	877,666	1,371,500	456,875	370,333
Laborers	9		1,142,333	1,148,000	3,255,000
Unemployed	10	2,093,000		1,141,500	
Military	11	1,548,500	953,000	190,785	326,666

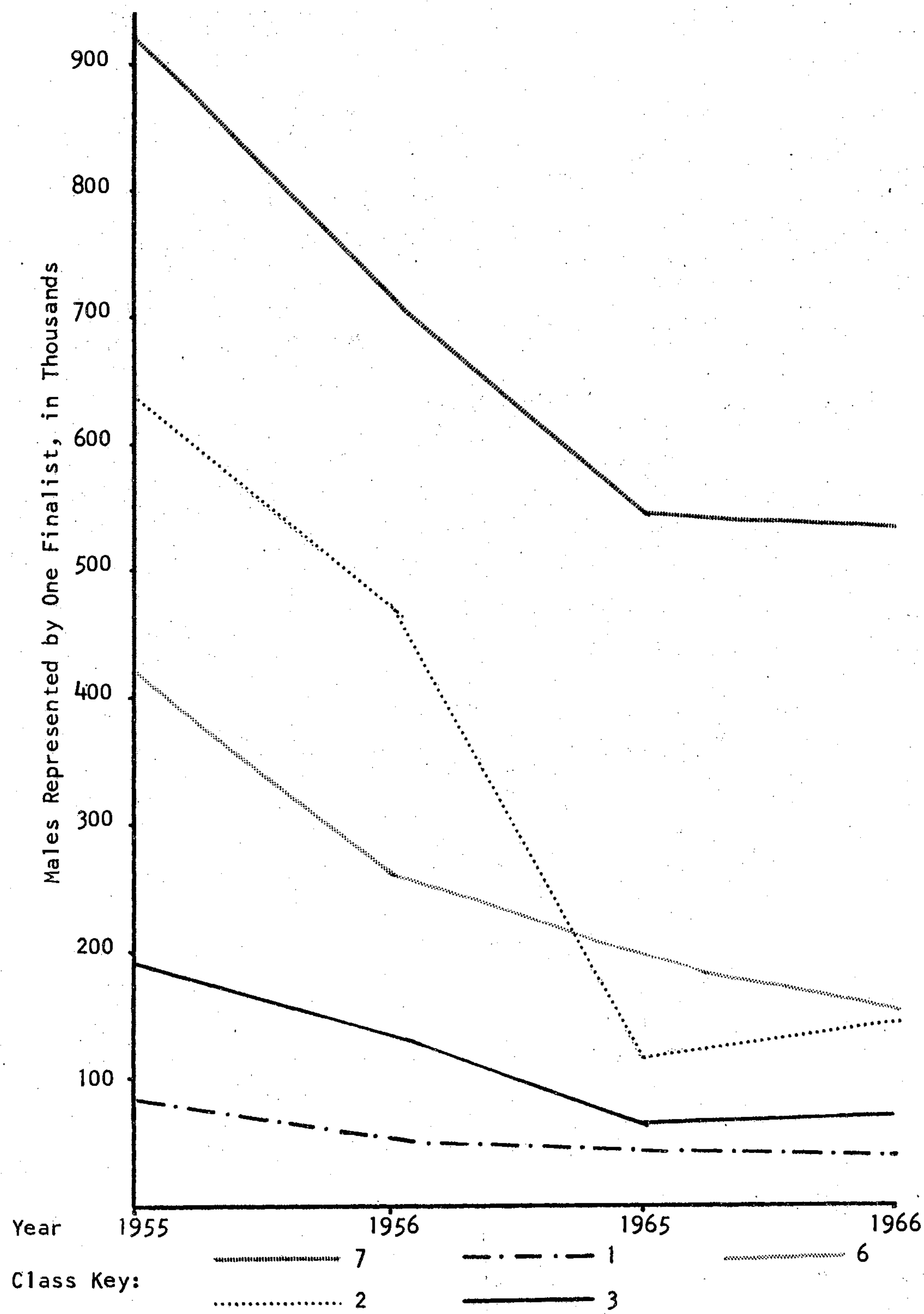

Figure 6. Index of Productivity of Five Selected Occupational Classes.

In 1965 five occupational classes (1, 3, 4, 5, and 6) had their highest representation distributed through the four top-ranked categories. Three additional classes (8, 9, and 10), while not placing finalists in over three categories, had finalists only in the top ranked categories. The same general trends--when totals of finalists participating in each category are considered, are indicated in 1966, with the first four ranking categories again including Medicine, Chemistry, Physics and Zoology. The three last-ranking categories, as in 1965, were Earth Science, Math, and Botany. Six occupational classes placed Earth Science in the four first-ranking categories, but the total finalist gain was only 15 projects, from 35 projects of 400 entered in 1965 to 50 projects of 401 entered in 1966, and no change in the first four ranking categories occurred, although Earth Science and Botany did show notable increases in group numbers.

Due to the fact that no more than two projects from each subordinate state and regional fair are qualified to the National Science Fair-International, a set of interesting implications is suggested: are projects in the top-ranked categories selected due to the dramatic impact often inherent in the subject, while meritorious research projects in Botany, Math, and Earth Science are possibly neglected? Further studies may also reveal a cyclic fluctuation in certain project categories, as subordinate science fair competitors attempt to compete in categories with the fewest number of projects. For example, a project might have a much better chance of winning an award at a regional or state fair in Botany, Mathematics, or Earth Science if the number of projects in these areas were only a fraction of those entered in other categories. By the same token, a project that qualified from a regional or state science fair would stand a much better numerical chance of being selected for an award at the National Science Fair-International in one of the least crowded categories, as the intense competition existing in the four first-ranked categories would be avoided.

Distribution of Specific Occupations in Project Categories

Finalists may enter their science project at the National Science Fair-International in one of seven categories for purposes of evaluation and judging. These categories include Botany, Zoology, Chemistry, Math, Physics, Medicine, and Earth Science. One could assume that finalists might tend to be influenced by the fathers' occupation in the choice of a research area. For example, one might expect a florist's son to enter a project in Botany, and the son of a geologist to enter a project in Earth Science. To explore this possibility, data were gathered as described below for the year 1966. Table IX, dealing with the finalists of 1966, summarizes the data relating to selected specific occupations of the fathers, and the category in which each finalist's project was placed. It will be noted that there often appears to be an inverse relationship between science project category and the father's specific occupation. This inverse effect is strongly suggested in three groups: Accountants and Auditors, with all six finalists ignoring the field of Mathmetics, Chemists, with none of the four offspring entering a project in Chemistry, and Physicians and Surgeons, where only one of ten finalists entered a project in the category of Medicine are groups exemplifying this trend.

The data discussed in the preceding paragraph seem to point toward a possible trend in regard to the choice of research categories by finalists with fathers in certain science-related occupations. In order to more completely investigate this possibility, it was decided to also accumulate data for the year 1965. Examination of Table X, which bears similar data regarding category selection of the 1965 finalists from the selected specific occupational origins, tends to slightly balance the inversion trend, with three of seven offspring of Chemists having entered their projects in Chemistry. The offspring of Physicians and Surgeons also placed two of nine projects in Medicine in 1965, and Accountants and Auditors' children had one of six projects entered in Mathematics. No definite trend is therefore conclusively indicated, and an additional study involving several consecutive years is planned to further investigate the matter.

Index of Productivity in Specific Occupations

A breakdown of occupational classes into sub-groups, hereafter described as specific occupations, indicates a general trend toward the disproportionate representation to the National Science Fair-International by certain specific occupations. Information taken from U. S. Bureau of Census publications pertaining to the 1960 census lists the number of males in the labor force engaged in a particular occupation. These figures were used as a basis for constructing an index of productivity of selected specific occupations for the years 1956 and 1966. Table XI and Table XII summarize these data.

Table XI deals with specific occupations represented by three or more finalists in the year 1966. Finalists representing the year 1956 are also included for purposes of comparison. The specific occupations are among many named by the Bureau of Census, and selection was done

TABLE VII

PROJECT SUBJECT CATEGORY AND OCCUPATIONAL CLASS OF FATHER--1965

Class		Project Category						
Name	Number	Botany	Zoology	Chemistry	Math	Physics	Medicine	Earth Science
Professional	1	12	21	29	14	21	21	9
Farmers	2	4	4	2	3	3	8	3
Managers	3	9	16	16	3	16	26	6
Clerks	4		6	3	2	3	5	
Sales	5	1	5	7		4	7	4
Craftsmen	6	2	6	10	3	8	8	6
Operatives	7		1	4	1	6	3	2
Services	8		1			1	5	
Laborers	9			1		1	1	
Unemployed	10		1				1	
Military	11		1	2	3	4	2	2
Deceased,etc.	12	1	2	4	1	4	6	3
TOTALS:		29	64	78	30	71	93	35

TABLE VIII

PROJECT SUBJECT CATEGORY AND OCCUPATIONAL CLASS OF FATHER--1966

Class		Project Category						
Name	Number	Botany	Zoology	Chemistry	Math	Physics	Medicine	Earth Science
Professional	1	16	23	11	12	30	25	19
Farmers	2	1	2	3	2	1	6	3
Managers	3	6	16	9	8	13	23	11
Clerks	4	2	4	4	1	1	7	3
Sales	5	3	4	5	2	2	5	2
Craftsmen	6	4	10	5	5	11	9	8
Operatives	7	4	4	5	2	1	2	
Services	8	1	2	1		2	2	1
Laborers	9						1	
Unemployed	10							
Military	11			3	2	3		1
Deceased,etc.	12	1	4	5	2	6	7	2
TOTALS:		38	69	51	36	70	87	50

TABLE IX

PROJECT CATEGORY OF FINALISTS FROM SELECTED SPECIFIC OCCUPATIONS--1966

Occupation of Father	Project Category						
	Botany	Zoology	Chemistry	Math	Physics	Medicine	Earth Science
Accountants and Auditors	1	2	1		1		1
Chemists	1	1			2		
Natural Scientists	1	1		1	1		2
Dentists			1		1	2	
Engineers	3	5	3	2	7	4	4
Physicians and Surgeons	2	2			4	1	1
School Teachers	1	6	3	2	3	4	1
College Presidents, Professors, Instructors	2	1	2	3		2	1

TABLE X

PROJECT CATEGORY OF FINALISTS FROM SELECTED SPECIFIC OCCUPATIONS--1965

Occupation of Father	Project Category						
	Botany	Zoology	Chemistry	Math	Physics	Medicine	Earth Science
Accountants and Auditors		4	1	1			
Chemists	1	1	3		1	1	
Natural Scientists	1	1			3	2	
Dentists			2			1	
Engineers	2	2	3	2	5	5	2
Physicians and Surgeons		1	1	1	2	2	2
School Teachers	4	6	3	3	4	2	2
College Presidents, Professors, Instructors	3	4	4	2	1	1	

arbitrarily on the basis of numbers of finalists qualifying during the years under consideration.

The index ranking, showing the finalist-adult male ratio for each specific occupation, has the following order, when finalist-adult ratios are ranked: Natural Scientists (1 : 9,852), College Presidents, Professors, and Instructors (1 : 12,683), Artists and Art Teachers (1 : 16,879), Chemists (1 : 19,282), Dentists (1 : 20,312), Physicians and Surgeons (1 : 21,392), School Teachers (1 : 23,899), Engineers (1 : 30,863), Lawyers and Judges (1 : 34,252), Mail Carriers (1: 65,801), Accountants and Auditors (1 : 66,057), Policemen, Sheriffs, and Marshals (1 : 92,325), and Carpenters (1 : 306,954).

For comparative purposes, the ratios of 1966 and 1956 may be considered. For example, in 1956 fathers who were Natural Scientists were represented at a ratio of 19,704 per finalist. In 1966, each finalist from this specific occupation represented 9,852 Natural Scientists in the labor force.

Keeping in mind the fact that the finalist population in 1956 was 213 and the finalist population to the National Science Fair-International in 1966 was 401, near-normal adjustments in representation are indicated for certain specific occupations, such as Natural Scientists (from three finalists in 1956 to six finalists in 1966), Artists and Art Teachers (from 2 to 4), School Teachers (from 12 to 20), and Engineers (from 14 to 28). College Presidents, Professors, and Instructors (from 2 in 1956 to 11 in 1966), have experienced more than the expected increase in representation, and other specific occupations, such as Chemists (from 7 to 4), and Carpenters (from 4 in 1956 to 3 in 1966), have apparently suffered a reversal in representation, if this expectation were based solely upon number of finalists for these two years.

Table XII contains data dealing with specific occupations not regularly or strongly represented at the National Science Fair-International. It will be noted that truck drivers, with a great number of adult males in the labor force, have an extremely large index of productivity, with one finalist representing over two million males in the labor force. Other specific occupations, such as Railroad Engineers and Authors, Editors, and Reporters, due in part to a smaller number of males in the labor force, have a higher proportionate degree of representation.

Finalists with Immigrant Parents

The biographical data sheets for the years 1955 and 1956 contained information regarding finalists' parents who were immigrants to the United States. An unusually high number of finalists with an immigrant parent appears in each of these years. Immigrant parents were represented by 10.29 percent of the finalists to the 1955 National Science Fair-International, and 11.27 percent of the finalists in 1956 came from homes with an immigrant parent. In view of the relatively small number of immigrant parents in the United States, this proportion of finalists tends to suggest a strong incentive toward the attainment of selected goals by our first generation Americans. One point worthy of consideration might be that the child often reflects the same attitudes and ambitions toward taking advantage of an opportunity for advancement that his parent exhibited when migrating to a new country, and views the United States as a land where effort expended toward a specific goal can result in the realization of the goal.

The rank of the first three classes in representation to the

TABLE XI

INDEX OF PRODUCTIVITY FOR SELECTED OCCUPATIONAL CLASS SUB-GROUPS

Occupation of Father	Males in Labor Force 1960 Census	Finalists 1956	Finalists 1966	Index of Productivity 1956	Index of Productivity 1966
Natural Scientists	59,111	3	6	19,704	9,852
College Presidents Professors, Instructors	139,508	2	11	69,754	12,683
Artists, Art Teachers	67,581	2	4	33,759	16,879
Chemists	76,967	7	4	10,995	19,282
Dentists	81,249	3	4	27,083	20,312
Physicians and Surgeons	213,918	9	10	23,769	21,392
School Teachers	477,985	12	20	39,832	23,899
Engineers	864,178	14	28	61,727	30,863
Lawyers, Judges	205,515	2	6	102,757	34,252
Mail Carriers	197,402	3	3	65,801	65,801
Accountants, Auditors	396,343	3	6	132,134	66,057
Policemen, Sheriffs, Marshals	276,976		3		92,325
Carpenters	920,862	4	3	230,215	306,954

TABLE XII

INDEX OF PRODUCTIVITY FOR SELECTED LOW-REPRESENTATION OCCUPATIONAL CLASS SUB-GROUPS

Occupation of Father	Males in Labor Force 1960 Census	Finalists		Index of Productivity	
		1956	1966	1965	1966
Railroad Engineers	57,561	1	2	57,561	28,780
Authors, Editors, Reporters	85,940	2	1	42,970	85,940
Firemen, Fire Protection	138,694	2	1	69,347	138,694
Welders, Flame Cutters	368,446		2		184,223
Metal Filers, Grinders	149,837	1	1	149,837	149,837
Waiters, Bartenders, Counter Waiters	331,013		1		331,013
Automobile Mechanics	700,716	3	2	233,572	350,358
Truck Drivers	2,080,754	1	1	2,080,754	2,080,754

National Science Fair-International is disrupted when comparing the children of immigrants with the total finalist population. As can be seen from Table III, the first ranking classes in the finalist population for the four years are classes 1, (Professional, Technical, and Kindred Workers), 3 (Managers, Officials, and Proprietors), and 6 (Craftsmen, Foremen, and Kindred Workers). Class 7 (Operatives and Kindred Workers) was never higher than fifth, and was as low as eighth place in order of rank. Table XII, containing data pertaining to finalists with immigrant parents, shows Class 7 having the highest representation in 1955, with five finalists. This class is typified by apprentice work and other types of occupations with similar requirements. The combined totals for the two years again shows a high degree of representation for this class.

Table XIV presents information concerning the origin of the immigrant parent. It will be noted that geographic areas of emigration are not limited in their class distribution, as each area represented by more than one finalist places a finalist in at least two different occupational classes. All geographic areas of emigration represented by more than four finalists have finalists in at least four different occupational classes. This indicates that no one stereotyped class of immigrant parent, such as a rocket scientist with a Ph.D. degree-equivalent education monopolizes the representation by the finalists of this particular geographic category.

Table XIV also directs attention to five finalists who were qualified two or more years, indicating a very high degree of research sophistication. Class 1, 3, and 6 are the highest in representation when all years are considered for the entire finalist population, as shown in Table XV. Table XIV reveals that Class 2 replaces Class 1 in the order, and Class 7 replaces Class 6 when the repeaters to the National Science Fair-International are tabulated for the children of immigrant parents.

Repeaters to the National Science Fair-International

Table XV contains data pertaining to the finalists who were qualified to the National Science Fair-International two or more times. Examination of these data reveals that Class 1 (Professional, Technical, and Kindred Workers) had the largest number of repeaters to the fair in all years except 1956, when only two finalists were qualified as participants for a second year.

When considering all repeaters by year, the trend previously indicated relating to the domination over all other classes in percentage of finalists is still observed. Class 1 is solidly represented with finalists making up 50, 20, 34.28, and 40.47 percent of the repeaters for the years 1955, 1956, 1965, and 1966, respectively. Class 3, (Managers, Officials, and Proprietors), with repeater percentages of 12.50, 30, 24.28, and 16.67 for the four years is the second-ranked major class, followed by Class 6 (Craftsmen, Foremen, and Kindred Workers), with 10, 5.70, and 19.05 percent of the repeaters during the last three years. Classes 9 (Laborers, Except Farm and Mine, and 10 (Unemployed) were not represented by finalists qualifying more than one year during the four years included in this study.

Attention is once again focused on finalists with immigrant parents, as Table XV shows that 12.5 percent of all repeaters in 1955 and 40 percent of all repeaters in 1956 were children of immigrant parents.

TABLE XIII

FINALISTS TO NATIONAL SCIENCE FAIR-INTERNATIONAL
WITH IMMIGRANT PARENTS

Class		1955			1956		
Name	Number	Father	Father & Mother	Mother	Father	Father & Mother	Mother
Professional	1	2	1		1	5	3
Farmers	2	1*			1#		
Managers	3	2			3*	1	1
Clerks	4						
Sales	5						
Craftsmen	6				3	2	
Operatives	7		4	1		1*	
Services	8		1				
Laborers	9				1		
Unemployed	10						
Military	11						
Deceased, etc.	12		1	1	1	1	
		Total for 1955 = 14			Total for 1956 = 24		

Key: Each symbol represents one finalist (*,#).
* = Finalist qualifying to National Science Fair-International 2 years.
# = Finalist qualifying to National Science Fair-International 3 years.

TABLE XIV

GEOGRAPHIC AREA OF PARENTAL EMIGRATION

Class		Geographic Area						
Name	Number	Canada	N. Europe	E. Europe	Mediterranean	N.W. Africa	Asia	West Indies
Professional	1	X0	$\underline{0}000*00$	X	0	X	$\underline{0}$	
Farmers	2		X*0#					
Managers	3		$X0\underline{0}$	0	X0*0			
Clerks	4							
Sales	5							
Craftsmen	6	0		0	00			0
Operatives	7	X	X0*	$\underline{X}$	X		X	
Services	8		X					
Laborers	9			0				
Unemployed	10							
Military	11							
Deceased, etc.	12		X0	$\underline{X}0$				

Key: Each * = a two year repeater; each # = a three-year repeater. Bar ( ) under a symbol = Mother. Each X = 1955 Finalist; each 0 = 1956 Finalist. Countries included in Geographic Areas: N. Europe: England, Wales, Norway, Holland, Germany, Switzerland; E. Europe: Russia, Poland, Estonia, Hungary, Romania; Mediterranean: Italy, Greece, Syria, Lebanon, Madeira Island, Azores; N.W. Africa: Seirra Leone; Asia: Japan, China.

Children of deceased fathers make up 100 percent of the Class 12 repeating finalists in 1965, and 66.66 percent from this class in 1966.

Finalists with Deceased Fathers

Table XVI contains data concerning Class 12, an artificial class not represented in the labor force. This group is composed of finalists whose fathers are deceased, retired, disabled, students, or unknown. Five repeaters to the National Science Fair-International are observed in this group, four of these are children of deceased fathers, one stated that his father was unknown.

It is interesting to find that 100 percent of the repeaters are without fathers. It may be noted that more finalists represent deceased fathers for each year than any of the other categories in this class, as recorded in Table XVI. Finalists with deceased fathers also are present in greater numbers than finalists representing classes 8 (Service Workers), 9 (Laborers), 10 (Unemployed), and 11 (Military Services). See Table III for data concerning classes 8, 9, and 10.

Although one would not necessarily agree with Admiral Rickover's attempts to introduce the European or English educational system into the United States in place of our own, his statements concerning the importance of motivation seem to apply to the data contained in the preceding paragraph, and also to the data relating to children of immigrant parents, as both groups were qualified as finalists to the National Science Fair-International in greater proportions than would normally be expected. Rickover states (57):

> Great efforts are being made abroad to induce more children to pursue a rigorous academic secondary school program. It is pretty generally believed that they will have to come from the top 30 percent. Today, no country has succeeded in motivating <u>all</u> of

TABLE XV

REPEATERS TO THE NATIONAL SCIENCE FAIR-INTERNATIONAL

Class		Years			
Name	Number	1955	1956	1965	1966
Professional	1	4	2#	21 (3)	15 (2)
Farmers	2	2#	(1)#	6 (1)	1
Managers	3	1	3#	13 (4)	7
Clerks	4		1	8	1 (1)
Sales	5			4	
Craftsmen	6		1	4	7 (1)
Operatives	7	1	1#		1
Services	8			1	2
Laborers	9				
Unemployed	10				
Military	11		1	3	1
Deceased, etc.	12			2**	2* (1)*

Key: Numbers enclosed in ( ) indicate three-time qualifiers, all others are two-time qualifiers.
Each * indicates that one finalist in the category had a deceased father.
Each # indicates that one finalist in the category had an immigrant father.
(Immigrant parents only recorded for 1955 and 1956)

> these 30 percent to pursue such a rigorous school program. Money has little to do with the situation. Motivation is the principal factor and family support is the best spur to intellectual effort.

One often hears of a person overcoming a serious physical handicap and later excelling in some athletic activity, over-compensating for his impediment and surpassing the accomplishments of more fortunate individuals. Two lines of thought may be considered relative to the large number of finalists representing deceased fathers. Could it be that the widowed mother provided the positive attitudes toward achievement which enabled the child to compensate for his apparent disadvantage? This point of view is taken by Clarke (58), who found that "father-absent" boys tend to attain higher achievement than "father-present" boys, and concluded that they overachieve for self-confidence and peer acceptance. Bradburn's (59) findings indicate that father dominance is associated with low achievement, and reported higher achievement in groups that were removed from the paternal dominance at an early age.

Roe (60) reports results of two studies in which scientists and mathematicians with a deceased parent comprised 25 percent of each group. A similar study of 624 college students contained only 6.3 percent with a deceased parent. At least in certain cases, one might assume that either or both of these factors could have influenced the results as shown in Table XVI.

Military Rank and Representation

An examination of the data presented in Table XVII reveals a possible trend in the representation to the National Science Fair-International from the military services. It is an obvious fact that the bulk of the men in the lower enlisted and the lower commissioned officer echelons are not of sufficient age to have children in high school. However, the finalists representing enlisted men and officers over the years involved in this study deserves attention. There exists a much larger number of non-commissioned officers (equivalent to master sergeant, staff sergeant, and sergeant first class) through all branches of the service than commissioned officers. These men are of comparable ages to commissioned officers, yet their representation is proportionally very low. Only in 1955 were there more enlisted men than officers represented. In 1965 enlisted men and officers fathered the same number of finalists, although the officers were greatly outnumbered by enlisted men in the same age bracket in the military services. In 1966 all finalists from military families were children of commissioned officers.

It is also of interest to note that an inverse order of representation exists among the commissioned officers when rank is considered. In the military ranks contained in this study, the Colonel should be at the apex of the pyramid of numbers, with the least number in the highest rank, followed by increasing numbers of Lieutenant Colonels, Majors, Captains, and Warrant Officers. The finalists representing Colonels outnumber the finalists representing the combined lower ranks of officers for the years considered in this study.

Ranks from the various military services were adjusted to fit the terminology employed by the army; for example, a navy Captain would be considered the equivalent to a Colonel in the army. All major branches of the armed services were found to produce finalists to the National Science Fair-International during the years of the study, with the exception of the Marine Corps.

These data suggest that stratification of representation in the military service follows a pattern similar to the stratification of representation observed in the major civilian occupational classes.

TABLE XVI

SUMMARY OF FINALISTS REPRESENTING CLASS 12

Status of Father	Year 1955	1956	1965	1966
Deceased	7	4	14**	11*#
Retired	1	3	3	10
Disabled	2	1		3
Student	1		2	
Unknown		1	2	3*

Key: * Each symbol indicates one finalist qualifying to the National Science Fair-International for two years.

Each symbol indicates one finalist qualifying to the National Science Fair-International for three years.

TABLE XVII

RANK OF FINALISTS' FATHERS IN MILITARY SERVICE

Year			
1955	1956	1965	1966
Enlisted 2	Enlisted 0	Enlisted 7	Enlisted 0
Officers 0	Officers 3	Officers 7	Officers 9
	Rank of Officers		
	Colonel 1	Colonel 3	Colonel 6
	Lt. Col. 0	Lt. Col. 2	Lt. Col. 1
	Major 0	Major 1	Major 1
	Captain 1	Captain 0	Captain 1
	Warrant Officer 1	Warrant Officer 1	Warrant Officer 0

Summary

Total Enlisted -- All Years	9	Officer's Ranks--All Years			
Total Officers -- All Years	19	Colonel	10	Captain	2
		Lt. Col.	3	Warrant Officer	2
		Major	2		

CHAPTER V

SUMMARY AND CONCLUSIONS

Review of the Purpose of the Study

The exhibition of science research projects by high school students in competitions known as science fairs has evolved from a small display in 1928 to a program involving approximately one million students a year. Follow-up studies reveal that a great majority of the participants in fairs at all levels developed deeper and continuing interests in science and science-related activities.

The finalists to the National Science Fair-International have been found to be high in scientific ability and achievement. Researchers indicate that an extremely high percentage of these students attend college and enter science-related careers.

Primarily, this study has attempted to investigate certain factors relating to the background of the finalists in an effort to determine the influence of parental occupational class upon success in science fair competitions leading to the National Science Fair-International.

Other factors included the construction of indices of productivity for occupational classes and also for selected specific occupations, and an examination of the distribution through the categories in which science projects were entered from the occupational classes, and from selected specific occupations. Additional data were collected pertaining to finalists with immigrant parents, finalists qualifying two or more times, finalists with fathers not classified in the labor force, and finalists from service-connected families.

The study was limited to 1,150 participants from the United States during the years of 1955, 1956, 1965, and 1966.

Summary of Results and Conclusions

The research data and the analysis resulting from the present study indicate the following:

1. There is a definite relationship between the occupational class and participation as a finalist at the National Science Fair-International. Of eleven groups considered in the chi-square analysis, three classes were consistently represented by a higher proportion of finalists than expected under the conditions dictated by the null hypothesis; six classes were represented by a lower proportion than expected, and two classes were proportionally lower for three of the four years in the study. The results dictated that the hypothesis of independence of participation at the National Science Fair-International and parental occupational class be rejected.
2. The percentage of finalists from each occupational class remained relatively stable over the years included in the study, as no class varied by more than 3.8 percentage points from the average for the class during the years included in the study.
3. Among the different occupational classes, there exists considerable differences between the occupational classes when a finalist to adult-male-in-the-labor-force ratio is tabulated. The range is from 1 : 42,455 to 1 : 3,255,000, indicating a

great difference in representation by various occupational classes.

4. Within occupational classes, there are significant differences in proportional representation among selected specific occupations.

5. Certain categories (Medicine, Chemistry, Physics, and Zoology), receive higher numbers of finalists than the others (Earth Science, Math, and Botany). Eight of the occupational classes followed this general trend. The 1966 data revealed a tendency for finalists from selected specific science-oriented occupations to enter projects in categories not directly related to the occupation of the father. The 1965 data tended to minimize this predisposition.

6. Finalists with immigrant parents were present at the National Science Fair-International in high proportions, as 10.29 percent in 1955 and 11.27 percent of all finalists in 1956 were first generation Americans.

7. Finalists with immigrant parents were from eight occupational classes, with a lower than expected representation for Class 5 (Sales Workers), and higher than expected proportions from Class 6 (Craftsmen, Foremen, and Kindred Workers), and Class 7 (Operatives and Kindred Workers), when compared with the data including all finalists.

8. Finalists with deceased fathers were qualified to the National Science Fair-International in greater numbers than finalists from four classes; these being Class 8 (Service Workers), Class 9 (Laborers, Except Farm and Mine), Class 10 (Unemployed,

and Class 11 (Military Services).

9. Students qualifying to the National Science Fair-International two or more years came mainly from Class 1 (Professional, Technical, and Kindred Workers), and Class 3 (Managers, Officials, and Proprietors), with classes 6 (Craftsmen, Foremen, and Kindred Workers), 2 (Farmers and Farm Managers), and 4 (Clerical and Kindred Workers) also being well-represented. The children of immigrant parents, and students with deceased fathers were repeaters in numbers that exceeded the normally expected proportions.

10. Among finalists representing fathers in the military services, enlisted men are not represented in numbers expected if participation were independent of the father's rank. Of the officers represented, an inverse order of representation exists, with the children of the higher ranking officers, such as Colonels, present in significantly higher proportions than officers of subordinate ranks, such as Lieutenant Colonels, Majors, Captains, and Warrant Officers.

Recommendations

The writer makes the following recommendations as a result of the study:

1. Efforts should be made to inform parents and teachers of students with high science potential, regardless of occupational class, of the opportunities associated with participation in science fair competition. It is felt that successful science project work is usually associated with positive attitudes

toward this activity from the teacher and the parent.

2. A feasability study or pilot study should be initiated to determine the effect of a program (similar to a summer institute) involving teachers, students from various occupational classes, and their parents in an informative, instructional, skills-and-attitudes-building format of operation.

3. Under the auspices of the National Science Foundation or the U. S. Office of Education, funds should be made available to cover certain student expenses incurred during the research, for selected promising students. This could be in the form of low or no-interest loans, or as grants to the school, with equipment purchased being consigned as school property upon graduation of the student. These funds might be of a set amount, perhaps not more than fifty dollars, and should be made after a research proposal has been approved through local and regional science fair officials. The primary purpose of these grants would not be to subsidize student research, but to demonstrate to groups not adequately involved in science fair participation at the present that students with similar backgrounds can succeed in scientific endeavors. It is postulated that an improving attitude toward science, and an understanding and appreciation of the role science plays in our society would result from this program.

4. A study should be designed to measure the effect of exposing fatherless students with high science potential to science teachers with project sponsoring experience who could serve as a strong father image.

5. Further research should be conducted to determine the extent to which parental attitudes affect successful and unsuccessful projects, and participants and non-participants in the science fair activities.
6. Additional research similar to the present investigation should be done for those years not included in the study.

SELECTED BIBLIOGRAPHY

(1) Schwab, Joseph J. Biology Teachers' Handbook. John Wiley and Sons, Inc., New York, N. Y. (1963).

(2) Drummond, Ainslie H., Jr. "The 'News' in Science: It's Place in the Curriculum." School Science and Mathematics, Vol. 65. (February, 1965) 182-187.

(3) Lockard, David J. Third Report of the Information Clearinghouse on New Science and Mathematics Curricula. The American Association for the Advancement of Science, College Park, Md. (1965).

(4) Haney, Richard E., The Changing Curriculum: Science, Association for Supervision and Curriculum Development, NEA, Washington, D. C. (1966).

(5) Cole, Charles W. Encouraging Scientific Talent, College Entrance Examination Board, New York (1956).

(6) U. S. Bureau of the Census, 1960 Census of Population, Alphabetical Index of Occupations and Industries, (Revised Edition) U. S. Government Printing Office, Washington, D. C. (1960).

(7) Meister, Morris. "The Educational Values of Scientific Toys," School Science and Mathematics, Vol. 22. (December, 1922) 813.

(8) Carothers, C. M. "Science Fair," Journal of Chemical Education, Vol. 8. (February, 1931) 244-255.

(9) Graber, Ellinor. (Quoted in John H. Woodburn and Ellsworth S. Obourn) Teaching the Pursuit of Science, The Macmillan Co., New York, N. Y. (1965).

(10) Watkins, Ralph K. "The Technique and Value of Project Teaching in General Science," General Science Quarterly, Vol. 7. (May, 1923). 235-256.

(11) Howe, Harrison E. "Report of the Committee on Prize Essays of the American Chemical Soceity," Journal of Chemical Education, (January, 1925) 3.

(12) Kraus, Joseph H. (Quoted in Harold W. Phend and Ronald J. Seman). Materials Engineering at the International Science Fair, Metals Park, Ohio, American Society for Metals (1966).

(13) Davis, Watson. Science Activities Handbook, Science Service, Washington, D. C. (1965).

(14) Science Service, Biographies of Finalists and Pertinent Data About Their Exhibits, Washington, D. C. (1966).

(15) Welte, Arden F., and James Dimond. Your Science Fair- An Opportunity for Youth. Burgess Publishing Co., Minneapolis, Minn. (1959).

(16) Science Service, National Science Fair-International, Washington, D. C. (1965).

(17) Sherburne, E. G. Jr., "Fairs: International-National-Local," Science News, Vol. 90. (September 3, 1966) 157.

(18) Harris, Chester W. "Secondary School Science Students," Encyclopedia of Educational Research, The Macmillan Co., New York, N. Y. (1960).

(19) Daniels, G. L. "Occupational Choices of Former National Science Fair Exhibitors," (unpub. Doctoral Dissertation, Columbia University, (1960).

(20) Moore, Shirley. "Science Youths Start Younger," Science News Letter, Vol. 84. (September, 1963) 170-173.

(21) Snakenberg, Forrest L. "Start Early in Science", Science News Vol. 89. (May, 1966) 367-368.

(22) Bowles, Richard D., "Who Makes a Scientist? You do." Grade Teacher, Vol. 84. (September, 1966) 98-99+.

(23) Bethune, Paul. "Student Investments in Science Fair Projects," Science Teachers' Journal, Vol. 5. (January, 1961) 13.

(24) Burkman, Ernest Jr., "An Analytical Study of Factors Contributing to the Development of Projects Exhibited in the 1961 Florida Regional and State Science Fairs," (unpub. Doctoral Dissertation, University of Michigan, 1962).

(25) Coyne, Joseph A., "Aiming at the National Science Fair," Catholic School Journal, Vol. 65. (December, 1965) 47-48+.

(26) Brennan, Robert, J. "Science Fairs - Intentions, Accomplishments and Failures," Science and Math Weekly, Vol. 4. (December 4, 1963) 1-3.

(27) Hammond, David H. "Science Fairs and Cooperation," Science and Math Weekly, Vol. 4. (January, 1964) 1-4.

(28) Sebastian, Mother M., E.B.V.M. "The Culturally Disadvantaged Student and the Science Fair," The American Biology Teacher, Vol. 27. (April, 1965) 277-280.

(29) Stalnaker, John M. "Scholarship Selection and Cultural Disadvantage," National Association of Secondary School Principals Bulletin, Vol. 49. (March, 1965) 143.

(30) Conant, James B. Slums and Suburbs, McGraw-Hill, New York, N. Y. (1961).

(31) Havinghurst, Robert J., and Bernice L. Neugarter. Society and Education, Allyn and Bacon, Inc., Boston, Mass. (1957).

(32) Jencks, Christopher. "The Public Schools are Failing," The Saturday Evening Post, Vol. 239. (April 23, 1966) 14.

(33) Porter Albert. "Validity of Socioeconomic Origin as a Predictor of Executive Success," Journal of Applied Psychology, Vol. 49. (February, 1965) 11-13.

(34) Altus, William D., "Birth Order and its Sequelae," Science, (January, 1966) 44-49.

(35) Duncan, Roger, "An Experimental Study of the Effect of Parents' Knowledge on Student Performance in SMSG Mathematics," Journal of Educational Research, Vol. 58. (November, 1964) 135-137.

(36) Steiner, G. J., "National Achievement Scholarhip Program; for Outstanding Negro Students," Chicago School Journal, Vol. 46. (October, 1964) 27-28.

(37) Associated Press dispatch, Stillwater (Oklahoma) News-Press, "Harvard Gamble is Paying Off," (February 17, 1966).

(38) Bond, Horace, "The Productivity of National Merit Scholars by Occupational Class," School and Society, Vol. 85. (September, 1957) 267-268.

(39) Visher, Stephen S. Scientists Starred, 1903-1943, The Johns Hopkins University Press, Baltimore, Md. (1947).

(40) Strauss, Samuel, "On the Backgrounds of Doctorates," Science Education, Vol. 49. (February, 1965) 5-35.

(41) Koelsche Charles L., "Characteristics of Potential Scientists," Science Education, Vol. 49. (February, 1965) 72-79.

(42) Torrance, E. P. (Quoted in Calvin W. Taylor and Frank Barron), Scientific Creativity: Its Recognition and Development, John Wiley and Sons, Inc., New York, N. Y. (1963).

(43) Getzels, J. W., and Jackson, P. W., Creativity and Intelligence, John Wiley and Sons, Inc., New York, N. Y. (1962).

(44) Wolfe, Dael, America's Resources of Specialized Talent, Harper and Brothers, New York, N. Y. (1954).

(45) Syed, Anna K., "Patterns of Parent Behavior Influencing Academic Achievement in the Junior High School," (unpub. Doctoral Dissertation, University of Illinois, 1961).

(46) Frierson, Edward C., "A Study of Differences Between Gifted Children from Upper and Lower Status Communities," Science Education, Vol. 49. (1965) 205-210.

(47) Science Service, Biographies of Finalists and Pertinent Data About Their Exhibits, Washington, D. C. (1955).

(48) ______, Biographies of Finalists and Pertinent Data About Their Exhibits, Washington, D. C. (1956).

(49) ______, Biographies of Finalists and Pertinent Data About Their Exhibits, Washington, D. C. (1965)

(50) Garrett, Henry E., Statistics in Psychology and Education, David McKay Co., Inc., New York, N. Y. (1964).

(51) Finerty, Joseph M., editor, Employment and Earnings, U. S. Department of Labor, Washington, D. C. Vol. 11. (May, 1965).

(52) ______, Employment and Earnings and Monthly Report of the Labor Force, U. S. Department of Labor, Washington, D. C. Vol. 13. No. 1 (July, 1966).

(53) U. S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1957, Washington, D. C. (1960).

(54) ______, Statistical Abstract of the United States: 1966, Washington, D. C. (1966).

(55) ______, Statistical Abstract of the United States: 1965 Washington, D. C. (1965).

(56) ______, Statistical Abstract of the United States: 1956, Washington, D. C. (1956)

(57) Rickover, H. G., "Education for ALL Children -- What We Can Learn from England," Testimoney before the House of Representatives Committee on Appropriations, Eighty-Seventh Congress, Second Session, U. S. Government Printing Office, Washington, D. C. (1962).

(58) Clarke, Alfred P. "A Study of the School Behavior Effects Upon Boys of Father Absence in the Home," Dissertation Abstracts, Vol. 25., No. 5. (1964).

(59) Bradburn, Norman N., "N Achievement and Father Dominance in Turkey," Journal of Abnormal and Social Psychology, Vol. 67, No. 5. (1963) 464-468.

(60) Roe, Anne. "A Psychological Study of Eminent Biologists," Psychological Monographs, Vol. 65., No. 14. (1951) 1-68.

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Doctor of Education

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