THE RELATIONSHIP OF SCIENCE DEFICIENCIES TO SUBSEQUENT ACADEMIC PROGRESS IN THE SCHOOL OF ENGINEERING AT MICHIGAN STATE COLLEGE OF AGRICULTURE AND APPLIED SCIENCE

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CHAPTER I

BACKGROUND AND NEED OF THE STUDY

College entrance is a problem that has intrigued, sometimes perplexed and often baffled educators for a long time. In its early days the high school was the intermediate school between the elementary or grammar school and the university. Under these conditions the one purpose of the high school was to supply the necessary tools for university entrance. These for the most part were Latin, Greek, and mathematics. Only the few who then attended the university thought it necessary to attend high school.

The coming of the mechanical age with the new century and the rapid increase of communication and transportation facilities together with the advent of mechanical power and complex machines on the farm demanded a better knowledge of the fundamentals of communication, transportation, and science. Consequently, those who now come to high school have new and varied interests and needs. A preparation for college entrance is not necessarily their major purpose. Many have not sufficiently

matured[1] either socially or mentally to decide what they wish to do as a life work or vocation. As a result many have entered college later without the subject pattern specifically required for their field of interest.

The requirements of the school of engineering have been inherited from the days when the basic philosophy of the secondary school was orientated around the need of a preparation for college, and on first examination they seem to be unquestionable. But the large number of college entrants with deficiencies[2] and the changing emphasis in the aims of the secondary school[3] as recognized by many

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[1] Maturation as used throughout this study refers to the reaching or approaching that stage of adulthood when the desires and purposes have become sufficiently stabilized so that future planning can be attempted with a degree of certainty.

Definition of terms used in this study will be given the first time the term is used and may also be found in Appendix A.

[2] Deficiency is a term used to include those high school subjects which are specifically required for admission to a given school of Michigan State College but which have not been successfully completed prior to the entrance of the student into the college.

[3] This has culminated in a new type of entrance pattern for colleges and universities in Michigan. Although the various schools within the universities have not agreed to change their specific requirements there will be, without doubt, an increasing pressure, from both within and without the university, to do so. For a full text of this agreement, known as the "Michigan College Agreement," as adopted by the Michigan College Association, November 7, 1946, the reader is referred to Appendix B.

educators today demand a re-examination of the traditions so carefully preserved by our educational system. Variations in the entrance requirements of the various schools[4] and the higher variation in the flexibility with which they are applied leads to serious questions regarding the validity of arguments insisting on their essentiality.

In comparison of the entrance requirements of selected schools of engineering as shown in Table I, the wide variation in the amount of science and mathematics and other subjects is apparent. Four of the schools require four years of mathematics while some of these same schools require but one year of science. Most of them are quite flexible regarding the extra year or years of mathematics and the second science, specifying that facilities at the university may provide for the make-up of such high school deficiencies there. Yet some, such as the Massachusetts Institute of Technology, specify that no exceptions to the requirements will be made. Four of the schools prescribe language as a requisite and two of these require three years of one language. Because of their abstractness these studies may act as a partial filter to prevent registration of some of the entrants who might find engineering subjects difficult. As the results of this study

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[4] See Appendix C for comparisons.

TABLE I

CERTAIN ENTRANCE REQUIREMENTS OF SEVENTEEN SELECTED SCHOOLS OF ENGINEERING

Requirement studied	Units required	Number of schools	Per cent
Mathematics	3	8	42
	3½	7	37
	4	4	21
Science (no specified subjects)	1	1	5
	2	1	5
(with Physics specified)	1	7	37
	2	9	47
	3	1	5
Language	2	4	21
	3	2	10
English	2	1	5
	3	14	78
	4	2	10

For a more detailed analysis of these requirements with the specific name of each school the reader is referred to Appendix C of this study.

are analyzed it becomes evident that at least the science and mathematics requirements would secure, on the average, a student of higher academic ability. This would probably be true for many such required subjects, including Latin, but it would seem that this is the only function that can logically be sustained.

Other schools have practically dispensed with all specified subject patterns for entrance.

> Under the leadership of Doctor Jordan, Stanford University asked only that the applicant should bring evidence of having completed 15 units of high school work with a high degree of scholarship, and English was the only absolute requirement. Thirty-six years of experience with that method of admission has demonstrated that it is not what the candidate took in high school, but what he brings with him to college in the way of mental ability, steadfastness of purpose, outlook on life, and qualities of leadership, that determine how far he will go in life. . . .
>
> We are not going to get anywhere in this college admission discussion until we succeed in switching the emphasis from that of insisting on a certain pattern of subjects taken in high school to that of selecting the best type of individual upon whom to expend the time and money involved in a college or university course.[5]

These variations suggest a need of study into the essentiality of the various entrance requirements.

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[5] Quotation from W. M. Proctor, Chapter VI, "The relationship between high school and college," Department of Superintendence of the National Education Association, Sixth Yearbook. (Washington: Department of Superintendence, 1928), p. 143,4. [Italics not in the original.]

Recent studies[6] such as the Eight-Year Study[7] and those more limited ones by Douglass,[8] Washburn,[9] Keeler,[10] Mitchel,[11] Bent,[12] and Odell[13] have found little variation in subsequent scholastic progress in any way directly connected with the pattern of high school subjects chosen by

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[6] For a review of these studies as they relate to to this problem the reader is referred to Chapter II of this report, pp. 31-34.

[7] Wilford Merton Aikin, The Story of the Eight-Year Study. (New York: Harper & Brothers, 1942), 157 pp.

Charles Dean Chamberlin, et al., Did They Succeed in College. (New York: Harper & Brothers, 1942), 291 pp.

[8] Harl R. Douglass, "the relation of high school preparation and certain other factors to academic success at the University of Oregon," School Review, 40:174,5, March, 1932.

[9] Oliver M. Washburn, "Predictive values of high school subjects," California Journal of Secondary Education, 15:400-2, November, 1940.

[10] L. W. Keeler, "An investigation of the effect of subject deficiencies upon accomplishment of students entering the College of Engineering at the University of Michigan during the academic years 1927-1928, 1928-1929, and 1929-1930," Bureau of Educational Reference and Research, Bulletin No. 138, March, 1931. (Ann Arbor: School of Education, University of Michigan), 68 pp.

[11] J. P. Mitchel, "The study clarifies college admission problems, " California Journal of Secondary Education, 17:144,5, March, 1942.

[12] Rudyard K. Bent, "Scholastic records of non-high school graduates entering the University of Arkansas," Journal of Educational Research, 40:108-15, October, 1946.

[13] William R. Odell, "College admission issues in California," California Journal of Secondary Education, 16:235-8, April, 1941.

the pupil. Study habits,[14] attitudes and goals,[15] and an inherent determination for success associated with a fair degree of intelligence seem to be the greatest assets toward successful academic progress in college.

The American Society for Engineering Education and its predecessor, The Society for the Promotion of Engineering Education, have been seriously interested in this problem for a number of years. The results of some of their researches have been exceedingly useful in the field of engineering education. As one would expect there are several schools of thought in the area of entrance requirements as expressed through the Journal of Engineering Education and the Proceedings of the Society.[16]

The one, as expressed in a recent article by Miller and Roth,[17] advocates that high school requirements must be raised academically so that more and earlier attention may be focused on purely engineering subjects in the

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[14] Douglass, loc. cit.; Washburn, loc. cit.

[15] Ruth E. Eckert, "The significance of curriculum choice," Studies in Articulation of High School and College, University of Buffalo Studies, Volume 13, 1936. (Buffalo: University of Buffalo), pp. 313-5.

[16] These are official organs of the "American Society for Engineering Education" and its predecessor, "The Society for Promotion of Engineering Education."

[17] Fredrick H. Miller and Sidney G. Roth, "A Report on Mathematics Preparation for Engineering Colleges," The Journal of Engineering Education, 37:628-637, April, 1947.

university. Miller's first recommendation furnishes a good illustration of the contentions of this school.

> The courses in algebra should be stepped up so that a higher attainment of skills can be accomplished at the end of each. Some of the techniques in intermediate algebra should be placed in the elementary algebra course and then reviewed and extended in later studies.[18]

This school of thought urges an increase of mathematics for its specific usefulness in the field of engineering with the apparent purpose in view of requiring a better and deeper knowledge of tool subjects upon entering college so that more time will be available during the college course for professional training. Yet, it hardly takes into account the full problem of the typical high school when it proposes that the high school training should include four years of mathematics and that this ought to include training in the elementary concepts of the calculus. Although recognizing the dual purpose of high school education, it overlooks the vital problem of the efficient separation of the college preparatory group during the early high school years before sufficient exploration has been allowed. The high school youth of today who will be the engineering student of tomorrow is often unprepared in educational maturation to fully decide

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[18] Ibid., p. 635.

upon a chosen field of study early in his high school career.

Another philosophy similar in its effects upon the high school program of studies, although widely separated in its basic concepts, is referred to by Wilds.

> Even today in many countries we find schoolmen who are still agencies for the preservation of the theory of formal discipline, defending the old formal grammar, Latin, algebra, and geometry as the most important subjects in the curriculum, on the grounds that they produce great minds through a training in logical thinking.[19]

This second school of thought contends that it is rigorous mental training that is a necessary stepping stone to success, and that this training in thinking is essential before any specialized training should begin. It might be significant to quote a few lines from Hutchins who is an outstanding example of this philosophy.

> With deference I suggest to the New England preparatory schools (after they have become colleges) a course of study based upon ideas--how to recognize them, analyze them, develop them, and apply them. This used to be done through what was called the "trivium": grammar, rhetoric, and logic. A course of study composed of the classics and the trivium would make the college an intellectual enterprise and college education an intellectual experience. The graduate would have had no vocational training. He would have trained his mind. He would be better equipped to meet practical situations than one whose training has been given him through the medium of

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[19] Elmer Harrison Wilds, The Foundations of Modern Education. (New York: Rinehart & Company, Inc., 1942), pp. 365,6.

> little imitation practical situations in the classroom. I suggest also that the graduate of such a college would be better equipped to go into the university than one who had passed through a preparatory school of the variety that exists today.[20]

Again. . . .

> We have then for general education a course of study consisting of the greatest books of the western world and the arts of reading, writing, thinking and speaking, together with mathematics, the best exemplar of the processes of human reason. . . . If we wish to prepare the young for intelligent action, this course of study should assist us: for they will have learned what has been done in the past, and what the greatest men have thought. They will have learned to think for themselves. . . . All the needs of general education in America seem to be satisfied by this curriculum.[21]

This concept fails to meet the strong public sentiment and philosophical concepts that have set up a new educational yardstick for successful secondary training. The old "disciplines," however successful they may have been, do not meet modern criteria for education--a truly democratic education in a democracy--although these "disciplines" with their, of necessity, concomitant transfer of training concepts have, perhaps, been too completely discarded in modern educational planning.

A third school of thought maintains quite a different point of view when it advocates that it is the

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[20] Robert Maynard Hutchins, No Friendly Voice. (Chicago: University of Chicago Press, 1936), pp. 79,80.

[21] Hutchins, The Higher Learning in America. (New Haven: Yale University Press, 1936), p. 85.

business of the high school to train for adequate living and thus leave the college or university free to administer the technical training. This concept integrates with the modern philosophy of the high school as expressed by Proctor.

> What the high school insists upon, since it belongs to all of the people and is supported by them, is the right to teach those subjects which are found to be best adapted to the development of worthy citizens for a democracy and for the orientation of those prospective citizens in the world as it now is, and not as it was in 1635, 1750, or even 1890.
>
> . . . It is because the emphasis on foreign languages and mathematics, in most of the proposed national standards of college admission, are so excessive as to make impossible the inclusion of the subjects which are coming to be recognized as of greater importance for carrying out the true principles of secondary education, that public education officials ought to think twice before endorsing such proposals.[22]

Moehlman continues this thought as he summarizes these responsibilities of the high school.

> Individual differences in human beings seem to me to demand that the school provide two distinct types of learning activities: (1) provisions which release to the full the creative talents and peculiarities of each personality; and (2) provisions which orient the individual in the cosmic process and prepare him for high-level social cooperation. . . . Both are needed

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[22] Quotation from W. M. Proctor, Chapter VI, "The relationship between high school and college," Department of Superintendence of the National Education Association, Sixth Yearbook. (Washington: Department of Superintendence), p. 144.

> for completeness of living. . . . Democracy represents a moving equilibrium between the two.[23]

While it is true that many high schools have not developed their philosophies to this point, yet the influence of the times--the democracy of the community—is making itself felt in the philosophy of the most conservative school or system. This philosophy of education developed through years of experience by the people of America has come to demand that:

> Schools should be dedicated to the proposition that every youth in these United States--regardless of sex, economic location, or race--should experience a broad and balanced education which will (1) equip him to enter an occupation suited to his abilities and offering reasonable opportinity for personal growth and social usefulness; (2) prepare him to assume the full responsibilities of American citizenship; (3) give him a fair chance to exercise his right to the pursuit of happiness; (4) stimulate intellectual curiosity, engender satisfaction in intellectual achievement, and cultivate the ability to think rationally; and (5) help him to develop an appreciation of the ethical values which should undergird all life in a democratic society. It is the duty of a democratic society to provide opportunities for such education through its schools. It is the obligation of every youth as a citizen to make full use of these opportunities.[24]

Spaulding suggests that it is the duty of the high school to train its pupils in (1) the fullest preparation for citizenship, (2) the abilities necessary for continued

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[23] Arthur B. Moehlman, School Administration. (Boston: Houghton Mifflin Company, 1940), p. 53, Cf. p. 28.

[24] Education for All American Youth, Educational Policies Commission. (Washington: National Education Association, 1944), p. 21.

learning, (3) a healthful program of recreation, (4) vocational experiences suitable to their individual needs. He also appeals for a new type of diploma and new standards of evaluation as a basis for recommendation from school to school or from school to other new environment such as the farm, shop, business, or home.[25]

As the aims of the high school have broadened to include the needs of a greater percentage of the population the enrollment has multiplied correspondingly. Edmonson suggests that:

> Many of the greatest achievements of secondary education, and most of its perplexing problems, have had a common origin in a rapidly increasing school enrollment. More liberal provision is made here [U. S. A.] than in any other country for the education of all youth, bright and dull, rich and poor. Schooling is now provided for a larger percentage of the population than ever before in our history. It is estimated that one-fourth of our total population is now enrolled in educational institutions. The general acceptance of the high school as democracy's agency for bringing secondary education to all the children of all the people, regardless of racial, political, or economic differences among parents, has been most encouraging. The United States has been proud to stand first among nations in the proportion of youth enrolled in high schools. Because of their great faith in the values of education, the people of this nation have been willing to make sacrifices in order to provide schooling for an increasing number of young people.[26]

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25 Francis T. Spaulding, High School and Life. (New York: The McGraw-Hill Book Company, Inc., 1938), pp. 263-83.

26 James Bartlett Edmonson, Joseph Roemer and Francis L. Bacon, The Administration of the Modern Secondary School. (New York: The Macmillan Company, 1941), p. 44.

This increase of high school population is best shown graphically. In Figure 1 the actual increase in enrollment is shown which represents the great expansion of the demands made on the facilities for secondary education. On this same Figure a graph of the increase of total population of high school age is shown. Figure 2, however, shows the increase in the percentage of the total population within the ages of 14-17 who are attending school. This increase means that there will be a much greater variability in needs, interests, and abilities, academically, socially, and vocationally within the school. As this percentage continues to rise so also does the heterogeneity of the school population increase. If the secondary school is for all of the people, then it seems certain that all will agree that most of these people will not get the greatest benefit out of a detailed study of mathematics or a specialized preparation in science. Expressing the same thought another way, if each high school furnished but one engineering student per year to the universities there would be over 31,000 entrants each year.[27] In 1939 there were but 31,797 engineers enrolled in the freshman classes

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[27] David T. Blose, Statistical Summary of Education 1943-4, Biennial Survey of Education in the United States 1942-4. (Washington: United States Government Printing Office, 1947), p. 19.

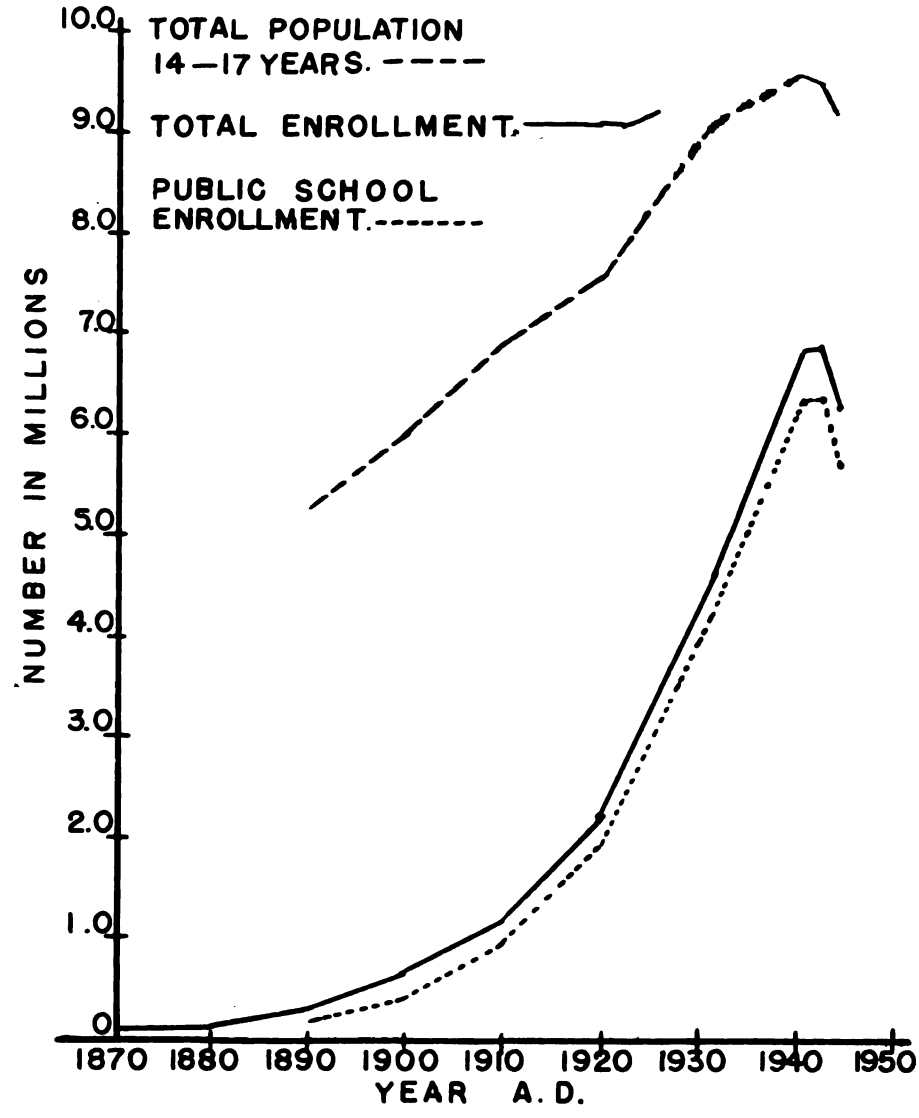

FIGURE 1

GROWTH OF HIGH SCHOOL ENROLLMENT AND TOTAL POPULATION OF HIGH SCHOOL AGE FROM 1870 TO 1944*

* After Edmonson, op. cit., p. 46-7.
Data from Blose, op. cit., p. 19. Table II.

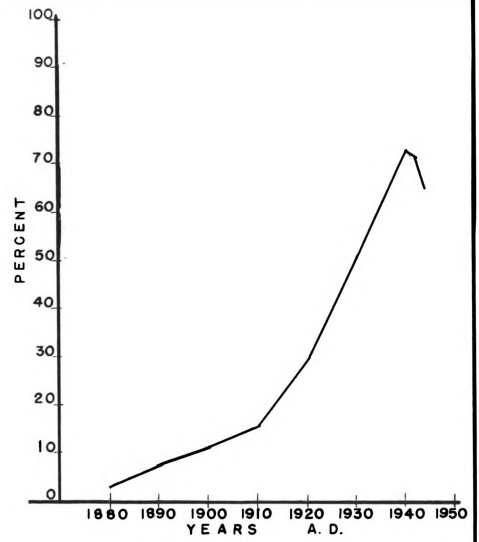

FIGURE 2

PER CENT OF TOTAL POPULATION
OF HIGH SCHOOL AGE (14-17 YEARS)
ENROLLED IN PUBLIC HIGH SCHOOLS IN THE
UNITED STATES FROM 1880 TO 1944*

* Ibid., also Blose, op. cit., p. 10.
See Table II.

TABLE II

TOTAL POPULATION AGE 14 TO 17 YEARS, SECONDARY SCHOOL ENROLLMENT, AND PER CENT OF THIS POPULATION ENROLLED IN PUBLIC HIGH SCHOOLS IN THE UNITED STATES FROM 1870 TO 1944*

Year	High school enrollment by thousands	Population from 14 to 17 years by thousands	Per cent enrolled
1870	80	- No data given -	
1880	110	3,937**	2.8***
1890	357	5,354	6.7
1900	696	6,152	11.3
1910	1,111	7,220	15.4
1920	2,496	7,736	32.3
1930	4,800	9,341	51.5
1940	7,113	9,720	73.2
1942	6,923	9,619	72.0
1944	6,021	9,298	64.8

* Blose, Op. cit., p. 10.

** Estimated. $\left(\frac{110 \times 100}{2.8}\right)$

*** Edmonson, Op. cit., p. 46.

in the United States.[29] It is apparent that the primary work of the high school cannot be said to be that of preparing pre-engineers since about 0.5% of the 1938 high school population enrolled for engineering in 1939. Since most of the schools are small, with a limited and sometimes highly overloaded faculty, the curriculums cannot be highly specialized. This means that pupils from these schools will often be ineligible for entrance to a school of engineering.

As these new philosophical concepts of the function of the secondary school and the rapidly growing recognition of secondary education as a necessary preparation for life, and the consequent increase in heterogeneity, especially in ability, interests and physical, emotional, and educational maturations of the school population are considered in conjunction with the complex and vital problems connected with the development of competent engineers, the urgent need of a study of the specialized requirements which the college makes upon the high school is manifest.

This study cannot hope to solve but only bring to light many of these pertinent problems. Its scope, field of emphasis, and geographical area must of necessity be

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[28] The Journal of Engineering Education, 30:457, 1940.

limited. Further studies such as this and others on related problems as they are revealed should be undertaken so that planning committees and entrance boards may have facts upon which to base their philosophies and hence their requirements.

Before taking up the details of this study a review of pertinent literature is essential to a proper understanding of the current approach to this problem.

CHAPTER II

A SURVEY OF PERTINENT LITERATURE

There is a vast amount of literature on the general topic of college and university admissions. Considerable of this material deals with high school requirements and some with deficiencies in general. An extensive bibliography dealing with college entrance requirements was furnished to the author by A. D. Graves of San Francisco. This is being supplemented every month by the magazines and journals in the field of education.

Related studies. A number of general studies in articulation of high school and college have been reported. Notable among these are the Buffalo Studies[1] in which a number of research workers pooled their resources, the Eight-Year Study[2] which was so aptly reported by members of the directing committee, and the Oregon Studies[3]

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[1] Edward Stafford Jones, Ed. Studies in Articulation of High School and College. University of Buffalo Series I, II, and III. (Buffalo, New York: University of Buffalo, 1934-1936).

[2] The study of Thirty Schools sponsored and directed by the Progressive Education Association and reported in a series of books. See bibliography under: Aikin, Chamberlin, and Thirty Schools Tell Their Story.

[3] University of Oregon Publications, Educational Service, Volume 3. (Eugene, Oregon: University Publications, September, 1931).

which have furnished several reports by Harl Douglass and others.

Mitchel[4] in a review of the Eight-Year Study emphasized the need of a specific preparation during the high school years for the "Hard Things" of life. Harl Douglass concludes that:

> There is no significant correlation between the number of units credit earned in high school in any subject field and the scholastic success in college. The scholastic success of those students whose pattern of high school subjects is deficient in amount in any of the various subject fields is to no significant degree inferior to that of the students presenting the prescribed credits.[5]

He also suggests, "It would seem that no more striking example of the application of fallacious untested theories to educational administration may be mentioned than in the prevailing method of selecting students for higher education."[6] A quotation from a recent article summarizes the case in point very aptly.

> One group believes that a certain number of specific courses in English, mathematics, science, and foreign

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[4] J. P. Mitchel, "The study clarifies college admission problems," California Journal of Secondary Education, 17:144,5, March, 1942.

[5] Harl R. Douglass, "The relation of high school preparation and certain other factors to academic success at the University of Oregon," (Eugene, Oregon: University of Oregon Publications, Education Series, Volume 3, September, 1931). 56 p.

[6] _____, "The relation of pattern of high school credits to scholastic success in college," North Central Association Quarterly, 6:283-97, December, 1931.

> languages are the key to success in the university. They say that these subjects have proved their value and that people who succeed in them in high school also succeed in college or university. Another group believes that these are hurdles only. They look with a skeptical eye on the length of time a student must devote to these subjects in high school and say that for many students other areas of learning might be far more profitable. . . . There is a great deal of evidence to indicate: (1) that success in the university or college is not dependent upon what pupils take in high school, but how well they do with what they take; (2) that success in the university or college can be predicted with considerable success by the use of aptitude tests, personal interviews, records of grade-point averages in high school and participation in high school activities; (3) that students from high school with curricula related to their life and problems of today make just as good records as pupils graduating from traditional curricula; (4) that the effect of college entrance requirements upon high school curricula cannot be minimized. This effect influences the subjects taken by the 85% who do not go to college, as well as the 15% who do go.[7]

Aiken[8] in a preliminary report on the Eight-Year Study made a very significant comment, the import of which has not been fully perceived by either the high schools or the colleges, when he pointed out that preparing students FOR college is not synonymous with preparing them for COLLEGE ENTRANCE.

The California Journal of Secondary Education has been active in publishing many minor studies in this same

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[7] Albert D. Graves, "Another look at college admissions," California Journal of Secondary Education, 21:122-125, February, 1946.

[8] Wilford M. Aiken, "preparing students for college," Educational Record, Supplement 11, 19:22-37, January, 1936.

field. The Michigan "College Agreement"[9] is an outgrowth of these and similar studies and their influence. It, perhaps more than any other one thing, suggested to the writer this area of research as being of active import. In the specific area of engineering education the Society for the Promotion of Engineering Education through the Journal of Engineering Education has done more active writing than the rest. These published opinions at times fail to realize the implications of the educational changes in the modern high school and the necessity of a readjustment in college entrance requirements to compensate for those changes. The engineering schools as a group continue to make the heaviest demands upon the high school in the field of specific subject requirements.

Special studies. A significant study in this particular area was made sixteen years ago of the entrants to the School of Engineering of the University of Michigan over a three-year period 1927-1930.[10] It was found that: (a) deficiency in mathematics was most frequent, and

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[9] For the text of the Agreement please see Appendix B.

[10] L. W. Keeler, An Investigation of the Effect of Subject Deficiencies upon Accomplishment of the Students Entering the College of Engineering of the University of Michigan During the Academic Years 1927-28, 1928-29, and 1929-30. Bureau of Educational Reference and Research, Bulletin No. 138, (Ann Arbor: University of Michigan, School of Education, March 30, 1931), 68 p.

greater than the sum of all other deficiencies; (b) deficiency in physics was next in order of frequency; (c) the percentage entering with deficiency was increasing; (d) there was no significant difference in progress in the college field between the groups with and without deficiency; (e) the rate of mortality was slightly higher among those with deficiency.[11]

The Society for the Promotion of Engineering Education published a bulletin[12] in 1926 in which the admission procedures with eliminations and their apparent causes were analyzed. They reported the rate of eliminations among those admitted with conditions in mathematics much higher than those with clear entrance.

The engineering school at Purdue University has employed an active psychologist on its staff for a number of years. His study in cooperation with Geiger[13] reported

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[11] Ibid., p. 66,7.

[12] "A study of admissions and eliminations of engineering students," Committee on Admissions and Eliminations (H. H. Jordan, Chairman), Investigation of Engineering Education, Bulletin No. 2, The Society for the Promotion of Engineering Education. (Lancaster, Pennsylvania: Lancaster Press, Inc., September, 1926), 35 p.

[13] H. H. Remmers and H. E. Geiger, "Predicting success and failure of engineering students in the schools of engineering at Purdue University," Studies in Higher Education, Volume 38. (Lafayette, Indiana: Purdue University, Division of Educational Reference, May, 1940). p. 10-19.

in 1940 that the correlation of various predicting examinations and future academic progress varied from .52 to .72. The experience of Purdue University with the admission of non-high school graduates[14] as a part of the accelerated education program during the war years revealed that the grades of these special students were slightly higher than the normal grades of the university. Corresponding studies at the University of Arkansas[15] revealed similar results. Grade-point averages were .28 higher with these accelerated pupils. Some of these studies drew conclusions from the population without regard to the variations of scholastic ability in the groups compared; at least, such considerations are not mentioned in the reports of the studies. Bent concluded his report with the comment:

> It should not be concluded from these studies that high school attendance is unnecessary, . . . or that colleges should admit all who apply for admission. They should, however, avoid the strict adherence to their stated requirements or the employment of a mechanical device or mathematical formula for predicting success as a basis for selective admission, for this cannot be done, since these devices merely

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[14] Jean Harvey and Kenneth Davenport, "Purdue University's experience with the admission of non-high school graduates," Studies in Higher Education, Volume 52, (Lafayette, Indiana: Purdue University, Division of Educational Reference, May, 1940). p. 3 - 9..

[15] Rudyard K. Bent, "Scholastic records of non-high school graduates entering the University of Arkansas," Journal of Educational Research, 40:108-15, October, 1946.

> supplement rather than become satisfactory substitutes for the employment of judgment in evaluating and guiding each candidate as an individual.[16]

There appears to be an urgent need for study into the basis upon which some of the present college entrance requirements rest, especially along specified subject matter fields. What better opportunity could be afforded than the present influx of large numbers of deficient entrants.

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[16] Ibid., p. 115.

CHAPTER III

DEFINITION AND SCOPE OF THE PROBLEM AND AN ANALYSIS OF CONCOMITANT FACTORS

Definition. This problem deals specifically with high school deficiencies and the relationship of science deficiencies to subsequent academic progress of all registrants in Basic College with engineering preference and the School of Engineering at Michigan State College of Agriculture and Applied Science during the fall term of 1946 and it follows them through the winter and spring terms of 1947. Thus, the minimum attendance of any entrant studied is three terms. Many, however, have had six terms or more in attendance.

During the past twenty-five years there has been little change in the entrance requirements of the School of Engineering of Michigan State College or its predecessor Michigan Agricultural College.[1] The wording of the engineering requirements has been altered twice but three

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[1] Michigan State College Catalogue and Michigan Agricultural College Catalogue, section entitled High School Requirements, 1920-1947.

units[2] of mathematics has always been required. Until 1937 physics was the only science required. At that time the requirement was changed to read two units of science. This remained in force until Basic College was instituted in 1945 when the science requirements were changed to read, "physics and one other laboratory science or Physical Science Basic 131, 132, 133 from Michigan State College."[3]

The problem as set up deals primarily with the science requirements but since these are so completely interwoven with the mathematics deficiencies, the mathematics deficiency must of necessity be considered in any rate of progress study. These two subject areas include more than 95% of the total deficient entrants[4] admitted to the study of engineering. In a further section of

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[2] Units refer to high school credits in which four units constitute a full load for a normal high school child for a school year. A unit was originally defined as the Carnegie unit in an effort to standardize high school studies. This required a class meeting of at least forty-five minutes, five days per week, with approximately forty-five minutes spent in preparation each day.

[3] General Catalog of Michigan State College, 1945-46, (East Lansing: Michigan State College, 1946), p. 57.

[4] A deficient entrant refers to a student who has been granted admission to the school of his choice, with deficiency, the understanding being that such deficiencies will be removed in a way acceptable to the school concerned by the active participation of the student.

this chapter the principal reasons for this concentration are analyzed.

Scope. The scope of this study includes: (1) an analysis of the type and frequency of deficiencies in the records of current students registered in Basic College with engineering preference and the School of Engineering at Michigan State College; (2) the methods by which these deficiencies are removed; (3) the variation in the time required for the removal of these deficiencies; (4) a comparison between frequency of drop-outs of the deficient and non-deficient groups; (5) an analysis of the scholastic achievement in the engineering subjects and the general education subjects of the early (terms one and two) and later (remaining terms) collegiate work as related to the deficiencies in high school science and mathematics on admission to Michigan State College.

An analysis of the causes of this problem. The present influx of ex-servicemen came with all types of educational backgrounds. Some were able to continue where they had left off in their educational program at the time they were called to service. Others, and this was probably the majority, had matured in the service and had caught new visions of the possibilities in education. Many had changed their fields of interest. Many who had dropped

out of school, perhaps several years before entering the service, for various reasons such as lack of finances or interest, now determined to attain their new educational ambitions with the aid of the promised government assistance. Most of these had completed their high school work and many were able during their time in service to obtain advanced credit, often within their field of choice. There are also deficiencies among the non-veterans but since the veterans form the greater percentage of the population of the engineering school, their problems form a vital part of the total picture.

Another reason why the high school work of many of these returning men, as well as some of the younger entrants, was not shaped toward an engineering program is that, in order for a high school graduate to attain in a normal manner the three units of mathematics (some engineering schools require four units) and two units of laboratory science required in engineering, his vocational choice must be made before he registers for his sophomore year in high school.

It is a common practice of our educational system for children to begin school when about five years of age and to be promoted one grade each year. Since individuals do not mature in a uniform pattern simultaneously with their chronological age, there is found considerable

heterogeneity among any single age group. Some at fourteen years are ready to decide upon their life interests; others must wait several years. When we consider the varying maturation[5] rates of a given individual, it is a real credit to the high school guidance program that so many are prepared to enter college without deficiency. Chance cannot help having played a part in this preparation, since there is a strong tendency to offer and encourage the program of studies that has been accepted by tradition as college preparatory in many high schools. The acceptance by the high schools of Michigan of the new College Agreement,[6] within the spirit of that agreement, will tend to produce a greater number of these deficiencies as the student is encouraged to explore throughout a wider field before he begins his specialization. For that reason, if for no other, the present study should be significant since in the future more of the regular entrants will, in all probability, show deficiencies for these highly specialized curricula.

Third, many small high schools are unable to offer the third unit of mathematics or the second unit of

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[5] Albert J. Huggett and Cecil Vernon Millard, Growth and Learning in the Elementary School. (Boston: D. C. Heath and Company, 1946), p. 14-45.

[6] See Appendix B.

laboratory science because of the small need for these subjects. This often results in a student of otherwise excellent pre-engineering qualifications entering with as much as two units deficiency due to no fault of his own or of the school which prepared him.

With the continued increase in the uses of engineering and complex engineering activities on the part of many trades, it is to be expected that an increasing percentage of the total population will require engineering training.[7] Therefore, it may be expected that many of the present conditions will continue to exist in the area of admission problems. Leaders in the engineering field estimate that labor and industry will continue to require over 23,000 new trained men per year.[8]

A brief analysis of present conditions. At present approximately 30% of the total current enrollment in engineering, i.e., Basic College with engineering preference and the School of Engineering, are deficient in some

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[7] Karl T. Compton, et al., "The outlook in the demands for and supply of engineering graduates," (Society for the Promotion of Engineering Education, Survey, The Journal of Engineering Education, 37:31,32, January, 1947).

[8] Ibid.

Henry H. Armsby, "A re-examination of the Compton report in the light of enrollment in engineering curricula, fall of 1946," The Journal of Engineering Education, 37:675-88, May, 1947.

requirements. One-half of these were deficient by more than one high school unit and one-third by one unit; the remaining one-sixth were deficient by less than a whole unit. There are approximately 400 deficient in mathematics and 350 deficient in science. More detailed analysis will be presented in later chapters. Figure 3 shows the frequency of deficiencies calculated from the basic engineering section of the general sample. (The selection of this sample is outlined on page 64.)

Policies of removal. Much of this work is made up during the first three terms (one year). At times this work is not made up until the eighth or ninth terms and in some instances the make-up has been omitted entirely. There are several recognized methods by which these deficiencies may be removed. Extreme cases are referred to the Servicemen's Institute (S. M. I.) where each student is allowed to complete his high school work as rapidly as his advanced maturity will permit. With the added age and consequent maturity combined with the added experience gained during useful employment these men often find it possible to do more than two years of high school work in the space of one school year. This group includes those with a language handicap or deficiency or those lacking one year or more of high school work. These cases are not included in any of the summarizations of this

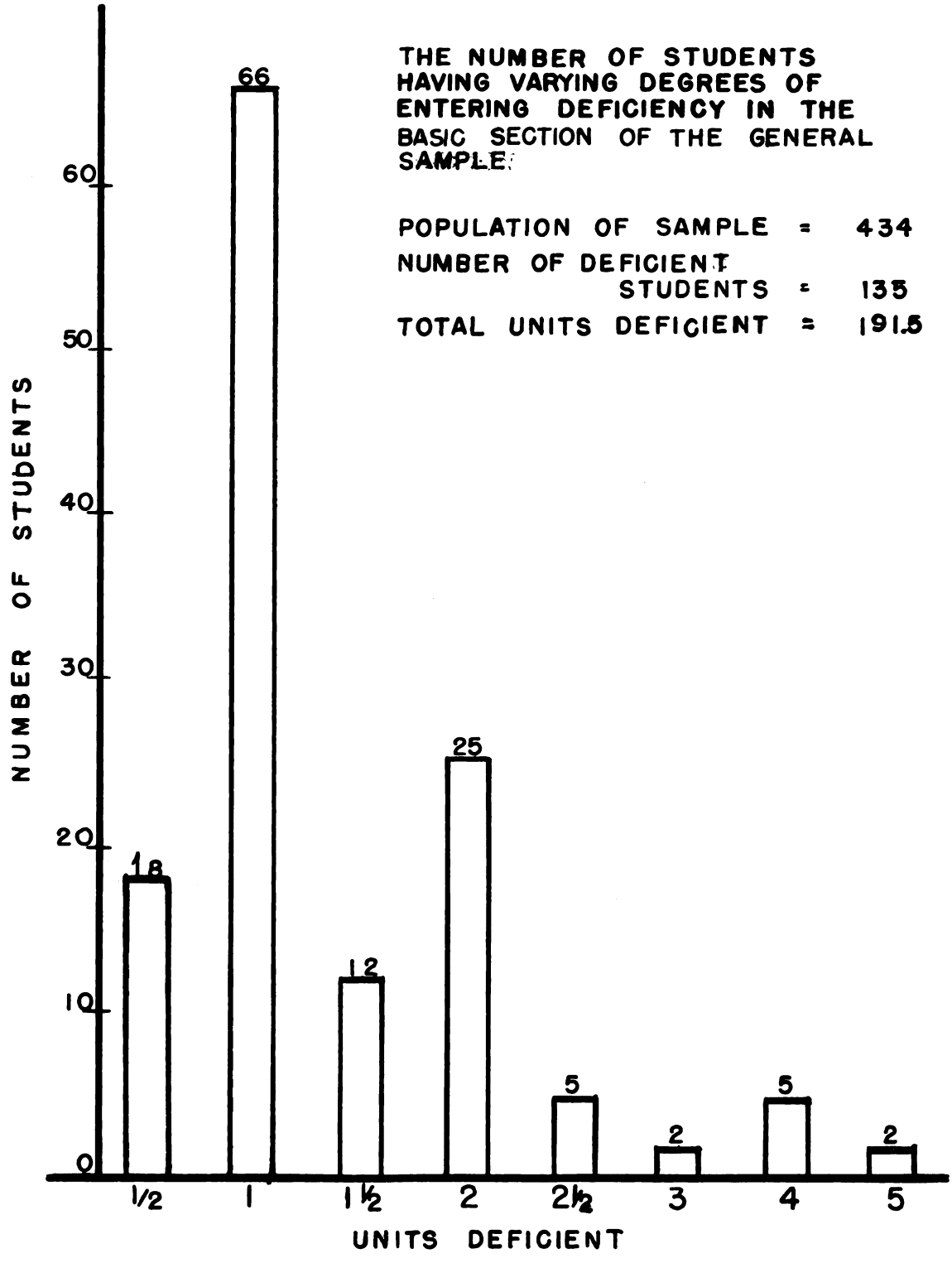

FIGURE 3

DISTRIBUTION OF DEFICIENCIES

study.[9] Other cases such as those included in this study may take refresher (non-credit) courses such as those offered in mathematics and physical science. A third method allows the substitution of six term credits of regular college work in the required field in lieu of each high school unit deficient. In a fourth method students are allowed to write examinations in certain subjects in which their experience and/or previous training have given them a background which will make the attempt worthwhile. If successful in the examination, credit is recorded in their high school record as credit by examination. A fifth and less frequently used method is removal by letter. If the chairman of the Michigan State College Board of Examiners or the Dean of the particular school feels that the work of the student shows sufficient attainment along this deficient field, he will write a letter of request to the registrar suggesting that the deficiency be waived. In the sixth method six credits of basic physical science automatically removes a deficiency in physics.

Data regarding the nature of these entering deficiencies and time and method of removal with an index of their effect on subsequent academic progress will form the essential material for a consideration of this problem.

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9 Mr. Ross Mateson of Michigan State College Counseling Department is making a particular study of this group.

CHAPTER IV

SELECTION AND RECORDING OF DATA

Sources. The Record Office, at the request of the Registrar, Mr. Linton, kindly opened its records for this study. These records are in two distinct groups. The record of registration and all work taken subsequent thereto are condensed onto a "Cardex" filing card approximately 8" x 11".[1] Matriculation details are written on the head of the card and on the body of the card is recorded the work of each term including course numbers and names, followed by hours credit, grade and honor points. Subtotals of hours credit and honor points are made at the end of each term. Disciplinary actions, waivers, and advance standing evaluations are summarized on the reverse side of the top of this card.

The application for admission, with a record of credit evaluation and copies of all inter-department correspondence regarding the student's enrollment and progress are kept in a vertical file. Here are to be found the recommendation of the high school principal, size of graduation class, rank in graduating class, and a complete

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[1] A sample record card may be found in Appendix D-2.

transcript of all high school credits as submitted by the principal or other officer of the graduating high school. There is also a summarized evaluation by the admissions officer of the college.[2]

A record of the results of the entrance examinations was obtained from the Board of Examiners and the psychological and reading test scores were used.

Preliminary survey. In the search for these data a preliminary survey was made of all records of the current attendance lists of both basic and undergraduate engineers of the fall 1946 term. During this survey a record was made of name, student number, number of terms in attendance, and the nature of the entering deficiency of all students lacking one or more units of science required for entrance by the School of Engineering. This formed the deficient group of this study.

The Individual Record. Subsequently a record sheet[3] (Figure 4) was made for each student who entered with science deficiency. The name was recorded as it is given on the permanent records of the Record Room. The

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[2] A sample of this record sheet is to be found in Appendix D-1.

[3] See Appendix D for a sample Individual Record sheet with cross references to the source of each item on the records of the Record Room.

INDIVIDUAL RECORD

Name_____ Age_____ Number_____

Date of Entry_____ Number of Terms_____

College Record

1st & 2nd terms	Remaining terms		1st & 2nd terms	Remaining terms	
_____	_____	Total Hours	_____	_____	Hours Failed
_____	_____	Honor Points	_____	_____	Ratio
_____	_____	Hours Engineering	_____	_____	Hours Failed
_____	_____	Honor Points	_____	_____	Ratio
_____	_____	Hours Science and Mathematics	_____	_____	Hours Failed
_____	_____	Honor Points	_____	_____	Ratio

Make up Work

Mathematics

Method of removal	Course	Grade	Term
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Ratio_____

Science

Method of removal	Course	Grade	Term
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Ratio_____

Key:- M-Sub-College Work, N-College Credits 2 or-1 u, O-Exam, P-by letter

Entering Deficiencies

_____ _____ _____ _____Math

_____Science

_____Physics ( ) Check if special

High School Record

Science Units_____ Average_____

Math Units_____ Average_____

Total Units_____ Average_____

Quartile_____

Psychological Examination

Part 1_____ Part 2_____

Docile_____

Transfer Credits_____

From_____

War Service Credit_____

FIGURE 4

INDIVIDUAL RECORD

(Completed for each case studied as explained in the text)

age was calculated as of April 1, 1947 for the sake of uniformity since the selection of the data spread over a period from December, 1946 to August, 1947. The number of terms was corrected during a final acceptance of the data during August, 1947. Number of terms followed by "s" indicates that the individual was in attendance during the 1947 summer session. However, no college grades were available for this term so no hours or honor points could be added. The date of entry was essential in order to obtain the psychological test scores.

College Record. In the first column under College Record is listed a summary of work during the first two terms in attendance. The first line is the total hours earned, and the second line gives the total honor points for that work. These totals were taken directly from the subtotals made by the Record Room on the "Cardex" filing card. The subtotal at the end of each term gives the total hours and honor points to date and includes subtractions for failures, since a grade of "F" carries with it a minus one honor point for each hour credit. Subtractions had to be made for transfer work and war service credit as these were recorded separately on the Individual Record sheet. The third and fourth lines give the same information for the engineering subjects except that the honor points were figured only for the hours passed (grade

of "D" or over) and no subtraction was made for subjects failed. Lines five and six give identical information for the science and mathematics subjects. The six blanks in the second column contain information identical to their parallel in the first for all of the remaining terms in attendance.

The third and fourth columns refer respectively to the same division of school work, with the first, third and fifth blanks giving the total hours failed and the second, fourth and sixth the "point hour ratio," that is, the quotient of credit points by hours credit, sometimes referred to as the grade point average (g. p. a.).

Point Grading System. At Michigan State College three credit points are given for an "A", two for a "B", one for a "C", none for a "D" and a minus one for an "F" grade for each hour credit. Successive failures of the same subject require but one subtraction. On the data sheet (Individual Record) this grade point system was used in all evaluation, both in college and high school grades. In computing the grade point average for the total hours in either the first two terms (T 1 and 2) or the remaining terms (Rem) a simple quotient was used, i.e.:

$$\frac{\text{total credit points}}{\text{total hours credit}} = \text{g.p.a.}$$

However, for the special subject fields of engineering and mathematics and science, points equal to the number of

hours failed in that field must be subtracted from the total credit points as recorded for that period before the quotient is taken, i.e.:

$$\frac{\text{credit points in field - hours failed}}{\text{hours credit (passed)}} = \text{g.p.a.}$$

This method was used because it greatly simplified the taking and recording of this data and was of insignificant trouble in later computations.

Make-up Work. For convenience the second section of the record sheet entitled Make-up Work was divided into two similar sections, mathematics and science.[4] The key to the first column headed, "Method of Removal" is given at the foot of this section, "M" referring to sub-college or work taken in one of the college departments at high school level, and includes such courses as mathematics 90 (plane geometry), physical science refresher, and other courses for which college credit is never allowed. "N" refers to a college course six credits of which are necessary to substitute for each unit of deficient high school work. This work is of college level and would give credit toward graduation if not substituted for high school deficiencies and if not already successfully completed in high

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[4] The interested reader is referred to the discussions on entrance requirements p. 38 and deficiencies p. 43 for further elucidation.

school. For instance, two pupils enter, without deficiency, both having one and one-half units of algebra and one of plane geometry, the first one-half unit of solid geometry and the second one-half unit of trigonometry. The first pupil will receive credit for mathematics 102, trigonometry, since he has not had that subject, yet has completed the three required units of mathematics.[5] Similarly, the second will receive credit for mathematics 100b, solid geometry. "O" refers to a deficiency removed by examination. "P" signifies that because of high scholarship in other subjects a request by the Board of Examiners or a Dean has waived the deficiency.

The second columns under mathematics and science respectively, in the "make-up work" section, refers to the particular course number in the department.[6] The third columns give the grade of that course and the fourth list the number of the term in the student's record in which he took this work to effect this deficiency removal. A blank was provided for a grade point average for this work. This average was not useful in the solution of the present

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[5] During the survey it has been noted that a number of students who have completed up to two units of algebra in high school are enrolled in mathematics 100a, apparently for college credit. It seems that such courses should be taken as "no credit" or refresher courses.

[6] See Appendix E for a record of the numbers and corresponding titles of all courses used to remove science and mathematics deficiencies as found in this investigation.

problem and, therefore, was never calculated. A comparison of these grades with corresponding high school and college grades might prove interesting and can be easily acquired from these data.

The High School Record. The third section deals entirely with the high school record. The first column records in units the various deficiencies as given in the college record sheet. The mathematical subjects are specifically listed. If the student has had two years of high school science with laboratory, then the physics requirement is checked as "special" to distinguish this deficiency from those deficients having but one acceptable science.

The second column of this section is filled entirely from the records as submitted in the original application of the student and the accompanying high school transcript. The size of the high school graduation class, when given, was written directly above the heading High School Record, and the name of the town and the year of graduation immediately follow. The units were taken from this record and checked against those recorded on the student's college record. The quartile was taken from the report of the principal on the back of the transcript and gives the academic standing of the applicant in his graduating class; e.g., first or upper quarter to fourth or

lowest quarter. The averages were computed from the high school transcript by allowing three points for an "A" for each half unit (as explained for the college grades, except that there were no subtractions for failures) and then finding the quotient of total grade points by total half units.

Due to the practice of accepting the evaluation of high school credits by a previous college, it was often impossible to obtain any grade point average for students who have transferred from other schools since only the summary of units is usually given with a college transcript. This required that twenty-two of the deficient group be dropped.

In the fourth section above the psychological examination is written the name of the intelligence test and the results, as an I.Q., if they were given in the high school record. Then follows the results, in deciles, of the American Council Psychological Examination which is scored in two parts. Part I or the Q-Score attempts to measure the "abilities involved in quantitative thinking."[7] Part II or the L-Score attempts to measure linguistic abilities. The third blank gives the total or composite score.

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[7] Report of Board of Examiners. Preface to fall and winter scores 1946-47, Michigan State College, East Lansing, Michigan.

under each blank is written the actual score when available. Below this on the dividing line is written as a continuous number the scores in deciles of the four parts of the Cooperative Test of Reading Comprehension. The first score is for the vocabulary section, the second is a rate measure of comprehension, the third is a difficulty measure of comprehension, and the fourth is a total or composite measure of the three. The column on the right lists the transfer credits from other colleges and the war service credits.

Below the line are listed the dates of disciplinary actions and a brief word as to the nature of the discipline whether probation or a request to withdraw.

Students in engineering who had less than one full unit deficiency in science were not studied, it being reasonable to expect that if a difference in progress were to be found there would need to be a real distinct difference in the preparatory training.

Mathematics deficiencies. The survey of mathematics deficiencies was taken from a sample of the general population, while a sample of the non-deficient group was being taken.[8]

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[8] For details regarding the selection of this general sample the reader is referred to page 64.

Drop-outs. The list of drop-outs was easily obtained between the winter and spring terms, as the registrar's office had run a complete list of non-returns. The engineering students were tabulated from this list. The fall 1946 to winter 1947 list had to be compiled by comparing the two lists of engineering students supplied by the registrar's office for names missing on the winter list.

The records of these students were then examined and information regarding psychological test score, number of terms in attendance and amount and kind of deficiency, if any, recorded. This information was taken from the total engineering population.

Transfers. The list of transfer students was taken from the general sample at the same time the non-deficient sample was taken.[9]

The essential parts of this data were tabulated as given in Appendices L and M for the non-deficient and deficient groups respectively. This provided easy access to the pertinent portions of this data for the necessary analyses within and between the groups.

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[9] Cf. p. 64.

CHAPTER V

A CRITICAL EXAMINATION OF THE GROUPS AND A SEARCH FOR A BASIS FOR COMPARISON

The non-deficient group. It was necessary to select a sample of the total population of the School of Engineering and Basic College with engineering preference since the total population presented too large a group. There were 1732 basic engineers[1] and 636 upper division engineers or a total of 2368 in the two schools in the fall term of 1947. The non-deficient group, in order to show proper contrast to the problem group as a control group, was selected only from those having no entering deficiencies in either mathematics or science. The selection of this group was done arbitrarily. The alphabetical lists of engineering and basic engineering students were taken as a basis and every twelfth name was selected and examined for deficiency, transfer or drop-out and lack of high school transcript. A sample of 111 cases without deficiency was acquired in the first selection consisting of Group B_1 of sixty-two cases from the Basic College and

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[1] Throughout this study students enrolled in Basic College with engineering preference will be referred to as basic engineers and their course as basic engineering.

Group E_1 of forty-nine cases from the Engineering School. Since a larger sample was desired this same technique was repeated over both lists covering again every twelfth name beginning with the seventh name, and a further sample of eighty-two non-deficient cases was acquired consisting of Group B_2 of sixty cases and Group E_2 of twenty-two cases. Upon careful analysis of the variance of the high school grade point averages of these two groups, a discrepancy between B_1 and B_2 sufficient to doubt their origin from the same parent appeared.[2]

After a careful and fruitless search for a cause of this degree of variance a third sample, B_3, consisting of seventy cases was taken from the basic engineering group, beginning with the fourth name on the list. The mean of the high school grade point average of this sample lay at almost the midpoint between the means of B_1 and B_2.[3] A comparison of the sample means, as shown in Table III, of other academic averages revealed considerable variation in rank of the three groups from Basic College. It was noticed earlier that the mean of the size of graduation classes of groups one and two were quite divergent, yet

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[2] Results of these analyses may be found in Appendix I, Section 1, Tables XLVIII and XLIX, page 175-6.

[3] See Appendix I, Section 2, Tables L and LI, for an analysis of variance of the five groups, p. 177-9.

TABLE III

MEANS, STANDARD DEVIATIONS AND STANDARD ERRORS OF THE MEANS OF VARIOUS ABILITY AND ACHIEVEMENT MEASUREMENTS OF THE FIVE SAMPLES OF THE NON-DEFICIENT GROUP

Measurement compared	Statistic compared	Sample B_1	B_2	B_3	E_1	E_2	Total Group
High school total grade point average	M	1.521	1.783	1.652	1.782	1.77	1.687
	S.D.	.448	.518	.570	.437	.518	.540
	$S.E._m$	.067	.057	.068	.063	.113	.031
A.C.E. psychological examination score ranks	M	5.74	6.84	6.91	5.99	5.10	6.45
	S.D.	2.31	2.81	2.94	2.81	2.42	2.60
	$S.E._m$	.291	.36	.36	.41	.52	.16
Remaining terms college total grade point average	M	1.271	1.357	1.233			
	S.D.	.724	.647	.758			
	$S.E._m$	.091	.084	.090			
High school science grade point average	M	1.60	1.887	1.731			
	S.D.	.515	.668	.498			
	$S.E._m$	.065	.085	.060			
First and second terms college science and mathematics grade point average	M	1.393	1.465	1.189			
	S.D.	.780	.772	.818			
	$S.E._m$	.098	.099	.098			

not sufficiently so as to have any statistical significance, the difference being equal to less than 1.1 standard errors of the difference of the means. The corresponding mean for the third group also lay between these two.

Judging entirely by these three samples it would appear that for equal abilities and achievements the smaller high school gives a distinctly higher grade.

For further study, the three basic engineering and two engineering groups were assembled in alphabetical order as if they had been taken in a single sample and divided into five equal sections. Careful inspection of the means of these sections, as shown in Table IV, showed little agreement between the variations of high school size and grade point average.

Upon comparison of high school size (as measured by the size of the graduating class) of the deficient group with that of the non-deficient groups the closest approximation occurred when all three basic samples were included. The mean size of the high schools of the deficient group was 190.4 while that found for the non-deficient group was 196.0 when the whole non-deficient group was taken. Figure 5 shows the distribution of the size of the senior classes of the deficient and non-deficient groups.

TABLE IV

HIGH SCHOOL GRADE POINT AVERAGE AND SIZE OF SENIOR CLASS FOR THE FIVE NON-DEFICIENT SAMPLES AND A COMPARISON WITH THE DEFICIENT GROUP
(as selected)

Mean of	Groups B_1	B_2	B_3	E_1	E_2	Total Group
High school grade point average	5.065	5.850	5.457	5.852	5.820	5.56
High school size	218.85	180.76	207.6	161.2	198.0	196.05

(as sectioned)

Mean of	Classes 1	2	3	4	5	Total Group
High school grade point average	5.900	5.299	5.392	5.58	5.43	5.56
High school size	221.2	191.2	216.1	173.6	186.7	196.05

Standard deviation of:
High school grade point average = 1.543
High school size = 183.2 pupils.

Mean high school size for deficient group = 190.28
Standard deviation = 159 pupils.

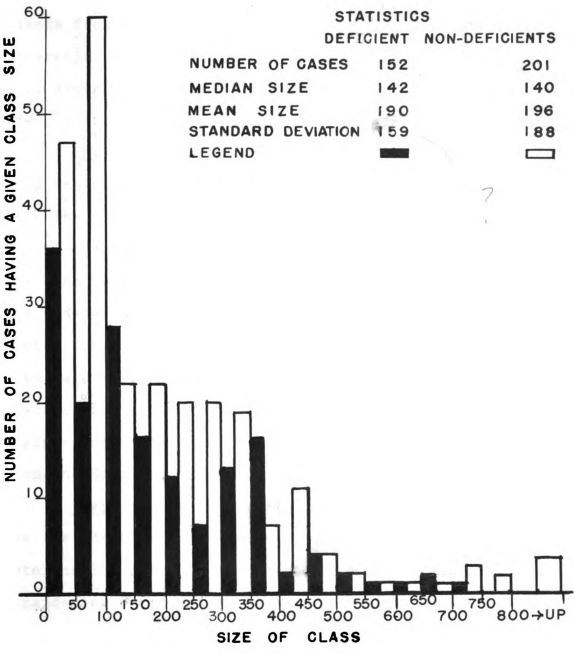

FIGURE 5

DISTRIBUTION OF THE SIZE OF HIGH SCHOOL SENIOR CLASSES

This group is large and includes all the non-deficients from over 20% of the total population. After consideration of all evidences at hand it seemed that this full group of 264 non-deficient cases best represented the non-deficient population of the engineering school.[4]

The general sample. A general sample of 548 cases from the engineering population was taken simultaneously with the selection of the non-deficient group. This sample of the general engineering population includes the 264 cases which formed samples B_1, B_2, B_3, E_1 and E_2 of the non-deficient group and the 284 cases which were rejected during the search for this non-deficient group. Data regarding deficiencies, transfers, and drop-outs were recorded for each of the 434 cases from Basic College with engineering preference (basic engineering) and 114 cases from the School of Engineering (engineering).

Frequency of deficiency. Within this general sample the 434 basic engineering students were deficient by a total of 103 units of mathematics and 97 units of science. Considering the requirement of three units of mathematics and two units of science, the science deficiency is the more frequent. One hundred thirty-five individuals in

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[4] A tabulation of the essential part of this data is to be found in Appendix L.

this group are deficient; therefore, the average deficiency is about 1.5 units per deficient student.

Figures 6 and 7 give a detailed picture of the frequency of these deficiencies as related to the basic engineering section of the general sample. Figure 7 shows the interrelation of these deficiencies--the type and frequency of mathematics deficiency accompanying the various kinds of science deficiencies.

The 114 upper division engineering students within the general sample had been, as entering freshmen, deficient by a total of eight units of mathematics and nine units of science. Fourteen individuals in this sample were deficient giving an average deficiency of about 1.2 units per deficient student.

The deficient group. From the preliminary survey of students from the total engineering population who entered with deficiency in high school science, a group of approximately 180 cases who had remained in engineering throughout the school year 1946-47 and whose records were sufficiently complete to make them usable was accepted. In further discussions this will be called the deficient group. This group was then divided into four classes according to the type of deficiency presented, namely: those having two units of science with the required laboratory but lacking physics (these were listed as physics

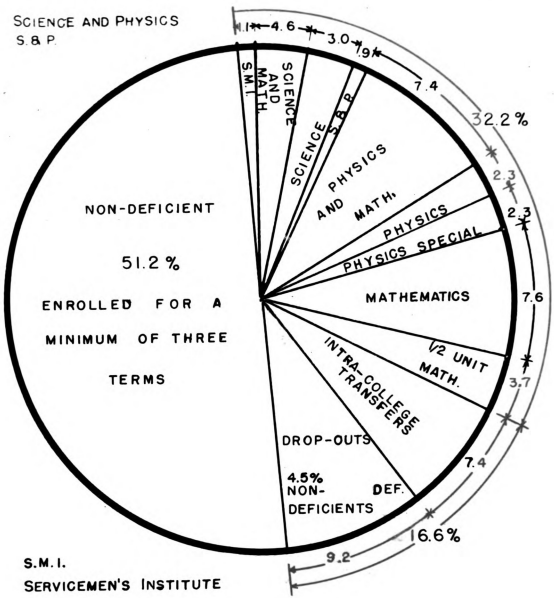

FIGURE 6

PERCENT OF DEFICIENCIES, TRANSFERS, AND DROP OUTS IN THE POPULATION OF THE BASIC ENGINEERING SECTION OF THE GENERAL SAMPLE

Note; Figures are percent of the total section.

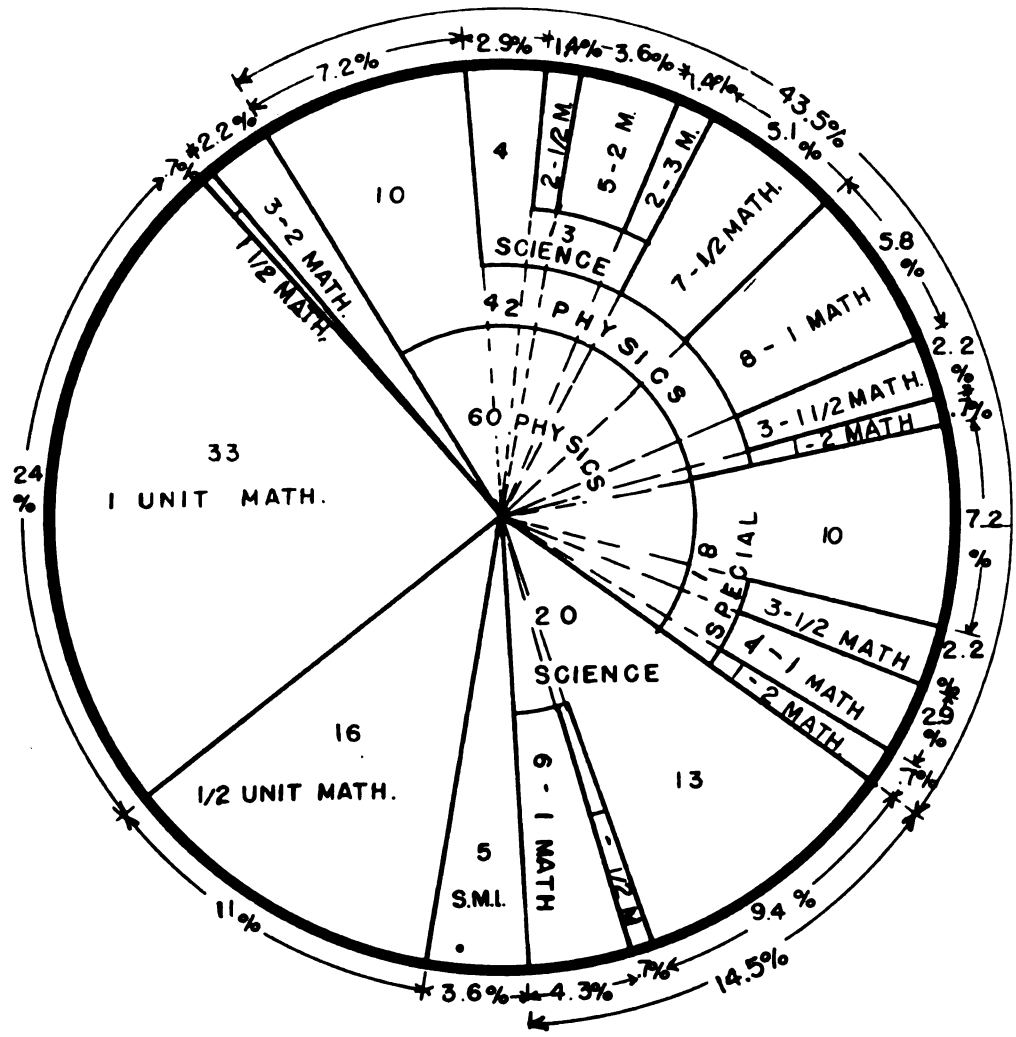

FIGURE 7

PERCENT OF EACH TYPE OF DEFICIENCY AND COMBINATION OF DEFICIENCIES

Taken from the 137 deficient entrants in the Basic College section of the general sample, (contains 32.2% of this section).

Note: Numbers in each sector refer to the actual number of students entering with that type of deficiency. The inner arcs represent the total physics and science deficiencies and their combinations with mathematics. To illustrate: There are sixty students or 43.5% with a physics deficiency including the eighteen listed as "special". Of the 42 physics, ten or 7.2% lacked physics only and thirteen lacked an additional science. Only four or 2.9% of these had no mathematics deficiency. Five (see sector 5 - 2M) or 3.6% lacked physics, a science and two units of mathematics (2M).

specials or just "specials"); those having one acceptable science but lacking physics; those lacking one unit of laboratory science; and those few having no acceptable science to present for entrance.

These four classes were then divided into subclasses according to the type of make-up, either (1) subcollege work, (2) basic college work, or (3) no make-up. In turn, these classes were divided according to the amount of mathematics deficiency associated with their science deficiency.[5] Examination of the high school and college grade point averages showed no visible pattern of averages that could be attributed to deficiencies.

Figures 8 and 9 show the variations in time required to make up these science and mathematics deficiencies respectively. The attention of the reader is called especially to the heel of the graphs on Figure 8 where those who have made no attempt to make up the science deficiency are placed.

An analysis of variance within the group. An analysis of variance between the four classes[6] without make-up work showed a very small variance between classes in either high school or college grades. A similar analysis

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[5] A tabulation of the essential part of this data is to be found in Appendix M.

[6] The detailed analyses may be found in Appendix G, Section 2, Tables XXXIX to XLVII, pp. 171-4.

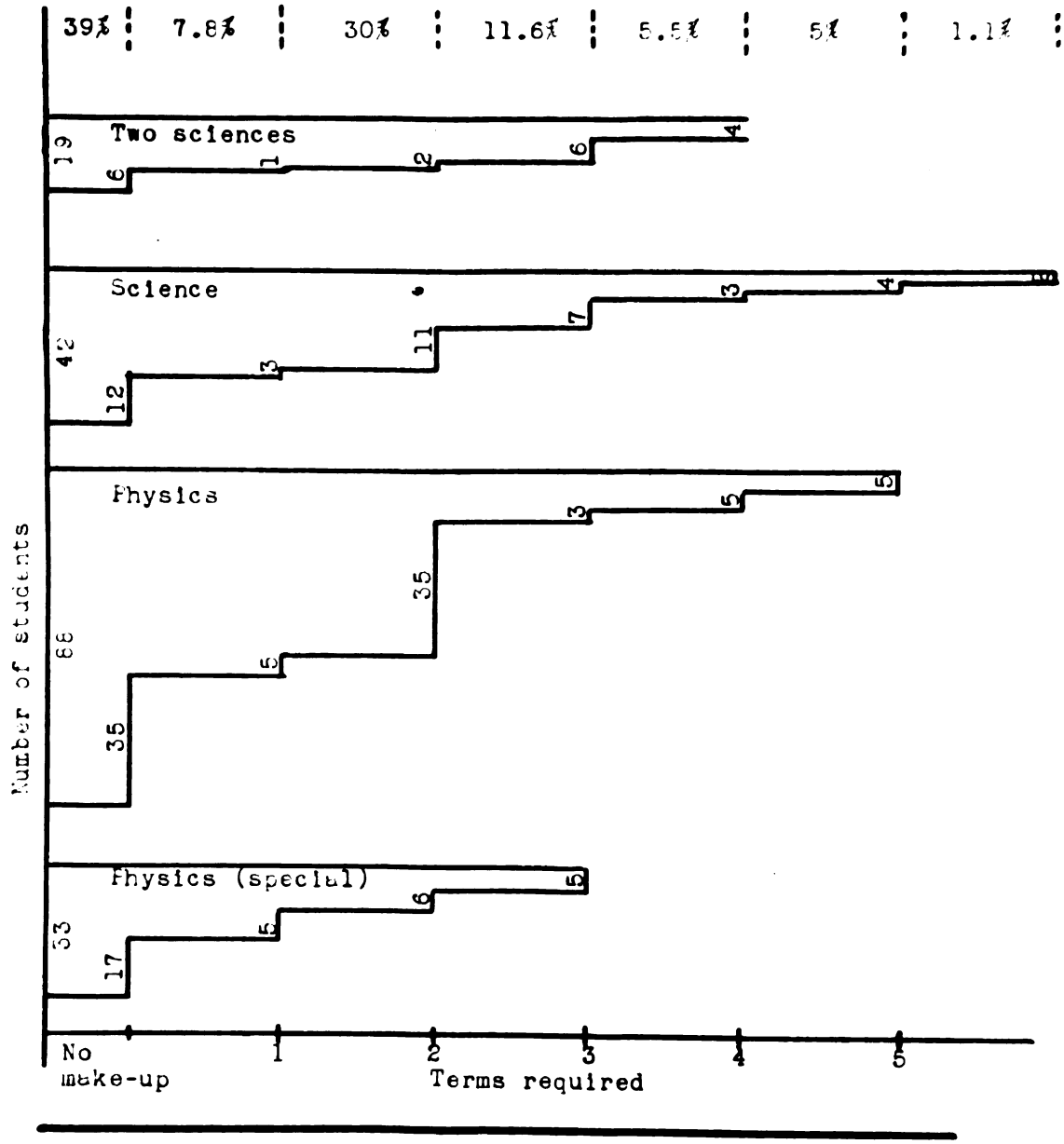

FIGURE 8

ANALYSIS OF TIME REQUIRED
TO COMPLETE REMOVAL OF SCIENCE DEFICIENCY

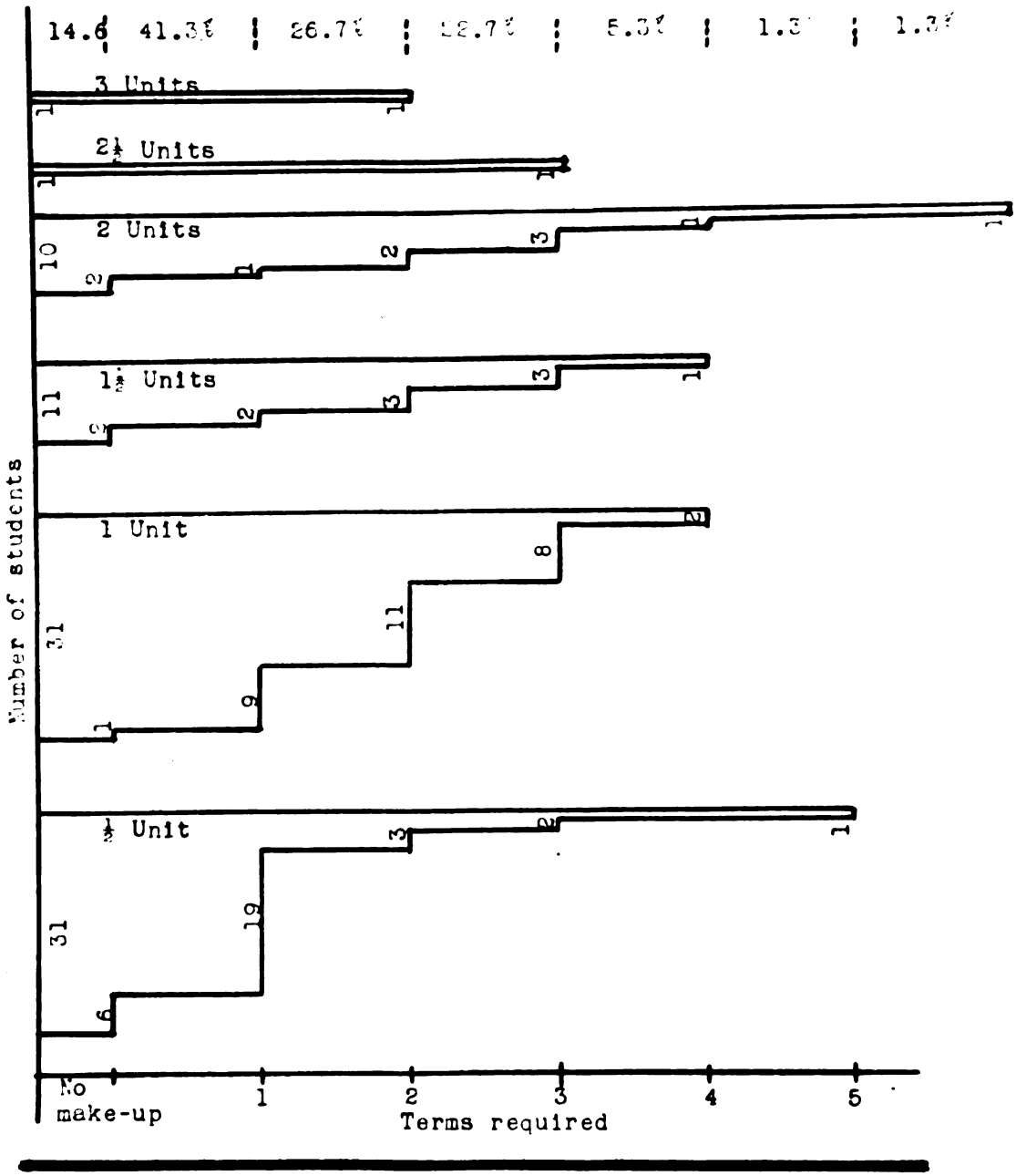

FIGURE 9

ANALYSIS OF TIME REQUIRED TO COMPLETE REMOVAL OF MATHEMATICS DEFICIENCIES WHEN ACCOMPANIED BY A SCIENCE DEFICIENCY

of variance between the four classes with make-up gave corresponding results. It was, therefore, logical to consider each of these two groups as a unit in further comparisons.

The comparison of the group without make-up with the group with make-up was sufficiently significant in the comparison of the college first and second term scores to warrant its inclusion within our text. Table V gives the breakdown of the analysis of variance between the group with make-up and the group without make-up work in both their high school achievement and the work produced during the first two terms of college attendance.

The variance between the high school scores of the two groups is very low which indicates that they are alike in their academic ability as measured by high school achievement. The variance between the college grade point averages of the two groups is almost highly significant indicating that there is a distinct difference between the college achievement of the two groups. An examination of the means of the two groups shows that there is a superiority of .1984 grade points in favor of the group having done no make-up work.

Thus it is clearly evident that in these 180 cases those who have not yet done their make-up are making significantly higher grades in college than those who have

TABLE V

ANALYSIS OF VARIANCE FOR MAKE-UP AND NO MAKE-UP HIGH SCHOOL TOTAL AND COLLEGE 1ST AND 2ND TERMS GRADE POINT AVERAGES

Source of variance	Df	x^2	y^2	Mean square x	Mean square y	F test
Total	179	62.4159	49.1749			
Between groups	1	.2429	1.6729	.243	1.675	for x insignificant
Within groups	178	62.1730	47.5020	.349	.267	for y = 6.27*

x = High school g.p.a. M_{x_1} = 1.53188 M_{y_1} = 1.32927

y = College 1&2 g.p.a. M_{x_2} = 1.4708 M_{y_2} = 1.1309

(1) = No make-up

(2) = Make-up.

* Significant at the 5% level. (The F test at 1 and 150 degrees of freedom gives 6.81 at the 1% level and 3.91 at the 5% level.)

done their make-up work, although there was no significant difference between the high school grades of the two groups. This difference is to be expected from the very nature of the principles adopted by the Board of Examiners and by the registration officers. It is a growing policy of the Board of Examiners and the deans to excuse the better students from this routine make-up since it is felt that their progress is not significantly hampered by omitting it. The foregoing seems to be a partial vindication of this policy.

A similar analysis was made comparing the results in the remaining terms of college, the results of which also substantiate the foregoing conclusions.[7]

With these conclusions in mind and with a knowledge of the similarity of high school records, it seems logical that the two sections of the deficient group, those with make-up and those without, should be accepted as a single group when comparisons are made between the deficient and the non-deficient groups.

Basis for the comparison of deficient and non-deficient groups. For a comparison of academic achievement between the deficient and the non-deficient groups

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7 The detailed analysis may be found in Appendix G, Section 2, Tables XXXV to XLVII.

the best available measure of their academic abilities must be found. No comparison either of individuals or of groups would be significant unless some knowledge of their equivalency could be accepted. From a series of correlations it seems that high school achievement is the best criterion available for this purpose. After considering the problem of measuring abilities Peters and Van Voorhis have come to the conclusion that:

> Any criterion is good that is likely to correlate highly with improvement in the function under experimental study; if scores on a criterion do not correlate well above zero with improvement in the function studied, that criterion is useless for purposes of matching. . . . Scores on an intelligence test are frequently used as a basis for matching in educational experiments. . . . Usually scores of previous academic achievement are more highly predictive of success, especially in the same field, than intelligence test scores are; hence, they make a better basis for measuring.[8]

There are factors other than intelligence which, no doubt, play a large part in achievement for which we have no adequate measure as yet.[9] Early in the study attention was given to this problem.

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8 Charles C. Peters and Walter R. Van Voorhis, Statistical Procedures and Their Mathematical Basis. (New York: McGraw Hill Book Company, Inc., 1940), p. 449.

9 Outstanding among these factors which seem vital to the author are breadth or scope and intensity of interest, also stick-to-it-iveness or determination. As there are no adequate measuring instruments for such characteristics, studies on them must depend upon some secondary measure. It seems logical that this could be one reason why the high school achievement should correlate more highly with college achievement than do the results of the psychological examination.

The psychological examination score gave low correlations with the deficient group progress wherever tested and the correction[10] for the linear distribution of decile ranks made but little change in the actual correlations.

Correlations of .124, .235 were obtained between psychological test ranks and high school totals and the college first and second term totals for the deficient group respectively. A correlation between the high school mathematics grade point average for the deficient group and rank in the quantitative section of the psychological test was found to be .105. These correlations are low and those with high school grades have no significance. Hence, it did not seem wise to attempt to use the results of this test as a part of the basis of comparison of abilities of the deficient and non-deficient groups. If the psychological examination aims to test academic ability, the high school total grade point average should contain that as a factor in its total. The unreliability of the high school average in single cases and from various high schools is readily recognized, since the 204 deficient pupils studied

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[10] T. L. Kelly, Statistical Method (New York: The Macmillan Company, 1923), p. 194, cited by Peters and Van Voorhis, Op. cit., p. 109. The formula given is: $r_{yx} = \rho\sqrt{\frac{\pi}{3}}$, where r = true correlation, ρ = the Pearson product-moment correlation between scores and ranks.

came from ninety-six high school systems, even though 51 of these came from the two cities of Detroit and Lansing. However, despite these differences the correlations between high school and college achievement are all well above .40 (see Table VI). If high correlation is a criterion of a true basis for matching, the high school academic achievement or grade point average seems to be the best one available for the purposes of this study.

Correlations. A brief review of a number of the correlations which were necessary in the preliminary part of this study presents a new and interesting problem. As the results are analyzed it becomes apparent that the psychological test ranks fail completely in a prediction of the scholastic success of the deficient group.[11] In contrast to this the high school grade point average is more consistent. The values of these various correlations have been assembled in parallel columns for the respective groups in Table VI.

The most outstanding relation shown here is the fairly high and uniform correlation between various college

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[11] The reasons for this are dubitable. Could it be a greater heterogeneity of experience or a lack of certain fundamental mathematical or scientific concepts in a way that is not correlated with academic ability that causes these low values? The answer to this question lies outside the scope of this study. It is unfortunate that the actual scores or "t" scores are not available for researches of this type.

TABLE VI

VARICUS CORRELATIONS FOR THE DEFICIENT AND NON-DEFICIENT GROUPS, AND THE SIGNIFICANCE OF THEIR DIFFERENCES##

Pearson product-moment correlation of	n	Defi-cient	n	Non-de-ficient	t test of difference
First and second term college total vs. high school total	186	.435	264	.436	
Remaining terms college total vs. high school total	177	.490	261	.3575	1.65
First and second term college science and math. vs. high school math.	187	.454	265	.4005	
Remaining terms college science and math. vs. high school math.	182	.464	258	.297	2.03*
First and second term college engineering & science and math. vs. high school total	179	.414	264	.469	
Remaining terms college engineering and science and math. vs. high school total	177	.438	258	.3175	
High school total vs. psychological test total ranks	191	.1362	258	.320	2.35*
High school math. vs. psychological test "Q" rank	183	.107	238	.330	2.37**
First and second terms college total vs. psychological test total ranks	185	.2405	258	.437	2.29**

TABLE VI (continued)

VARIOUS CORRELATIONS FOR THE DEFICIENT AND NON-DEFICIENT GROUPS, AND THE SIGNIFICANCE OF THEIR DIFFERENCES##

Pearson product-moment correlation of	n	Deficient	n	Non-deficient	t test of difference
Remaining terms college total vs. psychological test total rank	177	.2878	254	.362	
High school science vs. high school mathematics			264	.586	
#Multiple correlations of remaining terms college total vs. psychological test total and high school total	177	.538	260	.444	

These multiple correlations must be considered as estimates since an error is necessarily introduced because of the small variation of n in the respective correlations.

$$t = \frac{Z_1 - Z_2}{\text{dif.}}, \quad \text{where } Z = \tfrac{1}{2} \log \frac{1 + r}{1 - r}, \text{ and}$$

$$\text{S.E. dif.} = \sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}$$

For details of these correlations see Appendix F, Tables XII to XXX.

* Significant at the 5% level.

** Significant at the 2.5% level.

Note: The divergence from a normal distribution of the data used for these correlations was not sufficient to materially effect the correlations. Figures 12, and 13, pages 87 and 93, show the general distribution of the principal data used in these correlations.

work and the corresponding high school work in the deficient group. This is made more outstanding by the low and variable correlation of this same group when using the psychological examination ranks.

This variation is again more pronounced when the correlations of the psychological examination with the academic progress of the non-deficient group are compared with the corresponding correlations of the deficient group.

The differences between the correlation coefficients for the deficients and non-deficients for the respective subject combinations were compared with the standard error of their respective differences and the quotient appended in the t column. The statistical significance of the differences between the deficients and non-deficients when the psychological test scores are used for comparison is pronounced.

A search for the cause of this large variation between the correlation of college work with high school averages and with psychological test scores was beyond the scope of this study. This will be suggested as a topic useful for further study.

It is also interesting to notice that the correlations of the academic progress in college of the deficient group with high school grade point average, and again with the psychological test scores, remain practically constant

throughout the whole period of college attendance. In contrast to this the parallel correlations of the non-deficient group show a definite, although statistically non-significant, decrease in correlation coefficient under each type of comparison between the first two terms of college work and the remaining terms of college work.

In summary it can be said that psychological test scores and high school grade point average rank about equally effective in the prediction of academic success of engineers when they enter as non-deficients and, as shown in the checked line of Table VI, the two together as a multiple correlation appear to improve that prediction in the remaining terms of college.

For the deficients the high school grade point average is much better than the psychological test scores as a basis in predicting the academic success of the group in college work. This difference is statistically significant. A grouping of the high school grade point average and the psychological test score rank in a multiple correlation gave a very slight change in prediction over the high school grade point average alone.

It was because of this effect in the deficient group that for purposes of comparison of the academic ability of the deficient and non-deficient groups the high school grade point average was chosen.

CHAPTER VI

A COMPARISON OF THE TWO GROUPS AND THE APPARENT EFFECT OF DEFICIENCIES

Deficiencies do not seem to be as vital a limitation to the academic progress of the student as the name implies. However, before the full effect of deficiencies can be estimated the variations of the two groups with and without deficiencies must be carefully examined.

Drop-outs. An examination of Table VII reveals that 53.6% of the drop-outs during the year 1946-47 entered free of deficiencies while 46.4% had some form of deficiency. The Basic College section of the general sample had only 32.2% deficiencies. Approximately 22% of the deficient students while less than 12% of the non-deficient students dropped out during the year. Therefore, the rate of student mortality was appreciably higher among the deficient students. Of the drop-outs with deficiency 7.5% were deficient by one-half unit, 40% by one unit, 29% by two units, and 12% by more than two units.

A large number of the total drop-outs whose psychological test scores were available were in the lower three deciles. When the distribution of these scores is compared with those of the entire deficient and non-deficient

TABLE VII

THE ENTRANCE DEFICIENCIES AND PSYCHOLOGICAL TEST SCORE RANKS OF 261 ENGINEERING DROP-OUTS BETWEEN FALL TERM 1946 AND SPRING TERM 1947

Deficiencies	No score available	Psychological test score decile rank 1&2	3	4	5	6	7	8	9	10	Total
None	47	9	15	3	9	10	13	12	7	15	140
Physics	6	3	-	3	2	1	2	2	1	2	22
Science	1	-	-	-	1	-	1	-	-	-	3
2 Sciences	1	-	-	-	-	-	-	1	-	-	2
1 Math. ✓											
Physics	8	1	1	3	2	1	3	5	-	1	25
Science	-	-	-	-	-	-	1	-	-	-	1
2 sciences	1	-	-	-	-	-	-	-	-	-	1
1½-2 Math. ✓											
Physics	5	2	1	-	-	-	-	-	-	-	8
Science	-	-	-	-	-	-	-	-	-	-	-
2 Sciences	5	-	2	-	-	-	-	-	-	-	7
½ Mathematics	3	-	1	-	-	-	-	-	4	1	9
1 Mathematics	8	3	1	-	1	2	3	2	1	2	23
1½ Mathematics	-	-	-	-	-	1	-	-	-	-	1
2✓ Mathematics	5	-	1	1	-	-	-	-	-	-	7
Servicemen's Institute	7	3	-	-	-	-	-	-	1	1	12
	97	21	22	10	15	15	23	22	14	22	261

Mean decile = 5.77 for the deficient drop-outs.

Mean decile = 6.20 for the non-deficient drop-outs.

For the difference of the means t = 1.28 (insignificant)

Mean decile = 6.986 for the total science deficient group.

Mean decile = 7.452 for the non-deficient group.

groups as given in Figure 12, page 87, the extremely large number of drop-outs from the lower deciles is apparent.

Between the deficient and non-deficient drop-outs the difference of the means of the ranks was approximately equal to one standard deviation of the difference of the means. The mean decile of the deficients was 5.77 and that of the non-deficients was 6.20. The corresponding meansof the total groups were 6.986 and 7.452 for the deficients and non-deficients respectively. The difference of these groups was equal to 1.9 standard error of the difference of the means. The means of the psychological test scores of the drop-outs are approximately three standard deviations of their differences lower than the means of the respective groups.[1]

Transfers. The diagram in Figure 10 gives the distribution in percentage of the general sample that transferred to various departments within the college during the school year 1946-47. The percentages transferring with and without deficiencies were approximately equal. Business administration is by far the most popular department to which engineers transfer.

Age of entry. On the average, the deficient student

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[1] A summary of the essential data of the drop-outs is to be found in Appendix K.

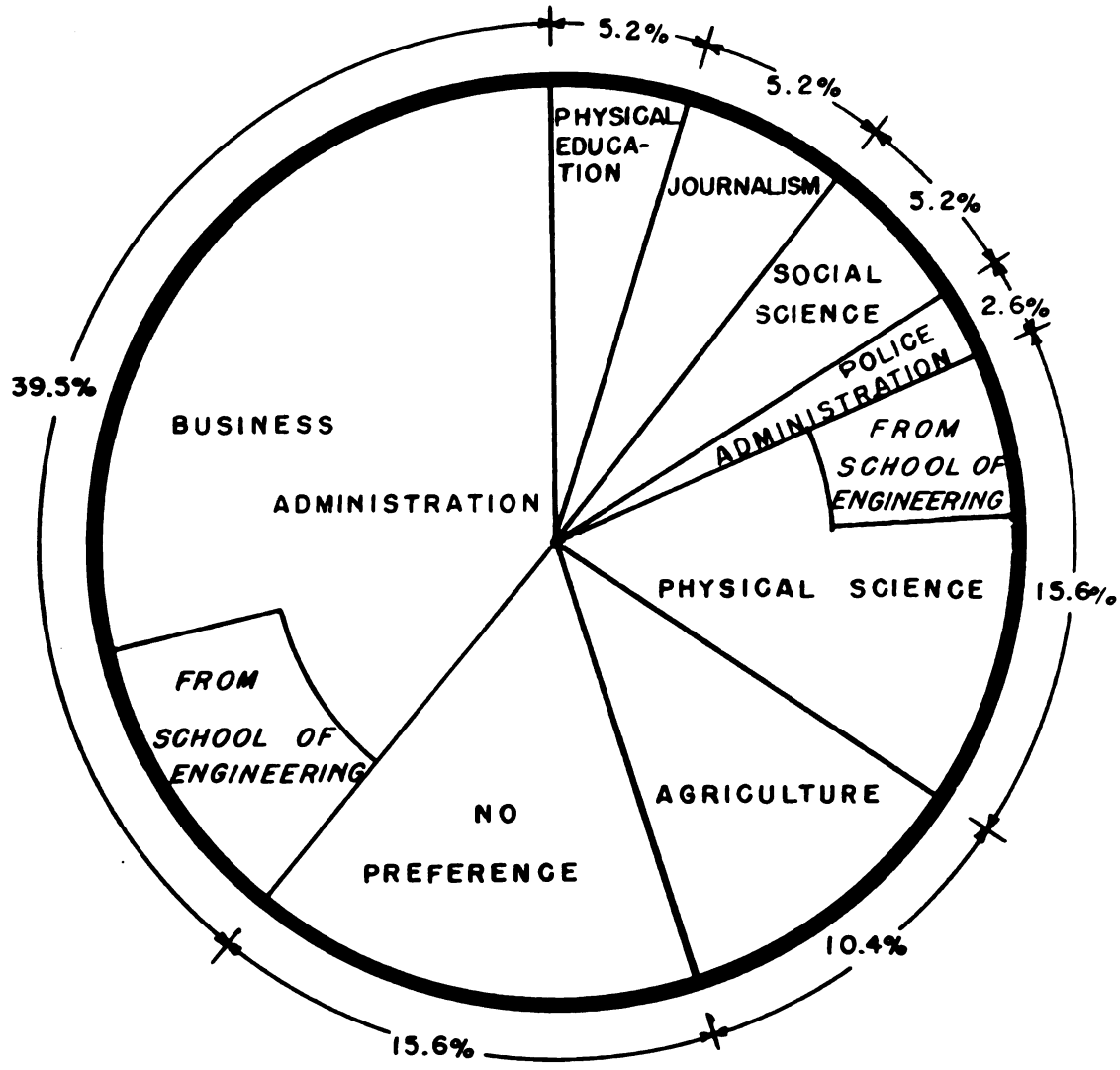

FIGURE 10

DISTRIBUTION OF TRANSFERS FROM THE GENERAL SAMPLE OF BASIC ENGINEERING AND ENGINEERING

(7.4% of the basic engineering group and 5.7% of the engineering group transfered during the year 1946 - 1947.)

begins his college work about nine-tenths of a year later than his non-deficient contemporary. Figure 11 gives a comparison of the distribution of the ages of the two groups. The chances are greater than four to one that students entering at seventeen years of age will be non-deficient while above twenty-five years of age the chances are almost one to one between the deficient and non-deficient entries.[2]

In the computation of these data the ages of the students were taken as of April 1, 1947. Since some entered before being called to the armed forces while others entered upon their release, it seemed best for this comparison to compute an index of the effective age of entry. This was done by subtracting one year of age from the actual chronological age for each three terms of school work completed.

Examination of the psychological test scores. The variation of the psychological examination test scores is worth noting. It is best shown by a graph, Figure 12,

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[2] Could it be, considering the composite of the evidence available, that the average overall maturation age of the deficients would be significantly lower for a given chronological age than that of the non-deficients, or that deficiencies are partially the result of the present practice of starting children in school too young?

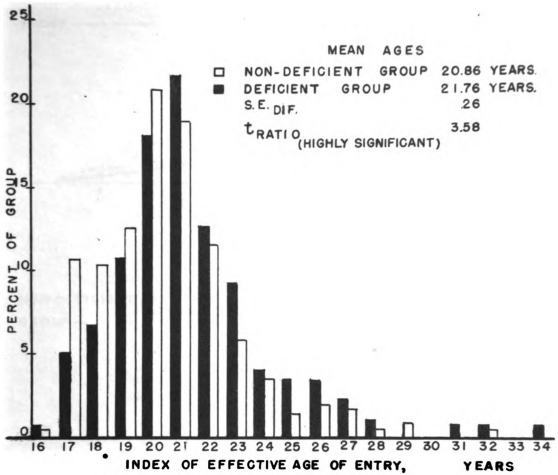

FIGURE 11

DISTRIBUTION OF THE EFFECTIVE AGES OF ENTRY OF THE TWO GROUPS

Note: The effective age of entry for each student was derived by subtracting one year for each three terms attendance completed at Michigan State College from the actual age as of April 1947.

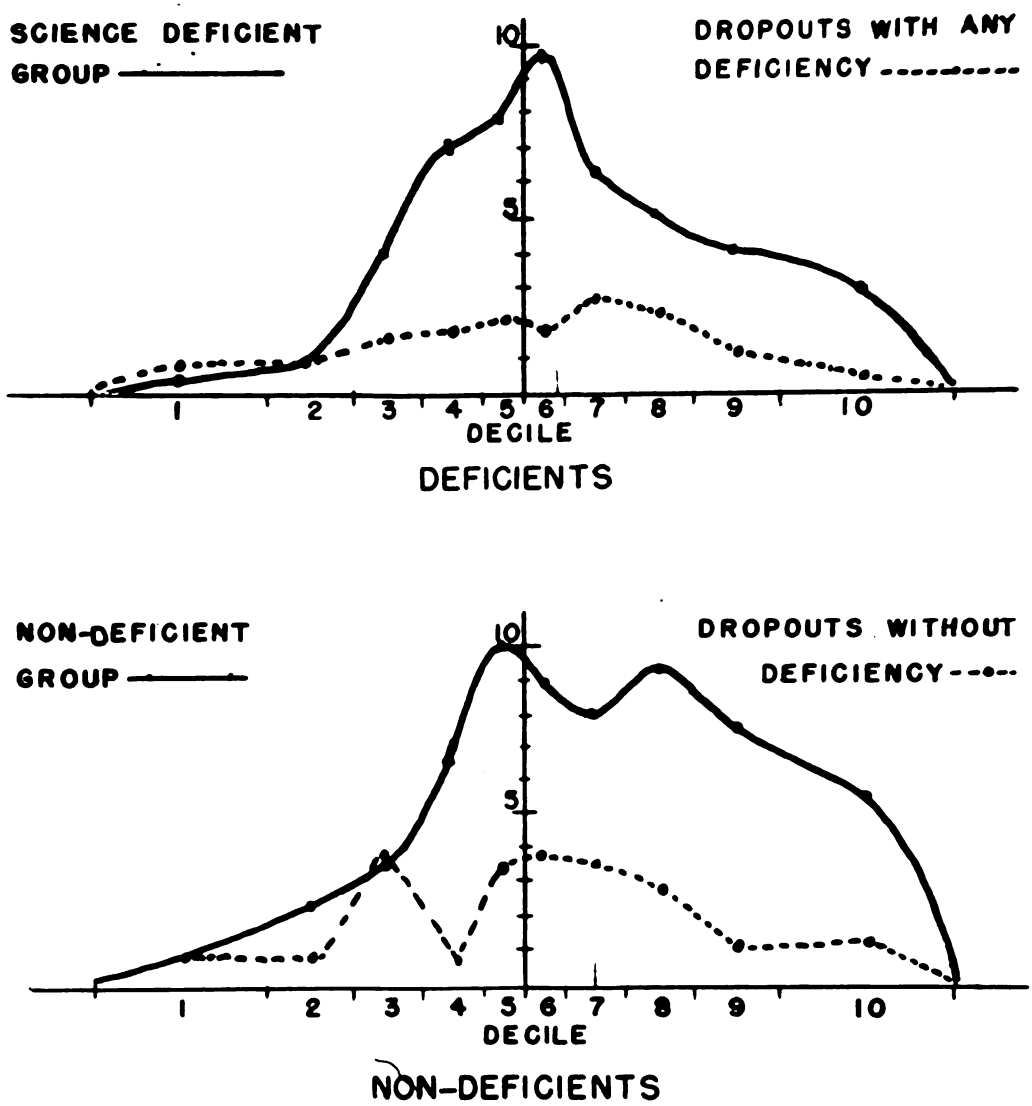

FIGURE 12

DISTRIBUTION OF THE PSYCHOLOGICAL TEST RANKS OF THE TOTAL GROUPS AND THE DROPOUTS

Note: An attempt was made to normalize the distribution of the linear decile ranks by histograms of an arbitrary width obtained by comparison of previous test scores. The detailed tables may be found in appendix J.

where an attempt was made to change the linear decile ranks to a normal distribution of scores.[3] Because of the loss in accuracy in reassigning scores within groups this method does not improve the correlation coefficient. For that reason the correction factor suggested by Kelly[4] was used to approximate the correlation in these statistics. There is no statistically significant difference between the deficient and non-deficient groups when figured from this estimated score. When the ranks are compared, the mean decile of the non-deficient is 7.452 while that of the deficient group is 6.986, which gives a difference of .466. The standard error of the difference of the means is .243, giving a quotient of 1.919 which would occur 6.3 times in 100 by chance. When the shapes of the two distributions are compared, it is apparent that the non-deficients show a greater skewness toward the upper deciles. This difference is consistent throughout the comparisons of the scholastic work both in high school and college.

High school academic standing. There is a highly

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[3] Please refer to the summary in Appendix J for details of their design.

[4] Cited by Charles C. Peters and Walter R. Van Voorhis, Statistical Procedures and Their Mathematical Basis. (New York: McGraw-Hill Book Company, Inc., 1940), p. 109.

significant difference between the means of the total high school grade point averages for the deficient and non-deficient groups.

The mean grade point average of the non-deficient group for the total high school program was found to be 1.6869 grade points. The corresponding mean for the deficient group was 1.5125 grade points. This gives a difference between the means of .1744 grade points. The standard deviations of these means were .514 and .560 for the non-deficient and deficient groups respectively. The standard error of the difference of these means was found to be .0518 and, therefore, the difference of the means is equal to 3.37 standard deviations. This difference should occur but fourteen times in 10,000 by chance.[5]

The specific scores for high school science and high school mathematics were isolated and their comparisons agree with the results of the total high school pattern. The difference of the science means was equal to 2.81 standard errors and that of the mathematics was equal to 2.40 standard errors. This is lower than the high school totals, yet both are statistically significant differences.

Thus it is seen that the records of high school work of the deficient and non-deficient groups are more widely

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[5] See Appendix G, Section 1, for detailed analysis.

separated than the psychological examination scores since the margin of measured academic ability as shown by the psychological test scores is relatively small. This greater divergence in achievement than measured academic ability may have a very direct connection with depth of interest,[6] since those without deficiencies have in the majority of cases done more specific and long time planning as evidenced by their high school preparation, i.e., lack of deficiencies.

If this divergence is generally associated with science deficiency, the opinion (or feeling) that has grown so strong among educators that the required high school mathematics and science constitute a necessary preperation for the engineering student may be due to this difference in scholastic ability and interest. It may be the latent academic ability and a more specific and intense interest that appears to give the almost certain promise of greater scholastic success to the student with a highly specialized high school subject pattern.

College academic progress. There is no appreciable difference in college academic progress that can be ascribed to deficiencies as such. As has been shown in comparison of psychological score ranks, there is a distinct though

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[6] See footnote 9 on page 74.

non-significant differences in the so-called "academic ability" of the two groups. The comparison of the high school scores shows that there is a distinct difference in the applied scholastic ability in the achievement of the two groups. An analysis of co-variance of the high school total grade point average and college grade point average of the first two terms' achievement between the deficient and non-deficient groups, as shown in Table VIII, yields a difference that is significant at the 5% level. A graphical comparison of the distribution of these grade point averages is to be found in Figure 13. From the corrected means of the college work, there is reasonable evidence to conclude that during the first two terms the deficient students of this study are handicapped to an average extent of .0975 grade points when compared with those non-deficient students of equal academic ability as measured by their high school grade point averages.[7]

This difference is small but, being true to the total pattern of college work attempted during the first two terms attendance, it is of interest to question what is the effect upon the closely allied fields of science, mathematics and engineering.

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[7] See Appendix G, Section 1, following Table XXXII for full details of the corrected means.

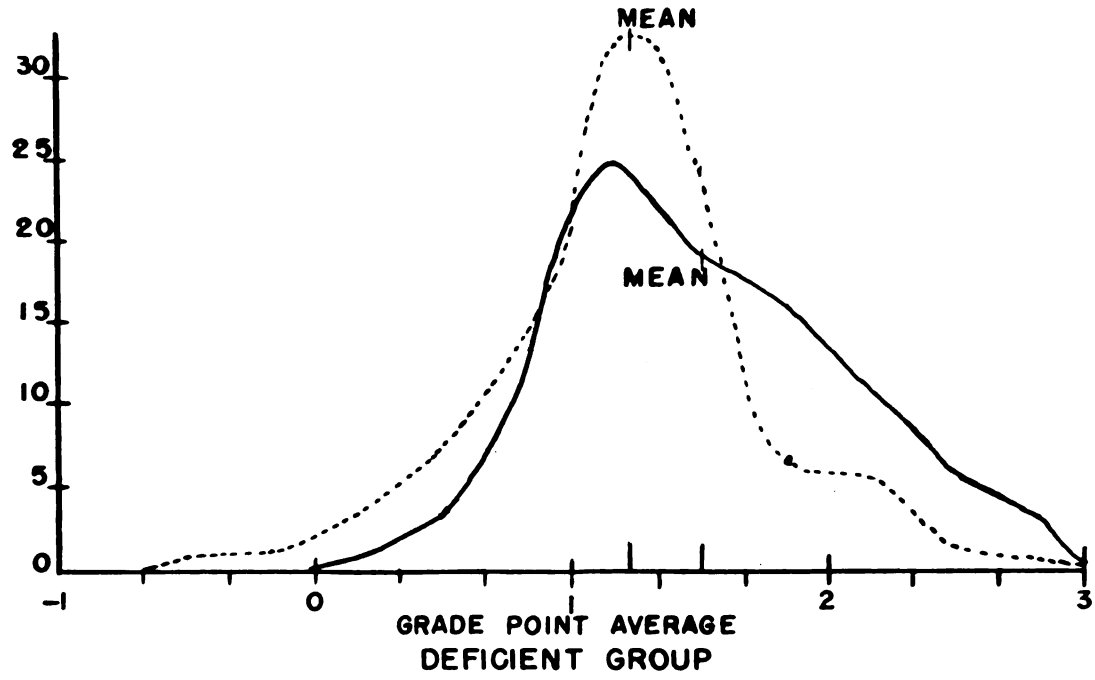
TABLE VIII

ANALYSIS OF THE CO-VARIANCE OF HIGH SCHOOL TOTAL GRADE POINT AVERAGE AND COLLEGE FIRST AND SECOND TERM ACHIEVEMENTS BETWEEN THE DEFICIENT AND NON-DEFICIENT GROUPS

Source of variance	D.F.	Σx^2	Σxy	Σy^2	$\Sigma(y-Y)^2$	D.F.	Reduced variance
Total	449	1179.61	513.5	1188.5			
Between deficient and non-deficient	1	29.95	29.28	28.73			
Within groups (error)	448	1149.65	484.21	1159.76	955.78	447	2.14
		Between groups plus error			964.50	448	
				Difference	8.72	1	8.72

$F = \frac{8.72}{2.14} = 4.07^*$ significant at the 5% level.
At 450 degrees of freedom F = 3.86 at 5% level, 6.70 at 1% level.

For details of the calculations of corrected college grade point averages see outline following Table XXXI, Appendix G, Section 1. In this and subsequent analyses of variance and co-variance, Nayer's test of homogeneity was satisfied.



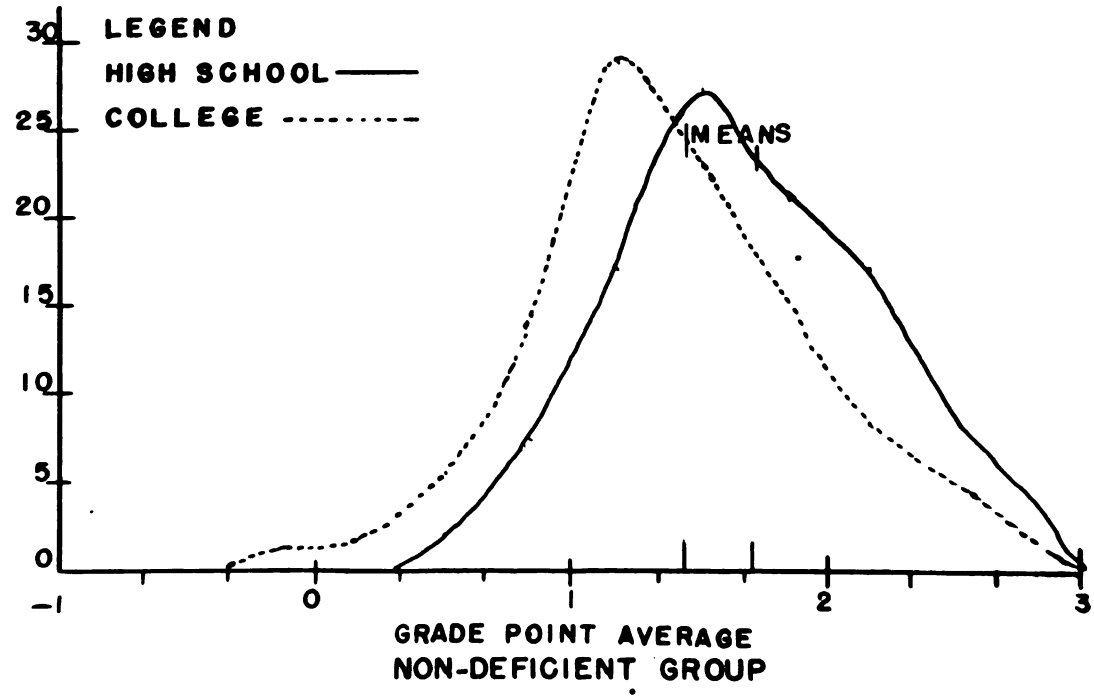


FIGURE 13

DISTRIBUTION OF, FIRST AND SECOND TERM COLLEGE TOTAL AND HIGH SCHOOL TOTAL, GRADE POINT AVERAGES OF THE TWO GROUPS

This question was settled in two parts. An analysis of co-variance was made covering the science and mathematics in college using the achievement in high school mathematics as the basis of comparison of applied ability.[8] The results of this analysis showed a small but non-significant difference in the field of science and mathematics in favor of the non-deficient group. A second analysis of co-variance, covering the fields of science, mathematics and engineering using the total high school grade point average as a basis of comparison showed no difference in this combined achievement between the two groups.[9] From this analysis it is evident that no claim can be made in this study that, in the first two terms of work, the deficient student finds any handicap within his professional field because of the lack of one or both sciences as part of his high school background. On the average his work, in science, mathematics and engineering, is fully equal to that of those having equivalent high school achievement with no accompanying science deficiency.[10]

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[8] See Appendix G, Section 1, for the full analysis of this co-variance, Tables XXXIII and XXXIV.

[9] See Appendix G, Section 1, for details of this analysis, Tables XXXV and XXXVI.

10 The cause of this difference between the results of these analyses of co-variance of the total subject pattern and of the professional work in early college is beyond the scope of this problem. It may be closely related

This division of early college work (terms one and two) was separated from the rest because many with whom the writer counseled during the early stages of research felt that if there is to be a difference in college work it will be most noticeable while the student is obtaining his orientation and basic college tools, and that the difference would be less and less observable as the student acquired the backgrounds of early college instruction.

There was another group who considered that the effect of these deficiencies would be noticeable only in the strictly engineering and scientific subjects whose foundation is supposed to rest on these preliminary science subjects in high school. The student does not usually begin this regular work in either engineering or mathematics and science, aside from basic science courses, college algebra, and engineering drawing, until after the end of the second term. In order to study this question specifically, a further analysis of co-variance was made of the high school total grade point average and the "remaining terms" of college work in engineering and science and mathematics between the deficient and non-deficient groups. Table IX

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10 (Cont.) to the problem discussed in footnote 9 on page 74, i.e., interest and determination, since many of these deficient students are, no doubt, deficient because they lack or have lacked that fire or determination that should enable them to attack the harder things of life.

TABLE IX

ANALYSIS OF REDUCED VARIANCE OF THE HIGH SCHOOL TOTAL GRADE POINT AVERAGE AND COLLEGE REMAINING TERMS OF ENGINEERING, AND SCIENCE AND MATHEMATICS ACHIEVEMENTS BETWEEN THE DEFICIENT AND NON-DEFICIENT GROUPS

Source of variance	$\Sigma(y - Y)^2$	df	Reduced variance
Error or within groups	1698.6924	432	3.9321
Error / between groups	1700.1764	433	
Difference (for testing)	1.484	1	1.484

$F = \frac{1.48}{3.39} = .397$. No significant difference F at 5% level at 1 and 432 degrees of freedom is 3.86.

gives the reduced variances for this analysis.[11] There is again no difference between the two groups. Thus it is apparent that no statistically significant differences can be found between the deficient and non-deficient groups, when due regard is taken of the initial applied academic ability as measured by high school achievement, except in the non-professional "general education" work of the first two terms.

After the deficient group entered college the actual differences in academic achievement appeared to decrease slowly, as is indicated by the following: (1) The difference in the means for college total grade point average during the first two terms was equal to 3.48 standard errors of the difference of the means; (2) For the remaining terms the corresponding difference was equal to 1.96 standard errors of the difference of the means. The mean for the non-deficient group in the science and mathematics grade point averages for the first two terms of college work exceeds the mean for the deficient group by approximately one standard error of the difference of the means and showed no appreciable change during the remaining terms. A brief summary of these means and standard deviations is to be found in Table X.

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11 Full analysis is to be found in Appendix G, Section 1, Tables XXXVII and XXXVIII, p. 169-70.

TABLE X

THE MEANS AND STANDARD DEVIATIONS OF VARIOUS MEASURES OF COLLEGE ACHIEVEMENT FOR THE DEFICIENT AND NON-DEFICIENT GROUPS

College work completed	Deficients			Non-deficients			Test of significance		
	n	σ	Mean	n	σ	Mean	$\sigma_{dif._m}$	Dif. means	t ratio
First and second terms total	186	.501	1.232	264	.545	1.404	.0497	.1725	3.48**
First and second term science and mathematics	187	.647	1.333	265	.794	1.3994	.0679	.0644	.96
Remaining terms total	177	.720	1.199	261	.667	1.335	.0695	.136	1.96*
Remaining terms science and mathematics	182	.665	1.194	258	.286	1.271	.0694	.0767	1.10
Remaining terms science, mathematics, engineering	177	.783	1.173	258	.667	1.314	.0720	.141	1.96*

** Significant at the 1% level.

* Almost significant at the 5% level.

In summary. (1) The percentage of drop-outs was appreciably higher from the deficient group. The average of the psychological test scores of the deficient drop-outs was only slightly (less than one standard error of the difference of the means) lower than the non-deficient group.

(2) The non-deficient group entered college at the effective age[12] of 20.865 years while the average of the deficient group was .901 years more, the average actual age being 22.610 and 23.097 years in their respective groups.

(3) There is a very significant difference between the ability of the group entering with deficiencies and the group with all high school requirements fulfilled:

(a) In the decile rank of the psychological scores the non-deficient group excelled the deficient group by 1.9 standard errors of the difference of the means;

(b) In the high school total grade point average the non-deficient group excelled by 3.37 standard deviations of the difference of the means;

(c) The grade point average of high school

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[12] The effective age used in this calculation was taken as the present age less one year for each three terms attended. This was done in order to make a comparison possible among those who entered college before entering service.

mathematics for the non-deficient group was 3.24 standard errors of the difference of the means above the average of the deficient group.

(4) After entering college the difference between the groups tends to decrease.

After a careful consideration of the grade point averages of high school and college work by both deficient and non-deficient groups, it is found that when allowance is made by an analysis of co-variance for the difference of initial ability as measured by high school achievement of the deficient and non-deficient groups, there is no significant difference in the performance of the two groups as measured by their academic achievement in college, except in the general college achievement during the first two terms. This is quite contrary to the generally accepted conclusions and the reasons usually given for the specific high school requirements. From the results of this study it appears that the college work most affected by the lack of science in the specific high school entrance pattern, is the work outside of the closely related fields of mathematics, science, and engineering.

CHAPTER VII

CONCLUSIONS

This investigation adds its confirmation to the serious questioning of many of the present methods used in screening college admissions. However, before any answer to the question can be given, the purpose or basic philosophy of higher education must be settled. This controversy was ably summarized in the Sixth Yearbook of the Department of Superintendence.

> In 1926 P. Angell of Yale addressing the North Central Association took the ground that the function of college being to raise up a race of intellectual leaders, college entrance requirements should be highly selective. A year later Chancellor Lindley of Kansas before the same body maintained that in a democracy the chief duty of the college is to train for useful, intelligent citizenship the largest possible number of young men and women.[1]

As the first conclusion of this study it would seem appropriate to state that before college admissions can be successfully approached a unification of purposes, i.e., philosophies, must be reached by the staff of the school, and that in a democracy these purposes must be consistent with democratic concepts of life and way of living.

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[1] Department of Superintendence, Sixth Yearbook. (Washington: Department of Superintendence of the National Education Association, 1928), p. 144.

Deficiencies and their removal. 32.2% of the entrants into Basic College with engineering preference were deficient, while about 14% of those now enrolled in the School of Engineering have or have had deficiencies. These deficients carried an average of 1.43 units of deficiency. In the investigation of over two hundred cases only two cases of English deficiency were listed. This did not include the group in the Servicemen's Institute.

The make-up of the science deficiencies covered a period of six terms with approximately 39% doing no make-up work. Half of those doing make-up work completed this work at the end of the second term. The make-up work for mathematics deficiencies when accompanied by a science deficiency covered the same range with only 14% doing no make-up work, and 47% of the make-up being completed during the first term.

Drop-outs. There is a distinctly higher rate of drop-outs from the deficient group. During the school year of 1946-47, 21.3% of the deficient group dropped out as compared with only 12.0% of the non-deficient. The mean decile rank of the drop-outs was more than three standard deviations of the difference of the means below the mean decile rank of their respective groups as measured by the scores of the psychological examination. This indicates

that the loss of these groups tends to raise the average of the academic ability of the parent groups.

Psychological examination. The lack of prognostic ability of the American Council of Education Psychological Examination with the deficient group is outstanding. This lack of correlation was equally low in comparison of previous work such as high school grade point averages and also subsequent work in college. In direct contrast to this was the high correlation of the high school and college grade point averages of the deficient group.[2] If this is a characteristic of this psychological examination, care must be used in applying its results to those who are deficient in science and mathematics.

Age of entry. The index of the average age of entry of all students studied, including both groups, was about 22.75 years. This index was derived by subtracting one year for each three terms completed. This increase of about four years above the usual age of entry is without doubt due to the effects of the war and the heavy demand it made upon the man power of the nation for its duration.

Scholastic ability. The average scholastic ability of the deficient group is almost significantly lower than

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[2] This, again, may be due to variability of interest or determination. It has been suggested that deficiency may sometimes be caused by a deliberate attempt on the part of the student to shun the hard things in life.

that of the non-deficient group as measured by the psychological examination ranks. When the applied scholastic ability is measured by the grade point average of high school achievement the difference is highly significant.

Effects of deficiency. The science deficiency introduces no noticeable handicap into the scholastic achievement during the college work, except that noted during the first two terms. This effect was tested both during the first two terms of work and during the specialized training of the remaining terms of study. Almost 40% of the deficients studied had successfully attempted advanced specialized training either before or without deficiency removal.

If the results of this study are generally true there is no special advantage that can be attached to any particular science requirement in the subject matter pattern. The slight disadvantage accepted by the deficient group during the first two terms in college does not seem to affect their remaining work to any significant degree and even during these first two terms it seems that there is no disadvantage found in the professional subjects of their chosen field. Academic success in college work was found to depend to a greater extent upon a better application of academic ability than upon the type of subject matter studied in high school. It seems, therefore, that

entrance requirements should be based upon what the candidate did with what he took in high school and not upon the subjects which he took.

Keeler's results.[3] In comparison with Keeler's study at the University of Michigan in 1930, it is interesting to note many similarities:

KEELER'S STUDY	PRESENT STUDY
Frequency of deficiency	
An average of 37.6% of the entrants deficient.	32.2% of students enrolled in Basic Engineering entered with deficiencies.
The average deficiency per deficient student	
1.42 high school units.	1.38 high school units.
Number of deficient students and length of time of observation	
127 students - 1 semester 98 students - 3 semesters 73 students - 5 semesters.	86 students - 3 terms 19 students - 4 terms 25 students - 5 terms 27 students - 6 terms 22 students - 7-12 terms.
Measures used in comparing academic ability	
Matched on an average of American Council of Education Psychological Examination, Iowa Placement Test English,	Compared by analysis of covariance on basis of high school grade point average.

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[3] L. W. Keeler, "An investigation of the effect of subject deficiencies upon accomplishment of students entering the College of Engineering of the University of Michigan during the academic years 1927-28, 1928-29, and 1929-30." Bureau of Educational Reference and Research, Bulletin No. 138. (Ann Arbor: School of Education, University of Michigan), 68 p.

KEELER'S STUDY	PRESENT STUDY
Measures used in comparing academic ability (Cont.)	
Iowa Placement Test Mathematics.	
The variations on academic ability of the deficient and non-deficient groups	
Mean decile rank of all entering freshmen = 5.07, σ = 2.11.	Mean decile rank of non-deficient group = 7.452, σ = 2.6.
Mean decile rank of deficient freshmen = 5.06, σ = 1.88.	Mean decile rank of deficient group = 6.986, σ = 2.5.
Academic achievement	
No difference during the first three semesters. Beyond third semester non-deficient group higher by small fraction of honor point.	Mean achievement of deficients = 1.232, non-deficients = 1.4045 during the first two terms of college work. This difference is equal to 3.39 standard errors of the difference of the mean. For the remaining terms the difference decreased to 2.0 standard errors of the difference of the means.
Percentage of withdrawals from deficient and non-deficient groups	
Deficient. . . . 29.8 Non-deficient. . 17.5	Deficients. . . . 21.3 Non-deficients. . 12.0
Ratio. 1.70	Ratio 1.77
Taken over first, third, and fifth semesters.	Taken over two terms.

The above comparisons show that the percentage of deficient entrants has changed but little, notwithstanding the large influx of war veterans and older students, over the values at the University of Michigan seventeen years ago. This was hardly to be expected considering the liberalizing influences that have been at work in the high school subject pattern during the last score of years. Perhaps the traditional influence of the university entrance requirements is still a potent guide in high school offerings.

Finally. It appears from the present study that the developments which have resulted in the new admission policies of the Michigan College Agreement[4] have been psychologically sound in their prognostications. If deficiencies play as small a part in successful college work as appears from the results of this study into the effect of a lack of a basically technical prerequisite within a highly specialized field, it is logical to inquire why all schools and colleges, whether separate institutions or units within a larger university, would not find a more functional selection policy in the whole-hearted support of the "College Agreement."

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[4] See Appendix B.

CHAPTER VIII

SUGGESTIONS FOR FURTHER STUDY

This study of the effect of entrance deficiencies should be repeated in at least a survey form after the new Michigan College Agreement[1] has been accepted long enough by a sufficient number of schools to make a significant change in the number and kind of deficiencies.

The most important field of research which this study suggested was in the field of interest. There seems to be exhibited in the data of this experiment a factor or factors which none of the present "yardsticks" are able to measure. This thought was first suggested during the exploratory period by Mr. Carl M. Horn, who was then Chief of the Division of Occupational Information and Guidance of the State Board of Control for Vocational Education. It is emphasized by the fact that students of relatively low I.Q. for college success (near 100), as measured by several examinations in high school, at times produce a two-point (B) average in their college work, while at the same time others with a high I.Q. (above 125) do failing work continually. The nature of these factors is beyond the scope of this problem and for want of a better term

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[1] See Appendix B for the text of the Agreement.

they have all been spoken of as interest during this report. It has been suggested that these may include certain experiences during childhood and youth or perhaps an association with a parent or friend whose occupation or hobby is closely related to engineering. The attitude toward work, including determination, drive, and reaction to difficult situations, without doubt plays an important role in college success. There is, at present, no adequate measuring instrument for these qualities. The results of previous work along comparable lines, oftimes, form the best basis of measurement in predicting future success, yet they are also closely related to the initial abilities and cannot be said to measure specifically any of these qualities. This effect of interest upon academic success was lightly touched by Eckert[2] in discussing the factors influencing curriculum choice at the University of Buffalo.

If some scale could be devised that would compare the depth and intensity of motivating interest between individuals, it would prove of exceptional value in dealing with admission problems.

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[2] Edward Stafford Jones, Editor, Studies in Articulation of High School and College. (University of Buffalo Studies, Series II, Bulletin 8. Buffalo, New York: University of Buffalo, 1936), pp. 313-335.

A short study could be made comparing the amount of high school algebra and geometry actually taken and the lowest corresponding course for which credit should be allowed in Basic College. There appears to be a very high variability in the present procedure. A number of students having had two units of algebra are apparently allowed credit for mathematics 100a.

An interesting study could be made into the reasons for the exceedingly low correlation of the psychological examination scores and high school work of the deficient group. There may be some valid significant reason for this. It is suggested that success in the psychological examination may be partially dependent upon subject matter contained in the deficient courses.

As suggested earlier in this study[3] an interesting analysis could be made of the grades earned by deficient students on their make-up work taken at the college in comparison with corresponding work in high school and subsequent work in college.

There is opportunity at the present time to study a group who normally do not attend college and to partially answer the question of how many would be successful college students if allowed the opportunity for advanced

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[3] See page 54.

study. It should be possible through personal interviews to find a group of students who would not have attended the university without the present government aid. A comparison of their abilities and progress with their contemporaries would be helpful in future planning.

A study comparing the academic ability of students transferring from other colleges and out-of-state students entering Michigan State College with that of the regularly enrolled in-state freshmen would prove useful. It should be one step toward answering the question, Why do students come from long distances to attend Michigan State College.

A problem presents itself in the apparent significant difference between the success of the deficient students in the professional subjects of their chosen field and in the general education subjects required during their early college work. This problem may be closely related to the first problem suggested. It may often be that the cause of their deficiency has been their unreadiness to accept what Mitchel has called the "Hard things of life." This problem should raise a challenge to those whose interest lies in the field of measurement of academic ability.

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A P P E N D I C E S

APPENDIX A

DEFINITION OF TERMS

Basic engineers as used in this study refers to those enrolled in Basic College with engineering preference.

Credit points are the number of points rating A = 3, B = 2, C = 1, D = 0, F = -1 per hour or per half unit of credit. They are totaled the same as hours or units of credit.

Deficiency is a term used to include those high school subjects which are specifically required for admission to a given school of Michigan State College, but which have not been successfully completed prior to the entrance of the student into the college.

Deficient entrant refers to a student who has been granted admission to the school of his choice, with deficiency, the understanding being that such deficiencies will be removed in a way[1] acceptable to the school concerned by the active participation of the student.

Deficient group refers to the selected group consisting of all those having had upon entrance one or more units of science deficiency who were registered at Michigan

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[1] See page 44 for accepted methods of removal.

State College for the fall term of 1946 and whose high school record was available. Its selection is described on page 48 of the text.

Grade point average is a quotient of the number of points earned by the number of hours or half units. It is the average grade points per hour or grade points per unit. This gives a convenient numerical quantity representing the average grade for a student.

General sample refers to the group of one-fourth of the total population from Basic College with engineering preference and one-sixth of the total population from the School of Engineering used as source of the control group in this study. Its selection is outlined on page 64.

Hours credit refers to the number of credit hours successfully completed. One credit hour is given for each hour which a class meets per week for a full term.

Maturation as used throughout this study refers to the reaching or approaching that stage of adulthood when the desires and purposes have become sufficientlt stabilized so that future planning can be attempted with a fair degree of certainty.

Non-deficient group refers to the selected group consisting of all those free of any kind of deficiency upon entrance, having high school records available, and registered for the fall term of 1946 in the School of

Engineering or Basic College with engineering preference, at Michigan State College, from the general sample. Its selection is described on page 57 of the text.

Remaining terms refer to all work taken subsequent to terms one and two (the student's first and second terms) at Michigan State College.

Terms one and two refer to all work taken during the first and second terms attendance of the given student at Michigan State College.

Units refer to high school credit in which four units constitute a full load for a normal high school student for a school year. A unit was originally defined as the Carnegie unit in an effort to standardize high school studies. This required a class meeting of at least forty-five minutes, five days per week, with approximately forty-five minutes spent in preparation each day.

APPENDIX B

"COLLEGE AGREEMENT"

A Proposal Regarding Admission to

Michigan Colleges and Universities

Unanimously adopted by the Michigan College Association, November 7, 1946.

1. It is proposed that the College Agreement of the Michigan Secondary Curriculum Study, with certain changes, be extended to include any accredited high school whose staff will make the commitments noted below in Section Two. The wording of the proposed Agreement is as follows:

> "The college agrees to disregard the pattern of subjects pursued in considering for admission the graduates of selected accredited high schools, provided they are recommended by the school from among the more able students in the graduating class."
>
> This Agreement does not imply that students must be admitted to certain college courses and curricula for which they cannot give evidence of adequate preparation.
>
> Secondary schools are urged to make available such basic courses as provide a necessary preparation for entering technical, industrial, or professional curricula. It is recommended further that colleges provide accelerated programs of preparation for specialized college curricula for those graduates who are unable to secure such preparatory training in high school.

2. It is proposed that high schools which seek to be governed by this Agreement shall assume responsibility for and shall furnish evidence that they are initiating and continuing such procedures as the following:

> a. A program involving the building of an adequate personal file about each student, including testing data of various kinds, anecdotal records, personality inventories, achievement samples, etc. The high school staff would assume responsibility for developing a summary of these personnel data for submission to the college.

b. A basic curriculum study and evaluation of the purposes and program of the secondary school.

c. Procedures for continuous follow-up of former pupils.

d. A continuous program of information and orientation throughout the high school courses regarding the nature and requirements of certain occupations and specialized college courses. During the senior year, to devote special emphasis to the occupation or college of the pupil's choice.

3. It is further recommended that a joint committee be established to study applications of new schools and to recommend certain of these schools to colleges for inclusion in the Agreement; also to determine from time to time whether the criteria have been met in the schools on the list. This joint committee would include representatives of the Michigan Secondary School Association, the Michigan College Association, the Department of Public Instruction, and the Department of Superintendence of the Michigan Education Association. It would be served by a part-time staff supplied from three sources: the Bureau of Cooperation of the University of Michigan, the Department of Public Instruction, and the Inservice Committees of various Michigan colleges and universities.

4. It is understood that high schools which cannot or will not make and observe the above commitments (see Section Two) will continue to employ the major and minor sequences for those students who wish to attend college.

APPENDIX C

TABLE XI

ANALYSIS OF THE ENTRANCE REQUIREMENTS
OF SELECTED SCHOOLS OF ENGINEERING

College	Date	Enforcement	Mathematics	Science	Language	English
Carnegie Institute of Technology	1942	I	3	2 P	2	4
California Institute of Technology	1946	F	4	2 P	-	3
or by examination	1946	-	3	1 P	-	2
Cornell University	1946	Any pattern from upper 40% of HS				
or	1946	-	4	1 P	2	3
Colorado A. and M. College	1946	-	3	2 P	-	3
Columbia University	1946	F	4	2 P	-	3
Massachusetts Institute of Technology	1946	I	4	1 P	-	3
Michigan College of Mines	1944	F	3	1 P	-	3
Michigan State College of Agriculture and Applied Science	1946	F	3	2 P	-	3
Ohio State University	1946	-	3	1 P	-	3
Princeton University	1946	-	3½	2 P	3	3

TABLE XI (Continued)

ANALYSIS OF THE ENTRANCE REQUIREMENTS
OF SELECTED SCHOOLS OF ENGINEERING

College	Date	Enforcement	Mathematics	Science	Language	English
Purdue University	1945	L	3	1 P	-	3
Rensselaer Polytechnic Institute	1947	I	3½	2 P	-	3
Stanford University	1946	L	3½	1	3	3
or better	1946	-	3½	3 P	-	4
University of California, Berkely	1946	-	3½	2	-	-
University of California, Los Angeles	1946	-	3½	2 P	-	-
University of Michigan	1946	L	3½	2 P	2	3
University of Notre Dame	1945	-	3	1 P	2	3

These requirements were taken from the catalogues of the date as listed of the respective schools of engineering.

Enforcement is classified as I, inflexible, L, limited flexibility, F, flexible application of these requirements as judged by the methods of removal of deficiencies suggested in the catalogue.

The numbers refer to high school units of the particular field required for entrance. "P" in the science column indicates that physics is specifically required as one of the sciences.

APPENDIX D
Section 1

MICHIGAN STATE COLLEGE

EAST LANSING, MICHIGAN

APPLICATION FOR ADMISSION

GENERAL INFORMATION

The *Basic College* has been established as an educational unit in which all students will be enrolled during their freshman and sophomore years.

The *Basic College* is designed to provide students with a sound educational foundation on which to build an intelligent interest in personal, family, vocational, social, and civic problems, a better understanding of these problems, and a greater ability to cope with them. It includes the study of man's relationship to physical, biological, and social sciences, an increased knowledge of the historical background of present-day civilizations, and an enhanced appreciation of cultures, past and present, that have been expressed in literature, music and art.

Students whose training may eventually become highly specialized need this foundation of general educational experience that each may have a greater appreciation of the relationship of his special field to the needs of society as a whole. Specialization for the Bachelor's degree is completed in the appropriate school.

INSTRUCTIONS

The first three pages of this blank are to be filled out by the applicant in ink; the entire blank is then to be referred to the principal of the high school from which the applicant graduated, who will fill out the remaining pages and forward the entire blank to the office of the Registrar.

1. **Name in full**_____ **Date**_____
(Last) (First) (Middle)

2. **Home address**_____
(Number and street) (City) (State)

3. **Mailing address**_____
(If different from home address) (Street and number) (City) (State)

4. **Birthplace**_____ **Date of Birth**_____ **Are you a U.S. citizen?**_____
(Month) (Day) (Year)

5. (a) **Single**_____ **Married**_____ Do you have any children?_____ **Number**_____

(b) **Are you a veteran of World War II?**_____ Total months in service_____ Branch of Service_____

6. **High School**_____
(Name of High School) (Location) (Date of Graduation)

7. (a) **Have you at any time applied for admission to any other college or university?**_____ **If so, give name of institution and full details of the outcome of your application**_____

(b) **Have you attended any college or university?**_____ If so, give name and location of the institution, time spent there, and reason for withdrawal_____

(c) **If you have attended another college, ask the registrar to send us a transcript of your record or a statement of honorable dismissal if no credit was earned.**

8. When do you expect to enter college? ☐ Fall ☐ Winter ☐ Spring ☐ Summer. Year_____.

(Print your name in space above.)

9a. (1) Father's full name:

_____
(First) (Middle) (Last)

(2) Living?_____ (3) Place of Birth_____

(4) National extraction_____

(5) Is he an American citizen?_____

(6) Occupation_____

9b. (1) Mother's full name:

_____
(First) (Middle) (Last)

(2) Living?_____ (3) Place of Birth_____

(4) National extraction_____

(5) Is she an American citizen?_____

(6) Occupation_____

10. If you have worked since graduation from high school, state positions held and duration of each term of employment .....

.....

.....

11. Give names, addresses and occupations of at least two responsible adult persons (not your former school teachers or officers, or relatives) as references .....

.....

.....

12. What influences led you to come to this College? .....

13. Do you expect to complete
- ☐ requirements for Bachelor's degree? (Four-year course)
- ☐ the two-year terminal course only?
- ☐ the one-year terminal course only?

14. Check your preference (check one):

SCHOOL OF AGRICULTURE

☐ General Agriculture *(Agricultural Economics, Agriculture Extension, Animal Husbandry, Farm Crops, Farm Management, Poultry Husbandry, Rural Sociology and Anthropology, Soil Science, Pre-Theological.)*

☐ Agricultural Education *(Teaching)*
☐ Food Technology

Agricultural Engineering Series:
- ☐ Farm Engineering
- ☐ Agricultural Engineering

Dairy Series:
- ☐ Dairy Production
- ☐ Dairy Manufactures

Forestry Series:
- ☐ Technical Forestry
- ☐ Housing and Lumber Merchandising

Horticultural Series:
- ☐ Floriculture
- ☐ Pomology
- ☐ Vegetable Production

Landscape Series:
- ☐ Landscape Architecture
- ☐ Urban Planning

SCHOOL OF BUSINESS AND PUBLIC SERVICE

Business Administration:
- ☐ Business Administration—degree curriculum
- ☐ 2 Yr. Terminal in General Business
- ☐ 2 Yr. Terminal in Insurance
- ☐ 2 Yr. Terminal in Retailing
- ☐ 2 Yr. Terminal in Secretarial Science
- ☐ 1 Yr. Terminal in Business

☐ Hotel Administration
☐ Journalism
☐ Physical Education, Health and Recreation
☐ Police Administration
☐ Public Administration
☐ Social Service

SCHOOL OF ENGINEERING

- ☐ Chemical
- ☐ Civil
- ☐ Electrical
- ☐ Mechanical
- ☐ Metallurgical
- ☐ Sanitary

SCHOOL OF HOME ECONOMICS

- ☐ Child Development
- ☐ Clothing and Textiles
- ☐ Foods and Nutrition
- ☐ General
- ☐ Home Economics and Nursing
- ☐ Institution Administration
- ☐ Related Arts
- ☐ Vocational Education *(Teaching)*
- ☐ 2 Yr. Terminal in Home Economics
- ☐ 2 Yr. Terminal in Food Supervision

SCHOOL OF SCIENCE AND ARTS
(Check Major Field)

Fine Arts:
- ☐ Art
- ☐ Applied Music
- ☐ Music Major
- ☐ Music Theory
- ☐ Musical Therapy
- ☐ Public School Music

Education:
- ☐ Elementary *(Teaching)*
- ☐ Secondary *(Check Major Field Also)*

Language and Literature:
- ☐ English
- ☐ Foreign Languages — check one: ☐ French ☐ German ☐ Latin ☐ Spanish
- ☐ Literature
- ☐ Speech, Dramatics and Radio

Biological Science:
- ☐ Bacteriology
- ☐ Botany
- ☐ Entomology
- ☐ Physiology
- ☐ Wildlife Management and Fisheries
- ☐ Zoology

SCHOOL OF SCIENCE AND ARTS (Continued)
(Check Major Field)

Physical Science:
- ☐ Chemistry
- ☐ Geography
- ☐ Geology
- ☐ Mathematics
- ☐ Physics and Astronomy

Social Science:
- ☐ Economics
- ☐ Foreign Studies
- ☐ History
- ☐ Philosophy
- ☐ Political Science
- ☐ Psychology
- ☐ Sociology

Pre-Professional:
- ☐ Dental
- ☐ Law
- ☐ Medical

SCHOOL OF VETERINARY MEDICINE

- ☐ Veterinary Medicine
- ☐ Medical Technology

BASIC COLLEGE

☐ No Preference *(Undecided on Major)*

IMPORTANT

WRITE YOUR NAME ON THE BACK OF A SMALL UNMOUNTED PHOTOGRAPH OR SNAPSHOT OF YOURSELF AND ATTACH HERE.

APPLICATION WILL BE CONSIDERED INCOMPLETE IF PHOTOGRAPH IS OMITTED.

THIS IS REQUIRED OF EVERY APPLICANT

FOR COUNSELOR

(To be completely filled out by the applicant.)

Name ..... Date of Birth .....
(Last Name) (First Name) (Middle Name) (Month) (Day) (Year)

Home address .....

Single ..... Married ..... Do you have any children? ..... Number .....

1. (a) Father's name .....

(b) Father's occupation .....

(c) Father's education (check if a graduate; otherwise give number of years in attendance):

Grade school ..... High school ..... College { M.S.C. ..... Other .....

(d) Mother's name .....

(e) Mother's occupation (if wage earner) .....

(f) Mother's education, (check if a graduate; otherwise give number of years in attendance):

Grade school ..... High school ..... College { M.S.C. ..... Other .....

2. Give names and relationships of relatives who have attended M.S.C., including years of attendance .....

3. (a) Have you contributed toward your support while in high school? .....

Nature of employment ..... Approx. number of hours per week .....

(b) Have you been employed since graduation? ..... How long and at what work? .....

4. (a) In what subject do you expect to specialize in college? ..... Do you plan to teach? .....

(b) Name high school subjects you liked best .....

(c) List any particular honors, prizes, other special awards for scholarship obtained in high school .....

5. (a) Make a complete list of the sports and other extra-curricular school activities in which you participated in high school

(b) What special recognition, if any, have you received in any of these activities? .....

(c) Which, if any, of these activities do you intend to continue in College? .....

6. What do you look forward to as a life work? .....

7. What are your plans for financing your college course during the first year? .....

8. If one year or more has passed since your graduation from high school, state whether or not and how your attitude towards higher education has changed .....

9. State condition of general health, naming any illness which may have handicapped you while in high school .....

10. Do you have periods of unconsciousness, convulsions, epilepsy, or fainting spells? .....

(Confidential)

CANDIDATE'S PERSONAL QUALIFICATIONS

(To be filled out by the high school counselor, principal, or superintendent.)
This sheet will be placed in the hands of the student's college Counselor.

1. To the high school official:

   (a) Please indicate your judgment of the candidate by placing check marks on the scale of ratings given below.

   (b) If a rating on any trait is omitted, it will be understood that you do not have sufficient knowledge of the candidate to express judgment. Such omissions will not put the candidate at a disadvantage.

Trait	Very low	Low	Average	Fairly high	High	Very high
Potential intellectual capacity						
Actual intellectual performance						
Seriousness of purpose						
Originality						
Tractability						
Social-mindedness						
Independence of effort						
Popularity						

2. If candidate took tests, please give:

Name of Test	Date Given	Percentile	Norm Group	Remarks

3. General rank in class (check one): (Best 25%) ____ (Second 25%) ____ (Third 25%) ____ (Poorest 25%) ____

4. (a) Has the applicant any defect of speech, sight or hearing? ____

   (b) Is the applicant subject to periods of unconsciousness, convulsions, epilepsy, or fainting spells? ____

5. State any other defects or qualities which are not covered by above ____

6. To what degree did the candidate's attitude towards scholastic work and application to academic subjects change during the last year or two in high school? ____

7. Describe any particular circumstances of the candidate's environment, personality, or fortunes of life that may have been influential in determining the record made in high school ____

8. Give any additional information which you think will be of value to us in understanding and guiding the candidate ____

Date _____ Signature _____

HIGH SCHOOL RECORD AND CERTIFICATE OF RECOMMENDATION

(Confidential)

High School 31 Located at

By what recognized accrediting associations is your school accredited?

Student's name
(Last) (First) (Middle)

Date of graduation 32 from (check one) ☐ College Preparatory Course ☐ Non-college Preparatory Course

(a) Years in attendance

(b) Names of and years in attendance at other high schools, if any, which candidate attended and from which credits were accepted

Has a statement of the applicant's credits been submitted to any other college or university? If so, when and to what school?

If candidate took tests, please give: (If given in page 4, omit here)

Name of Test	Date Given	Percentile	Norm Group	Remarks
				43
37				

(a) Number in candidate's graduation class 30 (b) Applicant's rank in class (e.g.—highest, 1; second highest, 2)

(c) General rank in class (check one): (Best 25%) 36 (Second 25%) (Third 25%) (Poorest 25%)

9. Check the group under which you think the scholastic record of the applicant may be expected to fall:

☐ Excellent ☐ Superior ☐ Average ☐ Inferior ☐ Probable Failure

10. Grade required for recommendation to College

11. Principal or Superintendent please check and sign the following:

I hereby certify that the following transcript is a true copy of the applicant's record

and (check one) ☐ 1.) do officially recommend admission to Michigan State College as checked: ☐ Clear. ☐ With examinations.
☐ 2.) do not officially recommend admission to Michigan State College.

Date

Principal or Superintendent

STUDENT'S NAME_____

Unit Value	STUDIES	Year Taken (I. II. III. IV)	No. of Weeks Pursued	No. of Hours Per Week	Grades	
					School	Regents
	ENGLISH:					
	First Year					
	Second Year					
	Third Year					
	Fourth Year					
	LATIN:					
	First Year					
	Second Year					35
	Third Year					
	Fourth Year					
	FRENCH:					
	First Year					
	Second Year					
	Third Year					
	Fourth Year					
	GERMAN:					
	First Year					
	Second Year					
	Third Year					
	Fourth Year					
	SPANISH:					
	First Year					
	Second Year					
	MATHEMATICS:					
	Algebra, First Yr.					
	Algebra, Second Yr.				34	
	Geometry, Plane					
	Geometry, Solid					
	Trigonometry					
	PHYSICS Lec.					
	PHYSICS Lab.					
	CHEMISTRY Lec.					
	CHEMISTRY Lab.				33	
	BIOLOGY Lec.					
	BIOLOGY Lab.					
	ADV. BIOLOGY Lec.					
	ADV. BIOLOGY Lab.					
	BOTANY Lec.					
	BOTANY Lab.					
	ZOOLOGY Lec.					
	ZOOLOGY Lab.					
	GEOLOGY Lec.					
	GEOLOGY Lab.					
	PHYSIOLOGY Lec.					
	PHYSIOLOGY Lab.					
	HISTORY:					
	Ancient					
	World					
	European					
	United States					
	English					
	ECONOMICS:					
	AMERICAN GOV'T.:					
	GEOGRAPHY:					
	SOCIOLOGY:					
	CIVICS:					
	SOCIAL PROBLEMS:					

Unit Value	STUDIES	Year Taken (I. II. III. IV)	No. of Weeks Pursued	No. of Hours Per Week	Grades	
					School	Regents
	*AGRICULTURE:					
	*HOME ECONOMICS:					
	*COMM'L WORK:					
	*INDUSTRIAL					
	*MUSIC					
	*OTHER STUDIES ACCEPTED TOWARD GRADUATION					
	*OTHER STUDIES NOT ACCEPTED TOWARD GRADUATION					

Unit Value	STUDIES NOW IN PROGRESS	No. of Hours Per Week	STUDIES FAILED	Year When Failed

Passing grade of school_____

Grading system (give numerical equivalents of letters, when letters are used.)

_____

_____

Length of Recitation Period_____

Length of Laboratory Period_____

Specify by (PG) any subjects taken subsequent to graduation.

*Mark (L) any studies occupying double periods.

The entire blank must be sent directly to the College Registrar by the official who signs it.

(Do not write in this space)

Curriculum desired ☐ Degree Curriculum ☐ Two Year Terminal ☐ One Year Terminal

GROUP: English Speech Journ. Dramatics

GROUP: Latin French German Spanish

GROUP: Algebra Pl. Geom. Sol. Geom. Trig.

GROUP: Physics Chem. Biology Botany Zool. Geol. Physiol. Gen. Sci.

GROUP: History Econ. Am. Govt. Geog. Social. Civ. Social Prob.

Acad. Cr.

GROUP: Agricult. Home Ec. Com'l Indust. Music Misc. Total

Conditions or deficiencies Check 27, 28, 29.

Tot. Cr.

Transcript(s) received from

Admission O.K.
Signature Date

Remarks:

$$\frac{\text{Total credit points}}{\text{Total half units}} = \text{Grade point average}$$

HIGH SCHOOL REQUIREMENTS FOR ADMISSION

The requirements for admission are stated in terms of units; a unit meaning a subject pursued through a school year with not less than five recitation periods each week.

TO BASIC COLLEGE

I. **For graduates from accredited high schools:**

1. **A satisfactory high school record. This means meeting the "college recommending grade," as designated by the high school.**
2. **A minimum of fifteen units. Three or more units must be in English; and seven units (six units if 4 units of English are presented) chosen from three of the following groups: foreign languages, mathematics, sciences, and social studies. Three additional units either from the subjects just mentioned or from vocational studies, such as agriculture, home economics, commercial or industrial, are required. (Music may be presented in place of vocational studies for those who expect to specialize in music). The other units presented may be from any other subjects accepted by the high school toward graduation.**
3. **Satisfactory recommendation from the high school principal or other proper administrative officer as to attitudes, habits, emotional stability, general conduct, character, ability and capacity, to indicate that the candidate will make a suitable college student.**

II. **For those not qualified for admission under the terms of I:**

1. **The applicant must have passed his eighteenth birthday except in the case of high school graduates.**
2. **Entrance examinations from the following areas will be required:**
   a. **Communications (English and Speech)**
   b. **Biological Science**
   c. **Physical Science (including mathematics)**
   d. **History and Social Studies**
   e. **Literature and Fine Arts**

   The Board of Examiners will determine which of these examinations will be required.
3. **The results of the entrance examinations, the applicant's previous record (scholastic and experience) and results of intelligence and aptitudes tests will be used by the Board of Examiners in judging the candidate for admission.**

TO THE SCHOOLS

For those students who plan to continue their education for a Bachelor's Degree, individual curricula specify, in addition to admission to the Basic College, the following minimum requirements:

SCHOOL	MINIMUM REQUIREMENTS
Agriculture	1 unit Algebra 1 unit Plane Geometry
Business and Public Service—	
Business Administration, Hotel Administration, and Public Administration	1 unit Algebra 1 unit Plane Geometry
Police Administration	Be qualified to pass physical examination for advanced R.O.T.C.
Engineering (*Including Agricultural*)	1½ units Algebra 1 unit Plane Geometry ½ unit Trigonometry 2 units Science: 1 unit Physics 1 unit Laboratory Science from High School or Physical Science (Basic 131, 132, 133) at M.S.C.
Home Economics	2 units Math. or Science or 1 unit Math. and 1 unit Sci.
Science and Arts—	
Biological and Physical Sciences, including Pre-medical and Pre-dental	1 unit Algebra 1 unit Plane Geometry
Veterinary Medicine	no additional requirements
Other Curricula (p-2)	no additional requirements

A STUDENT WHO ENTERS WITH DEFICIENCIES IN REQUIRED WORK MUST MAKE UP SIX COLLEGE CREDITS FOR EACH SUCH UNIT BEFORE BEGINNING THE SOPHOMORE YEAR.

Appendix B — Section 2 — 138.

1

MICHIGAN STATE COLLEGE
STUDENT'S RECORD

STUDENT NUMBER 3

CULUM

T OR GUARDIAN:

MAJOR

MATRICULATED 4
DATE OF BIRTH 2
BIRTHPLACE
SOCIETY AFFILIATION

HONORS

TRANSCRIPTS ISSUED

☐ SENIOR STATEMENT MADE

DEGREE

GRAD. FROM 31

ENGLISH	CHEMISTRY	33	CIVICS
SPEECH	BIOLOGY		SOC. PROBL.
JOURNALISM	BOTANY		AGRICULTURE
DRAMATICS	ZOOLOGY		HOME ECON.
LATIN	GEOLOGY		COMMERCIAL
FRENCH	PHYSIOLOGY		INDUSTRIAL
GERMAN	GENERAL SCI.		MUSIC
SPANISH	HISTORY		MISC.
ALGEBRA	ECONOMICS		
GEOMETRY	GOVERNMENT		
TRIGONOMETRY 34	GEOGRAPHY		
PHYSICS	SOCIOLOGY		

DEFICIENCIES: 26 - 29

COURSES	Term Grades 1st	2nd	3rd	Comp. Exam Gr.	Date	Adjusted Cr.	Pt.
and Spoken Engl							
al Science							
Science							
cience							
e Living							
of Civilization							
Fine Arts							

CR	GR	PT	CR	GR	PT	CR	GR	PT
	42							

6 - 23

24

25

CR	GR	PT	CR	GR	PT	CR	GR	PT

STUDENT NUMBER CURRICULUM

STUDENT NUMBER

RANK IN H. S.
PSYCH. TEST

APPENDIX D INDIVIDUAL RECORD Section 3

Name 1 Age 2 Number 3

Date of Entry 4 Number of Terms 5

College Record

1st & 2nd terms	Remaining terms		1st & 2nd terms	Remaining terms	
6	12	Total Hours	18	21	Hours Failed
7	13	Honor Points			Ratio
8	14	Hours Engineering	19	22	Hours Failed
9	15	Honor Points			Ratio
10	16	Hours Science and Mathematics	20	23	Hours Failed
11	17	Honor Points			Ratio

Make up Work

Mathematics				Science			
Method of removal	Course	Grade	Term	Method of removal	Course	Grade	Term
	24				25		
		Ratio				Ratio	

Key:- M-Sub-College Work, N-College Credits & or-l u, O-Exam, P-by letter

Entering Deficiencies 26

27 Math

28 Science

29 Physics ( ) Check if special

High School Record

Science Units Average

Math Units Average

Total Units Average

Quartile

Psychological Examination 37 43

Part 1 38 Part 2 39

Decile 40

Transfer Credits

From

War Service Credit 42

41

APPENDIX E

INDEX OF SUBJECTS USED IN SECTIONS 24, 25 OF APPENDIX D-3 TO REMOVE DEFICIENCIES

Science

Physics Preparatory.

General Physics.

Physics 158, 168, 178, General Physics, does not require Calculus.

Physics Refresher.

Basic Physical Science 131, 132, 133.
One method to remove physics deficiency.

Physics 271, 272, 273.
Regular college physics course, never used for high school substitute, but sometimes taken without high school background courses. In such cases the information was recorded in the Individual Record sheet during this investigation.

Basic Biological Science 121, 122, 123.
Used to remove science deficiencies.

Botany 101, 203b.
Used occasionally.

Mathematics

Mathematics 90 - Plane geometry on a high school level.

Mathematics 100a - Second year high school algebra.

Mathematics 100b - Solid geometry.

Mathematics 100c - Algebra for Statistics. Second year high school algebra.

Mathematics 102 - Trigonometry.

APPENDIX F

CORRELATIONS MADE IN THIS STUDY

APPENDIX F

TABLE XII

CORRELATION OF FIRST AND SECOND TERM COLLEGE TOTAL GRADE POINT AVERAGE WITH HIGH SCHOOL GRADE POINT AVERAGE * DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
					1	6	26	48	36	31	22	10	6
					-4	-3	-2	-1	0	1	2	3	4
					-4	-18	-52	-48		31	44	30	24
					16	54	104	48		31	84	90	96
3.00 2.67	1	5	5	25							1		
2.66 2.34	2	4	8	32							2		
2.33 2.00	12	3	36	1.8			1	1	1		3	2	4
1.99 1.67	12	2	24	48				4	11	3	3	1	2
1.66 1.34	48	1	48	48		1	5	9	12	8	6	5	2
1.33 1.00	61	0				2	11	18	16	9	4	1	
.99 .67	27	-1	-27	27			5	7	3	8	3	1	
.66 .34	15	-2	-30	60		1	2	8	2	2			
.33 .00	6	-3	-18	54	1	1	2	1		1			
.00 -.33	1	-4	-4	16		1							
-.34 -.66	1	-5	-5	26					1				

$n = 186$

$\Sigma x = 7$

$\Sigma y = 37$

$\Sigma x^2 = 523$

$\Sigma y^2 = 443$

$\Sigma xy = 209$

$\Sigma \bar{x}^2 = 522.737$ $M_x = 1.512$ G.P.A. B.S.T.

$\Sigma \bar{x}\bar{y} = 207.609$ $M_y = 1.252$ G.P.A. Col. 1 & 2

$\Sigma y^2 = 435.64$ $r_{yx} = .435$

$\sigma_{\bar{x}} = .551$

$\sigma_{\bar{y}} = .5015$

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TABLE XIII

THE CORRELATION OF FIRST AND SECOND TERMS COLLEGE GRADE POINT AVERAGE WITH HIGH SCHOOL TOTAL GRADE POINT AVERAGE - NON-DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
						4	19	42	71	54	44	22	8
						-4	-3	-2	-1	0	1	2	3
						-16	-57	-84	-71		44	44	24
						64	171	168	71		44	88	72
3.00 2.67	5	5	15	75						1	1		1
2.66 2.34	13	4	52	208					2	4	4	2	1
2.33 2.00	21	3	63	189				3	4	3	4	4	3
1.99 1.67	41	2	82	164		1	1	3	9	7	13	5	2
1.66 1.34	58	1	58	58		1	3	4	19	13	12	6	
1.33 1.00	75	0				1	5	18	23	17	7	4	
.99 .67	33	-1	-33	33			6	6	10	7	2	1	1
.66 .34	14	-2	-28	52		1	2	5	3	2	1		
.33 .00	3	-3	-9	27				3					
.00 -.33	3	-4	-12	36			2		1				

$n = 264$ $\Sigma x^2 = 647$ $M_x = 1.68$ G.P.A., H.S.Total

$\Sigma x = -116$ $\Sigma xy = 292.6$ $M_y = 1.405$ G.P.A., Col. 1 & 2

$\Sigma y = 118$ $\Sigma y^2 = 712.1$ $r_{yx} = .432$

$\Sigma x^2 = 698$ $\sigma_x = .545$

$\Sigma xy = 210$ $\sigma_y = .555$

$\Sigma y^2 = 842$

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TABLE XIV

THE CORRELATION OF REMAINING TERMS COLLEGE TOTAL GRADE POINT AVERAGE WITH HIGH SCHOOL TOTAL GRADE POINT AVERAGE - DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
					1	5	24	43	36	30	23	9	6
					-4	-3	-2	-1	0	1	2	3	4
					-4	-15	-48	-43		30	46	27	24
					16	45	96	43		30	92	81	96
3.00 2.67	1	5	5	25							1		
2.66 2.34	3	4	12	48						1		1	1
2.33 2.00	14	3	42	126			1		4	3	2	2	2
1.99 1.67	29	2	58	116			1	6	5	4	8	4	1
1.66 1.34	31	1	31	31			6	9	5	6	4		1
1.33 1.00	50	0				1	6	11	9	13	7	2	1
.99 .67	18	-1	-18	18		1	3	6	5	2	1		
.66 .34	10	-2	-20	40				4	6				
.33 .00	7	-3	-21	63		2	1	3	1				
.00 -.33	6	-4	-24	96	1		2	1	1	1			
-.34 -.66	0	-5											
-.67 -1.00	8	-6	-48	288		1	4	3					

$n = 177$ $\quad \Sigma \bar{x}^2 = 497.729$ $\quad M_x = 1.528$ G.P.A., H.S.Total

$\Sigma x = 15$ $\quad \Sigma \bar{x}\bar{y} = 318.56$ $\quad M_y = 1.199$ G.P.A., Col. Rem.

$\Sigma y = 17$ $\quad \Sigma \bar{y}^2 = 849.369$ $\quad r_{yx} = .490$

$\Sigma x^2 = 499$ $\quad \sigma_x = .55$

$\Sigma xy = 320$ $\quad \sigma_y = .72$ $\quad y = .222 + .64\,x$

$\Sigma y^2 = 851$

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TABLE XV

THE CORRELATION OF REMAINING TERMS COLLEGE TOTAL GRADE POINT AVERAGE WITH HIGH SCHOOL TOTAL GRADE POINT AVERAGE. NON-DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
						3	19	42	70	54	45	22	8
					-4	-3	-2	-1	0	1	2	3	4
						-9	-38	-42		54	86	66	32
						27	76	42		54	172	132	128
3.00 2.67	6	4	24	96					2		2		2
2.66 2.34	12	3	36	108					3	2	1	4	2
2.33 2.00	21	2	42	84			1		3	7	5	4	1
1.99 1.67	36	1	36	36		1	4	5	10	8	8	2	
1.66 1.34	51	0					2	8	22	8	8	2	1
1.33 1.00	72	-1	-72	72			3	16	18	15	12	6	
.99 .67	32	-2	-84	128			2	7	6	8	7	2	
.66 .34	12	-3	-39	117		1	1	2	4	3		2	
.33 .00	10	-4	-40	160			3	4	1	2			
.00 -.33	1	-5	-5	25				1					
-.34 -.66	2	-6	-12	72			2						
-.67 -1.00	5	-7	-35	245		1	1	1	1	1			

$n = 261$ $\quad \Sigma\bar{x}^2 = 545.95$ $\quad M_x = 1.690$ G.P.A., H.S.Total

$\Sigma x = 149$ $\quad \Sigma xy = 284.62$ $\quad M_y = 1.335$ G.P.A., Col. Rem.

$\Sigma y = -129$ $\quad \Sigma y^2 = 1079.2$ $\quad r_{yx} = .3575$

$\Sigma x^2 = 631$ $\quad \sigma_x = .482$

$\Sigma xy = 211$ $\quad \sigma_y = .677$

$\Sigma y^2 = 1143$

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TABLE XVI

CORRELATION OF FIRST AND SECOND TERMS COLLEGE SCIENCE AND MATHEMATICS WITH HIGH SCHOOL MATHEMATICS GRADE POINT AVERAGES. DEFICIENT GROUP

Class	f	d	df	d f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
					10	13	11	49	16	23	30	14	21
					-4	-3	-2	-1	0	1	2	3	4
					-40	-39	-22	-49		23	60	42	84
					160	117	44	49		23	120	126	336
3.00 2.67	7	5	35	175				1			2	2	2
2.66 2.34	7	4	28	112					1		1	1	4
2.33 2.00	20	3	60	180	1	1		1	1	5	3	2	6
1.99 1.67	22	2	44	88	1			2	4	5	6	2	2
1.66 1.34	27	1	27	27		2	2	9		3	5	2	4
1.33 1.00	51	0			2	4	4	17	8	6	6	2	2
.99 .67	24	-1	-24	24	3	2	2	9	1	2	1	3	1
.66 .34	14	-2	-28	56	1		2	6	1		4		
.33 .00	13	-3	-39	117		4	1	4		2	2		
.00 -.33	1	-4	-4	16	1								
-.34 -.66	1	-5	-5	25	1								

$n = 187$ $\Sigma x^2 = 956.37$ $M_x = 1.6053$ G.P.A., H.S.Math.

$\Sigma x = 59$ $\Sigma xy = 402.33$ $M_y = 1.335$ G.P.A.,1 & 2 Col. Sc. & Math

$\Sigma y = 94$ $\Sigma y^2 = 772.7$ $r_{yx} = .468$

$\Sigma x^2 = 975$ $\sigma x = .811$ $y = .735 / .347x$

$\Sigma xy = 432$ $\sigma y = .647$

$\Sigma y^2 = 820$

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TABLE XVII

THE CORRELATION OF THE FIRST AND SECOND TERMS OF COLLEGE MATHEMATICS AND SCIENCE WITH HIGH SCHOOL MATHEMATICS. NON-DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.35	1.34 1.66	1.67 1.99	2.00 2.35	2.34 2.66	2.67 3.00
					6	7	18	42	32	46	59	27	27
					-4	-3	-2	-1	0	1	2	3	4
					-24	-21	-36	-42		46	118	81	112
					96	63	72	42		46	236	243	448
3.00 2.67	14	4	56	224				2	1		2	4	5
2.66 2.34	18	3	54	162				3	1	4	1	1	8
2.33 2.00	36	2	72	144				4	2	10	11	6	3
1.99 1.67	34	1	34	34		2	1	1	5	3	13	7	2
1.66 1.34	30	0			2	1	3	2	3	4	3	2	5
1.33 1.00	67	-1	-67	67	3	1	4	14	8	14	15	5	4
.99 .67	21	-2	-42	84			5	6	5	2	2	1	
.66 .34	13	-3	-39	117	1			1	3	3	5		
.33 .00	19	-4	-76	304		3	3	6	2	3	1	1	1
.00 -.33	8	-5	-40	200				4	1	2	1		
-.34 -.66	3	-6	-18	108					2	1			
-.67 -1.00	2	-7	-14	96			2						

n = 265	Σx^2 = 1039.5	M_x = 1.7945	G.P.A., H.S. Math	
Σx = 234	Σxy = 500.6	M_y = 1.3994	G.P.A., 1 & 2 Col. Sc. & Math	
Σy = -80	Σy^2 = 1505.84	r_{yx} = .4005		
Σx^2 = 1246	σ_x = .658			
Σxy = 430	σ_y = .794			
Σy^2 = 1530				

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TABLE XVIII

THE CORRELATION OF REMAINING TERMS OF COLLEGE SCIENCE AND MATHEMATICS WITH HIGH SCHOOL MATHEMATICS GRADE POINT AVERAGES. DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.35	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
					11	11	11	48	15	23	31	14	18
					-4	-3	-2	-1	0	1	2	3	4
					-44	-33	-22	-48		23	62	42	72
					176	99	44	48		23	124	126	288
3.00 2.67	3	5	15	75					1		1	1	
2.66 2.34	11	4	44	176				2	1	2		1	5
2.33 2.00	17	3	51	153				3		3	5	3	3
1.99 1.67	12	2	24	48			2	2		1	2		5
1.66 1.34	24	1	24	24	1	1		6	2	2	9	1	2
1.33 1.00	64	0			4	6	3	16	6	12	8	8	1
.99 .67	14	-1	-14	14	2	1	1	4	1		4		1
.66 .34	14	-2	-28	56	2		2	4	3	1	1		1
.33 .00	10	-3	-30	90	1			5	1	2	1		
.00 -.33	1	-4	-4	16				1					
-.34 -.66	5	-5	-25	125		1	1	3					
-.67 -1.00	7	-6	-42	252	1	2	2	2					

$n = 182$ $\quad \Sigma x^2 = 913.15$ $\quad M_x = 1.5953$ G.P.A., H.S. Math

$\Sigma x = 52$ $\quad \Sigma xy = 459.72$ $\quad M_y = 1.1945$ G.P.A., Col. Sc. & Math.

$\Sigma y = 15$ $\quad \Sigma y^2 = 1027.76$

$\Sigma x^2 = 928$ $\quad \sigma_x = .6275$ $\quad r_{yx} = .464$

$\Sigma xy = 444$ $\quad \sigma_y = .665$

$\Sigma y^2 = 1029$

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TABLE XIX

THE CORRELATION OF REMAINING TERMS OF COLLEGE SCIENCE AND MATHEMATICS WITH HIGH SCHOOL MATHEMATICS GRADE POINT AVERAGES. NON-DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
					5	8	17	39	31	50	33	28	27
					-4	-3	-2	-1	0	1	2	3	4
					-20	-24	-34	-39		50	106	84	108
					80	72	68	39		50	212	242	432
3.00 2.67	10	4	40	160						1	4	2	3
2.66 2.34	15	3	45	135			1	1	2	1	3	2	5
2.33 2.00	32	2	64	128	1		3	5	3	7	5	2	6
1.99 1.67	16	1	16	16				2	1	4	4	3	2
1.66 1.34	36	0				2	1	5	5	7	6	6	4
1.33 1.00	65	-1	-65	65		3	5	12	8	12	14	6	5
.99 .67	22	-2	-44	88		1	1	3	4	6	3	3	1
.66 .34	37	-3	-111	333	2	1	3	5	4	10	10	2	
.35 .00	15	-4	-60	240		1	1	3	3	2	4	1	
.00 -.33	4	-5	-20	100	1			2				1	
-.34 -.66	0	-6	0										
-.67 -1.00	6	-7	-42	294	1		2	1	1				1

$n = 258$ $\quad \Sigma x^2 = 998.2$ $\quad M_x = 1.7961$ G.P.A., H.S.Math.

$\Sigma x = 251$ $\quad \Sigma xy = 556.6$ $\quad M_y = 1.2716$ G.P.A. Rem. Col Sc. & Math.

$\Sigma y = -177$ $\quad \Sigma y^2 = 1437.6$ $\quad r_{yz} = .297$

$\Sigma x^2 = 1205$ $\quad \sigma_x = .655$

$\Sigma xy = 198$ $\quad \sigma_y = .786$

$\Sigma y^2 = 1559$

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TABLE XX

THE CORRELATION OF REMAINING TERMS SCIENCE, MATHEMATICS AND ENGINEERING COLLEGE TOTAL GRADE POINT AVERAGE WITH HIGH SCHOOL TOTAL GRADE POINT AVERAGE DEFICIENT GROUP

Class	f	d	df	d f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
					1	5	26	45	54	29	23	8	6
					-4	-3	-2	-1	0	1	2	3	4
					-4	-15	-48	-45		30	46	27	24
					16	45	96	45		30	92	81	96
5.00 2.67	1	4	4	16							1		
2.66 2.34	6	3	18	54				1	1	1	1	2	
2.33 2.00	17	2	34	68			2	1	2	3	5		4
1.99 1.67	14	1	14	14				3	4		2	3	2
1.66 1.34	26	0					3	7	4	6	5	1	
1.33 1.00	62	-1	-62	62		1	10	14	15	13	8	1	
.99 .67	18	-2	-36	72		2	2	7	2	4		1	
.66 .34	14	-3	-42	126		1	3	5	3	1	1		
.33 .00	7	-4	-28	112	1		1	2	3				
.00 -.33	2	-5	-10	50			1	1					
-.34 -.66	4	-6	-24	144			3	1					
-.67 -1.00	6	-7	-42	294		1	1	3		1			

$n = 177$ $\quad \Sigma x^2 = 498.723$ $\quad M_x = 1.5132$ G.P.A., H.S.T.

$\Sigma x = 7$ $\quad \Sigma xy = 300.88$ $\quad M_y = 1.173$ G.P.A., COL.R.

$\Sigma y = -174$ $\quad \Sigma y^2 = 941.00$ $\quad r_{yx} = .438$

$\Sigma x^2 = 499$ $\quad \sigma_x = .570$

$\Sigma xy = 294$ $\quad \sigma_y = .785$

$\Sigma y^2 = 1112$

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TABLE XXI

THE CORRELATION OF THE REMAINING TERMS COLLEGE SCIENCE, MATHEMATICS AND ENGINEERING TOTAL GRADE POINT AVERAGE WITH HIGH SCHOOL TOTAL GRADE POINT AVERAGE — NON-DEFICIENT GROUP

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 5.00
					0	4	17	43	68	53	41	23	9
					-4	-3	-2	-1	0	1	2	3	4
						-9	-38	-42		54	86	66	32
						27	76	42		54	172	132	128
3.00 2.67	6	4	24	96					2		2		2
2.66 2.34	9	3	27	81					3		1	3	2
2.33 2.00	38	2	76	152		1	1	4	6	10	10	5	1
1.99 1.67	15	1	15	15					6	4	3	1	1
1.66 1.34	45	0				1	3	9	15	9	5	3	
1.33 1.00	70	-1	-70	70			5	12	20	12	11	7	3
.99 .67	38	-2	-66	132			1	5	10	10	5	2	
.66 .34	25	-3	-75	225			3	8	5	5	3	1	
.33 .00	13	-4	-52	208		2	3	2	1	3	1	1	
.00 -.33	1	-5	-5	25			1						
-.34 -.66	3	-6	-18	108				3					

$n = 258$ $\quad \Sigma x^2 = 626.6$ $\quad M_x = 1.695$ G.P.A., H.S.T.

$\Sigma x = 151$ $\quad \Sigma xy = 255.3$ $\quad M_y = 1.514$ GPP.A., Col.R.

$\Sigma y = -144$ $\quad \Sigma y^2 = 1051.55$ $\quad r_{yx} = .3175$

$\Sigma x^2 = 715$ $\quad \sigma x = .518$

$\Sigma xy = 171$ $\quad \sigma y = .667$

$\Sigma y^2 = 1112$

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TABLE XXII

THE CORRELATION OF HIGH SCHOOL TOTAL GRADE POINT AVERAGE WITH THE A. C. E. PSYCHOLOGICAL EXAMINATION SCORE RANKS. DEFICIENT GROUP

Class	f	d	df	d^2f	1	2	3	4	5	6	7	8	9	10
	f				4	4	13	25	20	25	22	19	19	29
		d			-6	-5	-4	-3	-2	-1	0	1	2	3
			df		- 4	-20	-52	-69	-40	-25		19	38	87
				d^2f	144	100	208	207	80	25		19	76	261
3.00 2.67	6	4	24	96					1		1		3	1
2.66 2.34	9	3	27	81		1		1		2		1	1	3
2.33 2.00	23	2	46	92	1		4	1	2	3	3		2	7
1.99 1.67	27	1	27	27	2	1	2	3	2	3	3	3	4	4
1.66 1.34	33	0					2	7	3	6	3	6	3	3
1.33 1.00	47	-1	-47	47	1	2	3	3	5	8	7	6	3	9
.99 .67	26	-2	-52	104			1	7	5	8	4	3	2	2
.66 .34	6	-3	-18	54			1	1	1	1	1		1	
.33 .00	1	-4	-4	16					1					

$n = 178$ $\Sigma x^2 = 1078.5$ $M_x = 7.017$ C.F. $= \sqrt{\frac{\Pi}{3}}$

$\Sigma x = -86$ $\Sigma xy = 99.45$ $M_y = 1.505$

$\Sigma y = 3$ $\Sigma y^2 = 516.95$ $r_{yx} = .1333$

$\Sigma x^2 = 1120$ $\sigma_x = 2.46$ r_{yx} corrected $= .1362$

$\Sigma y^2 = 517$ $\sigma_y = .567$

$\Sigma xy = 98$

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TABLE XXIII

THE CORRELATION OF HIGH SCHOOL TOTAL GRADE POINT AVERAGE WITH THE A. C. E. PSYCHOLOGICAL EXAMINATION SCORE RANKS. NON-DEFICIENT GROUP

Class					1	2	3	4	5	6	7	8	9	10
	f				6	10	15	24	25	23	28	37	36	54
		d			-6	-5	-4	-3	-2	-1	0	1	2	3
			df		-56	-50	-60	-72	-50	-23		37	72	162
				d^2f	216	250	240	216	100	23		37	144	486
3.00 2.67	8	4	32	128						1		1	1	5
2.66 2.34	21	3	63	189		1	1		1		4	4	2	8
2.33 2.00	43	2	86	172				2	4	6	5	5	11	10
1.99 1.67	53	1	55	55	2	6		6	6	3	5	7	9	9
1.66 1.34	70	0			3		4	7	6	7	8	11	9	14
1.33 1.00	41	-1	-41	41	1	1	3	6	5	4	5	7	2	7
.99 .67	18	-2	-36	72		2	5	3	2	1		2	2	1
.66 .34	4	-3	-12	36			2		1	1				
.33 .00		-4												

$n = 258$ $\quad \Sigma\bar{x}^2 = 1710.45$ $\quad M_x = 7.4225$

$\Sigma x = -20$ $\quad \Sigma\bar{x}\bar{y} = 319.23$ $\quad M_y = 1.6873$ G.P.A., H.S.T.

$\Sigma y = 145$ $\quad \Sigma\bar{y}^2 = 609.5$ $\quad r_{yx} = .313$

$\Sigma x^2 = 1712$ $\quad \sigma_{\bar{x}} = 2.57$ $\quad$ Corrected = .320

$\Sigma xy = 308$ $\quad \sigma_{\bar{y}} = .512$

$\Sigma y^2 = 691$

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TABLE XXIV

THE CORRELATION OF HIGH SCHOOL MATHEMATICS GRADE POINT AVERAGE WITH THE PSYCHOLOGICAL "Y" SCORE DECILE. DEFICIENT GROUP

Class					1	2	3	4	5	6	7	8	9	10
	f				2	6	9	21	20	13	14	27	31	40
		d			-6	-5	-4	-3	-2	-1	0	1	2	3
			df		-12	-30	-36	-65	-40	-13	27	27	62	120
				d^2f	72	150	144	189	80	13		27	124	360
3.00 2.67	21	4	84	336				3	2	2	2	1	2	9
2.66 2.34	14	3	42	126	1				2	1		3	2	5
2.33 2.00	30	2	60	120		2	3	4	1	2	1	5	6	6
1.99 1.67	22	1	22	22			1	1	1	2	1	4	6	6
1.66 1.34	14	0					1	3		1		3	3	3
1.33 1.00	48	-1	-48	48	1	3	3	6	5	3	9	6	6	6
.99 .67	12	-2	-24	48				2	2		1	3	1	3
.66 .34	11	-3	-33	99		1		1	4	1		1	2	1
.33 .00	11	-4	-44	176			1	1	3	1		1	3	1

$n = 183$ $\quad \Sigma x^2 = 1157.77$ $\quad M_x = 7.582$

$\Sigma x = 15$ $\quad \Sigma xy = 167.17$ $\quad M_y = 1.607$ G.P.A.,H.S.Math

$\Sigma y = 59$ $\quad \Sigma y^2 = 955.91$ $\quad r_{yx} = .105$

$\Sigma x^2 = 1159$ $\quad$ Corrected = .1073

$\Sigma xy = 181$

$\Sigma y^2 = 975$

APPENDIX F

TABLE XXV

THE CORRELATION OF HIGH SCHOOL MATHEMATICS GRADE POINT AVERAGE WITH THE PSYCHOLOGICAL "Q" SCORE. NON-DEFICIENT GROUP

Class					1	2	3	4	5	6	7	8	9	10
	f				5	7	10	13	19	16	26	25	42	75
		d			-6	-5	-4	-3	-2	-1	0	1	2	3
			df		-30	-35	-40	-39	-38	-16		25	84	225
				d^2f	180	175	160	117	76	16		25	168	675
3.00 2.67	23	4	92	368						1	1	4	5	12
2.66 2.34	24	3	75	225		1	1			3	6	1		13
2.33 2.00	51	2	102	204	1			1	4	4	6	4	12	19
1.99 1.67	42	1	42	42	1		4	1	3	3	7	4	6	13
1.66 1.34	31	0			1	1		2	4	2	3	5	4	9
1.33 1.00	39	-1	-39	39	2	2	4	6	4	2	2	4	7	6
.99 .67	15	-2	-30	60		2	1	1	1		1	2	4	3
.66 .34	7	-3	-21	63		1			2			1	3	
.33 .00	5	-4	-0	80				2	1	1			1	

$n = 238$ $\Sigma x^2 = 1514.3$ $M_x = 8.072$ [illegible] rank

$\Sigma x = 136$ $\Sigma xy = 378.1$ $M_y = 1.7815$ Average high school mathematics

$\Sigma y = 201$ $\Sigma y^2 = 911.2$

$\Sigma x^2 = 1592$ $\sigma_x = .840$ $r_{yx} = .322$

$\Sigma xy = 493$ $\sigma_y = .652$ Corrected = .330

$\Sigma y^2 = 1081$

APPENDIX F

TABLE XXVI

THE COORELATION OF COLLEGE FIRST AND SECOND TERM GRADE POINT AVERAGE WITH THE A.C.E. PSYCHOLOGICAL EXAMINATION RANKS. DEFICIENT GROUP

Class					1	2	3	4	5	6	7	8	9	10
	f				1	5	16	26	22	27	22	21	22	28
		d			-6	-5	-4	-3	-2	-1	0	1	2	3
			df		-6	-25	-64	-78	-44	-27	0	21	44	84
				d^2f	36	125	256	234	88	27		21	88	252
3.00 2.67	1	5	5	25										1
2.66 2.34	2	4	8	32									1	1
2.33 2.00	12	3	36	108			1		1	1	1		3	5
1.99 1.67	11	2	22	44			1		1		1		1	7
1.66 1.34	49	1	49	49		1	6	8	7	7	5	5	6	4
1.33 1.00	60	0			1	1	3	10	5	9	9	11	6	5
.99 .67	28	-1	-28	26		2	3	3	1	3	4	3	3	5
.66 .34	14	-2	-28	56		1	2	3	4	1	1		2	
.33 .00	5	-3	-15	45				1	1	1		2		
.00 -.33	3	-4	-12	48				1	2					

$n = 185$ $\quad \Sigma x^2 = 1076.25$ $\quad M_x = 6.987$

$\Sigma x = -95$ $\quad \Sigma xy = 159.5$ $\quad M = 1.252$ G.P.A., 1 & 2 Col. T.

$\Sigma y = 36$ $\quad \Sigma y^2 = 428.00$ $\quad r_{yx} = .235$

$\Sigma x^2 = 1124$ $\quad \sigma x = 2.279$ $\quad$ Corrected $= .2405$

$\Sigma xy = 141$ $\quad \sigma y = .4982$

$\Sigma y^2 = 435$

APPENDIX F

TABLE XXVII

THE CORRELATION OF COLLEGE FIRST AND SECOND TERM GRADE POINT AVERAGE WITH THE A.C.E. PSYCHOLOGICAL EXAMINATION RANKS. NON-DEFICIENT GROUP

Class					1	2	3	4	5	6	7	8	9	10
	f				6	10	15	24	25	23	28	37	36	54
		d			-8	-5	-4	-3	-2	-1	0	1	2	3
			df		-36	-50	-60	-72	-50	-23		37	72	162
				d^2f	216	250	240	216	100	23		37	144	486
3.00 2.67	2	4	8	32										2
2.66 2.34	13	3	39	117					1		1		3	8
2.33 2.00	20	2	40	80			1			1		5	6	7
1.99 1.67	38	1	38	38				2	1	6	5	7	4	13
1.66 1.34	54	0			1	1	3	9	7	1	5	7	9	11
1.33 1.00	77	-1	-77	77	2	4	3	8	9	8	10	10	10	12
.99 .67	32	-2	-64	128	1	2	5	3	4	5	6	5	1	1
.66 .34	15	-3	-45	135	2	2	2	1	2	2		3	1	
.33 .00	3	-4	-12	46		1		1					1	

$n = 258$

$\Sigma x = -20$

$\Sigma y = -88$

$\Sigma x^2 = 1712$

$\Sigma xy = 482$

$\Sigma y^2 = 728$

$\Sigma x^2 = 1710.45$

$\Sigma xy = 475.175$

$\Sigma \bar{y}^2 = 725.0$

$\sigma_{\bar{x}} = 2.57$

$\sigma_{\bar{y}} = .568$

$M_x = 7.4225$ [illegible]

$M_y = 1.3863$ G.P.A., 1 & 2 Col. T.

$r_{yx} = .427$

Corrected = .437

APPENDIX F

TABLE XXVIII

THE CORRELATION OF THE REMAINING COLLEGE TERMS GRADE POINT AVERAGE WITH THE A.C.E. PSYCHOLOGICAL EXAMINATION RANKS. DEFICIENT GROUP

Class					1	2	3	4	5	6	7	8	9	10
	f				4	4	13	24	18	26	21	19	19	29
		d			-6	-5	-4	-3	-2	-1	0	1	2	3
			df		-24	-20	-52	-72	-36	-26		19	38	87
				d^2f	144	100	208	216	72	26		19	76	261
3.00 2.67	1	4	4	16										1
2.66 2.34	3	3	9	27					1				1	1
2.33 2.00	16	2	32	64		1		4	2	1		1	2	5
1.99 1.67	28	1	28	28	1		2	1	4	4		2	6	8
1.66 1.34	28	0					3	3	1	5	4	3	5	4
1.33 1.00	50	-1	-50	50	1	1	4	8	2	6	9	8	2	9
.99 .67	16	-2	-32	64	2		1	1	2	6	2		1	1
.66 .34	12	-3	-36	108		1		1	1	2	3	4		
.33 .00	9	-4	-36	144			1	2	4		1		1	
.00 -.33	6	-5	-30	160				1	1	2	1		1	
-.34 -.66	0	-6												
-.67 -.99	8	-7	-56	392		1	2	3			1	1		

$n = 177$ $\quad \Sigma x^2 = 1080.2$ $\quad M_x = 7.013$

$\Sigma x = -86$ $\quad \Sigma \bar{x}\bar{y} = 274.8$ $\quad M_y = 1.1855$ G.P.A.,Col. Rem. T.

$\Sigma y = -167$ $\quad \Sigma \bar{y}^2 = 885.5$ $\quad r_{yx} = .281$

$\Sigma x^2 = 1122$ $\quad \sigma_x = 2.466$ $\quad$ Corrected = .2878

$\Sigma xy = 356$ $\quad \sigma_y = .745$

$\Sigma y^2 = 1043$

APPENDIX F

TABLE XXIX

THE CORRELATION OF THE REMAINING COLLEGE TERMS GRADE POINT AVERAGE WITH THE A.C.E. PSYCHOLOGICAL EXAMINATION RANKS. NON-DEFICIENT GROUP

Class					1	2	3	4	5	6	7	8	9	10
	f				6	10	15	24	25	22	28	35	35	54
		d			-6	-5	-4	-3	-2	-1	0	1	2	3
			df		-36	-50	-60	-72	-50	-22		35	70	162
				d^2f	216	250	240	216	100	22		35	140	486
3.00 2.67	4	4	16	64								1	2	1
2.66 2.34	12	3	36	108						1	1	2	2	6
2.33 2.00	21	2	42	84			1	1		3	5	2	3	6
1.99 1.67	35	1	35	35		1	1	3	1	3	2	7	7	10
1.66 1.34	50	0			1		2	8	7	5	5	9	6	7
1.33 1.00	72	-1	-72	72	2	5	5	4	7	6	6	7	9	19
.99 .67	30	-2	-60	120		3	1	5	2	1	7	2	6	3
.66 .34	13	-3	-39	117	1		3		3	2	2	1		1
.33 .00	9	-4	36	144	1		1	3		1		2		1
.00 -.33	1	-5	-5	25								1		
-.34 -.66	2	-6	-12	72			1		1					
-.67 -.99	5	-7	-35	245	1	1			3					

$n = 254$ $\quad \Sigma x^2 = 1704.355$ $\quad M_x = 7.4488$

$\Sigma x = -13$ $\quad \Sigma xy = 471.35$ $\quad M_y = 1.329$ G.P.A.

$\Sigma y = -130$ $\quad \Sigma y^2 = 1019.5$ $\quad r_{yx} = .354$

$\Sigma x^2 = 1705$ $\quad \sigma_x = 2.59$ $\quad$ Corrected = .362

$\Sigma xy = 478$ $\quad \sigma_y = .6745$

$\Sigma y^2 = 1086$

APPENDIX F

TABLE XXX

THE CORRELATION OF HIGH SCHOOL MATHEMATICS WITH HIGH SCHOOL SCIENCE GRADE POINT AVERAGES. NON-DEFICIENT

Class	f	d	df	d^2f	0 .33	.34 .66	.67 .99	1.00 1.33	1.34 1.66	1.67 1.99	2.00 2.33	2.34 2.66	2.67 3.00
					3	7	8	64	29	40	66	12	35
					-4	-3	-2	-1	0	1	2	3	4
					-12	-21	-16	-64		40	132	36	140
					48	63	32	64		40	264	108	560
3.00 2.67	28	4	112	448					1	2	5	5	10
2.66 2.34	27	5	81	243				2	1	4	13	1	6
2.33 2.00	60	2	120	240		2		9	6	9	21	3	9
1.99 1.67	44	1	44	44				11	7	10	12	1	4
1.66 1.34	34	0					1	15	5	8	3	1	1
1.33 1.00	42	-1	-42	42	1	2	3	15	6	4	9	1	
.99 .67	17	-2	-34	68	1	2	1	9	2	2			
.66 .34	7	-3	-21	63		1	2	1			3		
.33 .00	5	-4	-20	80	1		1	1	1	1			
.00													

$n = 264$ $\quad \Sigma x^2 = 969.8$

$\Sigma x = 235$ $\quad \Sigma \dot{x}\dot{y} = 578.5$

$\Sigma y = 240$ $\quad \Sigma y^2 = 1009.9$ $\quad r_{yx} = .586$

$\Sigma x^2 = 1179$

$\Sigma xy = 792$

$\Sigma y^2 = 1228$

APPENDIX F-2

An estimate of the multiple correlation between the remaining terms college total grade point average with the A.C.E. psychological test score rank and the high school total grade point average.

$$R_{y.xz} = \sqrt{\frac{r_{yx}^2 - 2r_{yx}r_{xz}r_{yz} \not + r_{xy}^2}{1 - r_{xz}^2}}$$ *

Let: y = the remaining college total grade point average.

x = the psychological test score rank.

z = the high school total grade point average.

The deficient Group:

$$R_{y.xz} = \sqrt{\frac{.288^2 - 2 \times .288 \times .490 \times .136 \not + .490^2}{1 - .136^2}}$$

$$= .538$$

The non-deficient group:

$$R_{y.xz} = \sqrt{\frac{.362^2 - 2 \times .362 \times .320 \times .358 \not + .358^2}{1 - .320^2}}$$

$$= .444$$

Where the linear correlation coefficients are:

	deficient	non-deficient
r_{yx}	.288	.362
r_{xz}	.136	.320
r_{yz}	.490	.357

*William Dowell Baten, Elementary Mathematical Statistics, (New York: John Wiley and Sons, Inc., 1928), p. 187.

APPENDIX G
Section 1.
TABLE XXXI

THE ANALYSIS OF COVARIANCE OF HIGH SCHOOL TOTAL AND COLLEGE FIRST AND SECOND TERMS TOTAL BETWEEN THE DEFICIENT AND NON-DEFICIENT GROUPS

		High School Total			College 1st & 2nd Terms Total								
		x_1			x_2			y_1			y_2		
Class Mark	d	f	df	d^2f	f	df	d^2f	f	df	d^2f	f	df	d^2f
2.833	4	6	24	96	8	32	128	1	4	16	3	12	48
2.500	3	10	30	90	22	66	198	2	6	18	13	39	117
2.167	2	22	44	84	44	88	176	12	24	48	21	42	84
1.833	1	31	31	31	54	54	54	12	12	12	41	41	41
1.500	0	36			71			48			58		
1.167	-1	48	-48	48	42	-42	42	61	-61	61	75	-75	75
.833	-2	26	-52	104	19	-38	76	27	-54	108	33	-66	132
.500	-3	6	-18	54	4	-12	36	15	-45	135	14	-42	126
.167	-4	1	-4	16				6	-24	96	3	-12	48
-.167	-5							1	-5	25	3	-15	75
-.500	-6							1	-6	36			
Totals		186	7	523	264	148	710	186	-149	555	264	-76	746
Mean Grade Points		1.5125			1.6869			1.233			1.404		

(1) Deficient group. $\Sigma x_1y_1 = 186.$ $\Sigma x_2y_2 = 250.$

(2) Non-deficient group

$n = 450$
$\Sigma x = 155$
$\Sigma y = 225$
$\Sigma x^2 = 1233$
$\Sigma xy = 436$
$\Sigma y^2 = 1301$

C. F. x = 53.389
C. F. xy = -77.500
C. F. y = 112.5

TABLE XXXII

ANALYSIS OF THE VARIANCE AND COVARIANCE OF TABLE XXXI AND A TEST OF SIGNIFICANCE

Source of Variance	D.F.	Σx^2	Σxy	Σy^2	$\Sigma(y - Y)^2$	D.F.	Red. Var.
Total	449	1179.61	513.5	1188.50			
Between Groups	1	39.95	29.28	28.39			
Within Groups (error)	448	1149.76	484.21	1159.61	955.78	447	2.14
Between groups plus error					964.50	448	
Difference for testing					8.72	1	8.72

$F = \frac{8.72}{2.14} = 4.07$ significant at the 5% level.

$r_{xy} = .418$ for error. $t = 9.75$ t = for 1 and 448 degrees of freedon.

$b_{yx} = .421$

Correcting college grade point averages for differences in high school abilities.

$Y = \bar{y}i - b_{yx}(xi - \bar{x})$

$Y_1 = 1.26975$ corrected mean for deficient college grades.

$Y_2 = 1.36725$ corrected mean for non-deficient college grades.

Difference of means = .09750

S. E. of the difference of these means $= \frac{1}{3}\sqrt{2.14\left(\frac{1}{186} + \frac{1}{264} + \frac{(.1744)^2}{1149.8}\right)}$ *

$= \frac{.140}{3}$

$t = \frac{.09750}{.140/3} = 2.085$ significant at 5% level.

*J. Wishart, "Tests of significance in analysis of covariance," Supplement to Journal Royal Statistical Society, 3:79-82, cited by, Harry H. Love, Experimental methods in Agricultural Research. (Rio Piedras, Puerto Rico: The Agricultural Experiment Station of the University of Puerto Rico, 1943.) p. 66.

APPENDIX G

TABLE XXXIII

THE ANALYSIS OF CO-VARIANCE OF HIGH SCHOOL MATHEMATICS GRADE POINT AVERAGE (x) AND COLLEGE FIRST AND SECOND TERMS SCIENCE AND MATHEMATICS GRADE POINT AVERAGE (y) BETWEEN THE DEFICIENT AND THE NON-DEFICIENT GROUPS

Group.	n	Σx	Σy	Σx^2	Σxy	Σy^2
Deficient	187	59	-93	975.	361.	819.
Non-deficient	265	234	-80	1246.	430.	1530.
Total	452	293	-173	2221.	791.	2349.
Correction factor				189.9314	-112.1438	66.2146
Total S. S.				2031.0686	903.1438	2282.7854

TABLE XXXIV

ANALYSIS OF THE CO-VARIANCE OF TABLE XXXIII AND A TEST OF SIGNIFICANCE

Source of variance	Degrees of freedom	Σx^2	Σxy	Σy^2	$\Sigma(y - Y)^2$	D.F.
Total	451	2031.0686	903.1438	2282.7854	1881.1896	450
Between G.	1	35.3099	4.1900	12.1601		
Within G. (E)	450	1995.7587	898.9538	2270.6253	1865.7127	449

TABLE XXXIV (continued)

THE REDUCED VARIANCE

Source of variance	$\Sigma(y - Y)^2$	D. F.	Reduced Variance	F
Total	1881.1896	450		
Within Groups, error	1865.7127	449	4.1552	3.7247
Difference for testing	15.4769	1	15.4769	

No significance. F at the 5% level and 450 degrees of freedom is 3.86.

APPENDIX G

TABLE XXXV

ANALYSIS OF CO-VARIANCE OF THE HIGH SCHOOL TOTAL GRADE POINT AVERAGE (x) AND COLLEGE FIRST AND SECOND TERMS ENGINEERING AND SCIENCE AND MATHEMATICS GRADE POINT AVERAGE (y) BETWEEN THE DEFICIENT AND THE NON-DEFICIENT GROUPS

Group	n	Σx	Σy	Σx^2	Σxy	Σy^2
Deficient	179	4	-119	516.	237.	729.
Non-deficient	264	148	-115	718.	336.	1191.
Total	443	152	-234	1234.	573.	1920.
Correction Factors				52.1534	-80.2889	123.6027
Total sum of Squares				1181.8466	653.2889	1796.3973

TABLE XXVI

ANALYSIS OF THE CO-VARIANCE OF TABLE XXXV AND A TEST OF SIGNIFICANCE

Source of Variance	Degrees of Freedom	Σx^2	Σxy	Σy^2	$\Sigma(y - Y)^2$	D. F.
Total	442	1181.8466	653.2889	1796.3973	1435.2791	441
Between G.	1	30.9056	13.1601	5.6036		
Within G. (E)	441	1150.9410	640.1288	1790.7937	1434.6678	440

TABLE XXXVI (continued)

THE REDUCED VARIANCE

Source of Variance	$\Sigma(y - Y)^2$	D.F.	Reduced Variance	F
Total	1435.2791	441		
Within Groups, error	1434.6678	440	3.260	5.33
Difference	.6113	1	.6113	

No significance. F at the 5% level and 450 degrees of freedom is 254.

APPENDIX G

TABLE XXXVII

THE ANALYSIS OF CO-VARIANCE OF HIGH SCHOOL TOTAL GRADE POINT AVERAGE AND COLLEGE REMAINING TERMS ENGINEERING AND MATHEMATICS AND SCIENCE BETWEEN THE DEFICIENT AND THE NON-DEFICIENT GROUPS.

		High School Total						College Remaining Terms Total Engineering and Mathematics and Science					
		x_1			x_2			y_1			y_2		
Class Mark	d	f	df	d^2f	f	df	d^2f	f	df	d^2f	f	df	d^2f
2.833	4	6	24	96	9	36	144	1	4	16	6	24	96
2.500	3	8	24	72	23	69	207	6	18	54	9	27	81
2.167	2	23	46	92	41	82	164	17	34	68	38	76	152
1.833	1	29	29	29	53	53	53	14	14	14	15	15	15
1.500	0	34			68			26			45		
1.167	-1	45	-45	45	45	-45	45	62	-62	62	70	-70	70
.833	-2	26	-52	104	17	-34	68	18	-36	72	33	-66	132
.500	-3	5	-15	45	4	12	36	14	-42	126	25	-75	225
.167	-4	1	-4	16				7	-28	112	13	-52	208
-.167	-5							2	-10	50	1	-5	25
-.500	-6							4	-24	144	3	-18	108
Totals		177	7	499	258	151	715	177	-174	1112	258	-144	1112
Mean Grade Points		1.5132			1.695			1.173			1.514		

(1) Deficient Group
(2) Non-deficient Group

$\Sigma x_1y_1 = 294.$ $\Sigma x_2y_2 = 171.$

$n = 435$ $\Sigma x^2 = 1214$ C.F. x = 57.3885

$\Sigma x = 158$ $\Sigma xy = 465$ C.F. xy = 115.5034

$\Sigma y = -318$ $\Sigma y^2 = 2224$ C.F. y = 232.4689

TABLE XXXVIII

ANALYSIS OF THE VARIANCE AND CO-VARIANCE OF TABLE XXXIII AND A TEST OF SIGNIFICANCE

Source of variances	D.F.	Σx^2	Σxy	Σy^2	$\Sigma(y - Y)^2$	D.F.	Red. Var.
Total	434	1156.61	580.50	1991.53			
Between Groups	1	31.26	25.33	18.95			
Within Groups(error)	433	1125.34	555.17	1972.57	1698.69	432	3.93
Between groups plus error					1700.17	433	
Difference for testing					1.48	1	1.48

$F = \frac{1.484}{3.93} = .3774$ no significance

$r_{yx} = .372**$ for error $t = 8.32$ for 1 and 448 degrees of freedom

Correcting college grade point averages for differences in high school abilities.

$Y_1 = 1.2261$ corrected mean for deficient college grades.

$Y_2 = 1.2776$ corrected mean for non-deficient college grades.

Difference of the means = .0515

S. E. of difference of means = .1940

t = .436 no significance

APPENDIX G

Section 2.

ANALYSIS OF THE VARIANCE WITHIN THE DEFICIENT GROUP

TABLES OF SUMS AND MEANS OF GRADE POINT AVERAGES.

TABLE XXXIX

HIGH SCHOOL TOTAL (x) AND COLLEGE FIRST AND SECOND TERMS TOTAL (y) WITH MAKE UP

Group	n	Σx	Σy	Σx^2	Σxy	Σy^2	M_x	M_y
Special	15	24.86	18.67	46.7254	34.2831	27.9460	1.6573	1.2446
Physics	54	73.59	58.76	118.0701	87.1674	77.7904	1.3627	1.087
Science	28	45.08	33.15	78.0585	54.6640	44.8219	1.6100	1.8309
Ph./Sc.	14	19.73	14.96	31.4317	22.8934	18.6989	1.4092	1.069
Total	111	163.26	125.54	274.2857	199.0079	169.2569	1.4708	1.1309
C. F.				240.1245	184.6456	141.9846		

TABLE XL

HIGH SCHOOL TOTAL (x) AND COLLEGE REMAINING TERMS TOTAL, (y) WITH MAKE UP

Group	n	Σx	Σy	Σx^2	Σxy	Σy^2	M_x	M_y
Special	15	24.86	21.55	46.7254	38.7620	35.8379	1.6573	1.4367
Physics	54	73.59	51.41	118.0701	83.4690	91.8690	1.3627	.9520
Science	28	45.08	29.84	78.0585	51.7466	44.0210	1.6100	1.0657
Ph./ Sc.	14	19.73	13.56	31.4317	22.8934	18.6986	1.4092	1.069
Total	111	163.26	116.36	274.2857	195.7641	191.7351	1.4708	1.0483
C. F.				240.1246	171.1435	121.9788		

TABLE XLI

HIGH SCHOOL TOTAL (x) AND COLLEGE FIRST AND SECOND TERMS TOTAL (y) WITH NO MAKE-UP

Group	n	Σx	Σy	Σx^2	Σxy	Σy^2	M_x	M_y
Special	17	26.61	23.79	47.9449	40.9017	36.9667	1.5047	1.39941
Physics	34	52.15	44.80	91.2949	72.8325	70.5818	1.5338	1.3176
Science	13	19.87	16.38	38.2465	28.3363	24.1682	1.5284	1.2600
Ph. & Sc.	5	8.07	6.75	15.5289	12.6729	10.4341	1.614	1.350
Total	69	106.70	91.72	193.0152	154.7497	142.1508	1.5388	1.32927
C. F.				164.9984	121.9211	141.8337		

TABLE XLII

HIGH SCHOOL TOTAL (x) AND COLLEGE REMAINING TERMS TOTAL (y) WITH NO MAKE UP

Group	n	Σx	Σy	Σx^2	Σxy	Σy^2	M_x	M_y
Special	17	26.61	24.35	47.9449	40.5700	38.3977	1.5652	1.4323
Physics	34	52.15	38.05	91.2949	64.5767	56.9445	1.5338	1.1191
Science	11	18.34	18.44	35.8006	33.0020	35.6798	1.6673	1.6764
Ph. & Sc.	5	8.07	7.37	15.5289	13.5230	13.4939	1.614	1.474
Total	67	105.17	88.21	190.5693	151.6717	144.5159	1.5697	1.3165
C. F.				165.0855	138.4633	116.1343		

ANALYSIS OF VARIANCE AMONG THE GROUPS WITH MAKE-UP COMPLETED

TABLE XLIII

ANALYSIS OF VARIANCE OF TABLE XXXIX
HIGH SCHOOL TOTAL (x) AND COLLEGE FIRST AND SECOND TERMS TOTAL (y).

Source of variance	D.F.	Σx^2	Σy^2	Mean Square x	Mean Square y	t ratio
Total	110	34.1561	27.2725	.3105	.2479	x 1.92
Between Classes	3	1.7476	.4258	.5825	.1419	y .57
Within Classes (error)	107	32.4086	26.8465	.3029	.2509	

No significance

TABLE XLIV

ANALYSIS OF VARIANCE OF TABLE XL
HIGH SCHOOL TOTAL (x) AND COLLEGE REMAINING TERMS TOTAL (y)

Source of variance	D.F.	Σx^2	Σy^2	Mean Square x	Mean Square y	t ratio
Total	110	34.1561	69.7563	.		x 1.92
Between Classes	3	1.7475	2.8603	.5825	.9534	y 1.52
Within Classes (error)	107	32.4086	66.8960	.3029	.62519	

No significance

ANALYSIS OF VARIANCE AMONG THE GROUPS WITHOUT MAKE-UP COMPLETED

TABLE XLV

ANALYSIS OF THE VARIANCE OF TABLE XLI
HIGH SCHOOL TOTAL (x) AND COLLEGE FIRST AND SECOND TERMS TOTAL (y)

Source of variance	D.F.	$\leq x^2$	$\leq y^2$	Mean Square x	Mean Square y	t ratio
						x
Total	68	28.0168	20.2297	.412	.297	
						.05
Between Classes	3	.0383	.1528	.0127	.0509	
						y
Within Classes (error)	65	27.9785	20.0769	.430	.3089	
						.13

No significance

TABLE XLVI

ANALYSIS OF THE VARIANCE OF TABLE XLII
HIGH SCHOOL TOTAL (x) AND COLLEGE REMAINING TERMS TOTAL (y)

Source of variance	D.F.	$\leq x^2$	$\leq y^2$	Mean Square x	Mean Square y	t ratio
						x
Total	66	25.4838	28.3816	.386	.430	
						.13
Between Classes	3	.1585	3.1015	.0528	1.034	
						y
Within Classes (error)	63	25.3253	25.2801	.402	.401	
						2.58

No significance

TABLE XLVII

ANALYSIS OF VARIANCE BETWEEN THE GROUP WITH MAKE-UP AND THE GROUP WITHOUT MAKE-UP (TABLES XLV AND XLVI)

Source of variance	D.F.	$\leq x^2$	$\leq y^2$	Mean Square x	Mean Square y	t ratio
						x
Total	179	62.4159	49.1749			
						.69
Between Groups	1	.2429	1.6729	.243	1.673	
						y
Within Groups (error)	178	62.1730	47.5020	.349	.2670	
						6.27*

*Significant at the 5% level.
For the 5% level t = 3.90, and for the 1% level t = 6.78

APPENDIX I
Section 1.
TABLE XLVIII

THE ANALYSIS OF VARIANCE OF HIGH SCHOOL GRADE POINT AVERAGE AMONG THE FOUR INITIAL GROUPS OF THE GENERAL SAMPLE

		Groups											
		B_1			B_2			E_1			E_2		
Class Mark	d	f	df	d^2f	f	df	d^2f	f	df	d^2f	f	df	d^2f
2.833	9				3	27	243	2	18	162	1	9	81
2.500	8	1	8	64	6	48	384	3	24	192	3	24	192
2.167	7	10	70	490	12	84	588	9	63	441	3	21	147
1.833	6	10	60	360	13	78	468	15	90	540	5	30	180
1.500	5	23	115	575	14	70	350	13	65	325	5	25	125
1.167	4	8	32	128	9	36	144	6	24	96	4	16	64
.833	3	9	27	81	2	6	18	1	3	9	1	3	9
.500	2	1	2	4	1	2	4						
Totals		62	314	1702	60	351	2179	49	287	1760	22	128	798
Mean of Samples			5.065			5.850			5.852			5.820	
Mean G.P.A.			1.5217			1.7836			1.7839			1.7735	

M_{total} = 5.5958, or 1.6869 grade points.

f = 193 C. F. = 6025.441

Σx = 1080 Σx^2 = 413.559

Σx^2 = 6439

Sum of squares between columns = 6068.177

= 42.736

TABLE XLIX

ANALYSIS OF VARIANCE OF TABLE XLVIII

Source of variance	Degrees of freedom	Sum of squares	Mean square	F ratio
Total	192	413.559		
Between columns	3	42.736	14.245	7.25**
Within columns (error)	189	370.823	1.963	

**Significant at the 1% level.

F at 150 and 3 degrees of freedom = 2.66 at 5% level and 3.91 at 1% level.

M_{total} = 5.5958, or 1.687 grade points.

$\sigma_{\bar{x}} = 1/3 \sqrt{1.963} = .467$

There is a highly significant difference between the means of B_1 and B_2. A careful search of the records reveals no reason for this discrepancy except as a result of two highly divergent samples from the parent sample. B_2 is in close agreement with the two samples of E_1 and E_2. However there is no logical premise by which it can be inferred that the basic sample should agree with that of the engineering sample. A further sampling will be necessary to attempt a selection of the true sample.

APPENDIX I
Section 2.
TABLE L

ANALYSIS OF VARIANCE AS MEASURED BY HIGH SCHOOL TOTAL GRADE POINT AVERAGES AMONG SAMPLES OF THE CONTROL GROUP

Classes Coded G. P. A.		Groups B_1 f	B_1 df	B_2 f	B_2 df	B_3 f	B_3 df	E_1 f	E_1 df	E_2 f	E_2 df	Total f	Total d^2f
2.83	9	0	0	3	27	2	18	2	18	1	9	8	648
2.50	8	1	8	6	48	9	72	3	24	3	24	22	1408
2.17	7	10	70	12	84	10	70	9	63	3	21	44	2156
1.83	6	10	60	13	78	10	60	15	90	5	30	53	1908
1.50	5	23	115	14	70	16	80	13	65	5	25	71	1775
1.17	4	8	32	9	36	15	60	6	24	4	16	42	672
.83	3	9	27	2	6	6	18	1	3	1	3	19	171
.50	2	1	2	1	2	2	4	0	-	0	-	4	16
Totals		62	314	60	351	70	382	49	287	22	128	263	8754
Mean of columns		5.065		5.850		5.457		5.852		5.820		df = 1462	
Mean of G. P. A.		1.5217		1.7836		1.6522		1.7839		1.7735			

M_{total} = 5.57, or 1.6869 grade points

Σf = 263

Σx = 1462

Σx^2 = 8754

C. F. = $\frac{(1462)^2}{263}$ = 8127.163

$\Sigma \bar{x}^2$ = 626.837

Sum of squares between columns = 26.79

TESTS BETWEEN COLUMNS OF TABLE L

$M_{E_1} - M_{B_1} = .787$

\# $\sigma_{dif._M} = \sqrt{2.32\left(\frac{1}{62} - \frac{1}{49}\right)}$

$= .29115$

$t = \frac{.787}{.29115} = 2.706^{**}$ 1 to 100 chance. 109 degrees of freedom

$M_{B_3} - M_{B_1} = .392$

$t - 1.392$ no significance 130 degrees of freedom

$M_{B_1} - M_{B_2} = .785$

$t = 3.175^{**}$ Well above 1% level 120 degrees of freedom

$M_{B_2} - M_{B_3} = .393$

$t = 1.467$ no significance 128 degrees of freedom

\# George W. Snedecor, Analysis of Variance. (Ames, Iowa: Collegiate Press, Inc., 1934). p 17.

TABLE LI

ANALYSIS OF VARIANCE OF TABLE L

Source of variance	Degrees of freedom	Sum of squares	Mean square	F ratio	
Total	262	626.84	2.39		
Between columns	4	26.80	6.70	2.88*	
Within Columns (error)	258	600.05	2.32		
Between $B_{1,2,3}$ & $E_{1,2}$	1	7.957	7.957	3.363	No significance
Within groups	261	618.883	2.37		

*Significant at the 5% level.

F at 250 and 3 degrees of freedom = 2.65 at the 5% level and 3.86 at the 1% level.

M_{total} = 5.57, or 1.6869 grade points.

The variance with the addition of the third group from basic engineering has decreased from the .14% level to the 4% level when the variance of the high school scores are compared. Upon comparison of the scores of the other subject divisions as given in Table III the variations of these groups are seen to be quite random. Section 2 of this Appendix I shows that if these samples had been taken in a single sample and then analyzed the variance would be extremely small.

APPENDIX I - 2

TABLE LII

ANALYSIS OF VARIANCE AS MEASURED BY HIGH SCHOOL TOTAL GRADE POINT AVERAGE AMONG FIVE ALPHABETICALLY SEPARATED GROUPS OF THE NON-DEFICIENT SAMPLE

Classes Coded G. P. A.		Groups 1 f	df	2 f	df	3 f	df	4 f	df	5 f	df	Sum of squares f	d^2f
2.83	9	3	27	1	9	1	9	2	18	1	9	8	648
2.50	8	4	32	3	24	2	16	6	48	6	48	21	1344
2.17	7	11	77	6	42	12	84	5	35	11	77	45	2201
1.83	6	14	84	13	78	11	66	10	60	5	30	53	1908
1.50	5	12	60	16	80	11	55	19	95	13	65	71	1775
1.17	4	6	24	7	28	11	43	8	32	11	44	43	688
.83	3	3	9	6	18	3	9	2	6	5	15	19	171
.50	2	0	-	1	2	2	4	1	2	0	-	4	16
Totals		53	313	53	281	53	286	53	296	52	288	264	8751
$M_{columns}$		5.900		5.299		5.392		5.580		5.430		df = 1464	

TABLE LIII

ANALYSIS OF VARIANCE OF TABLE LII

Source of variance	Degrees of freedom	Sum of Squares	Mean square	F ratio
Total	264	632.9	2.39	No Significance
Between Classes	4	11.23	1.81	
Within Classes (error)	260	621.17	2.38	

APPENDIX J

ANALYSIS OF THE DISTRIBUTION OF THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION SCORES FOR BOTH GROUPS.

TABLE LIV

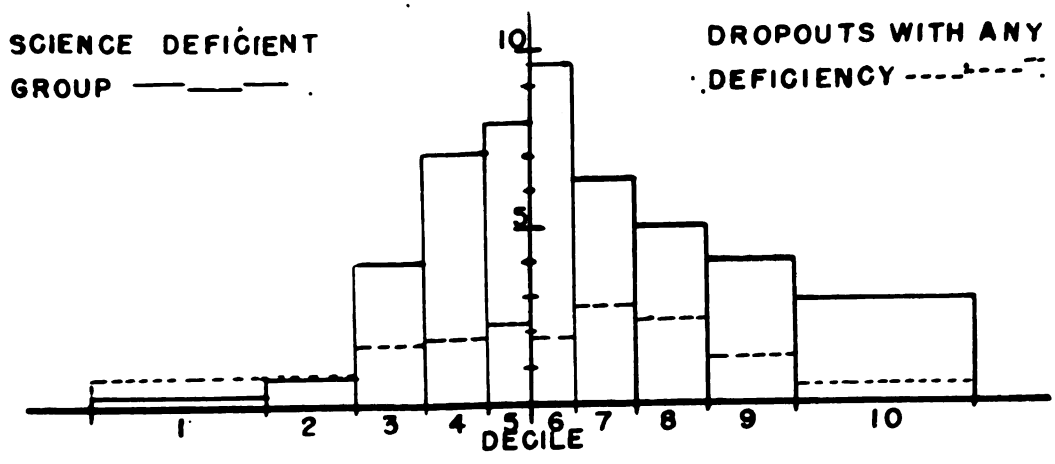
RANGES OF ACTUAL SCORES FOR EACH PERCENTILE RANK FOR THE YEARS 1937 - 1946 INCLUSIVE. (UPPER SCORE OF EACH RANK GIVEN)

Percentile rank	Year										Average Range
	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	
10th											
9th	243	101	111	135	133	130	136	129	127	127	9
8th	217	91	102	127	124	121	127	120	119	119	6.5
7th	200	84	96	120	118	114	121	114	112	112	6
6th	185	79	90	114	112	109	114	108	105	105	5
5th	172	73	86	109	106	103	108	103	100	100	5.4
4th	160	68	81	103	101	97	103	98	95	95	6
3rd	48	61	77	98	95	91	97	91	88	88	6.9
2nd	133	54	71	91	88	84	92	83	80	80	9.6
1st	113	47	63	80	78	74	83	73	71	71	

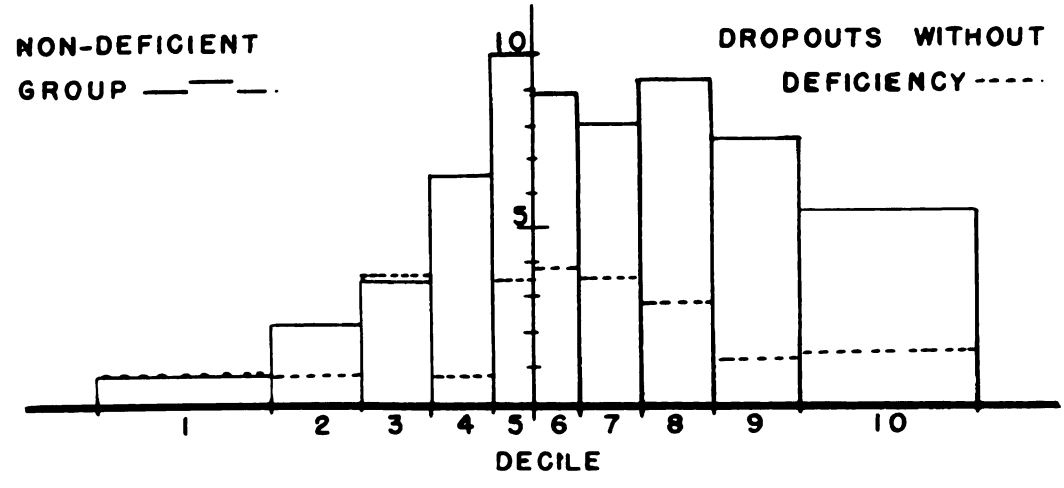
TABLE LV

SUMMARY OF STATISTICS

Statistic	Decile Ranks	
	Deficient	Non-Deficient
n	183	258
Mean Decile	6.986	7.452
$\sigma_{\bar{x}}$	2.455	2.6
σ_{M_x}	.1815	.1615
σ_{dif_m}	.243	
$M_1 - M_2$	.466	
t	1.919	
Chance	6.3/100	



DEFICIENT STUDENTS



NON-DEFICIENT STUDENTS

FIGURE 14

DISTRIBUTION OF THE PSYCHOLOGICAL TEST SCORE RANKS ON AN ARBITRARY BASE

APPENDIX K

A COMPARISON OF THE DEFICIENT AND NON-DEFICIENT DROP-OUTS

TABLE LVI

ANALYSIS OF THE DISTRIBUTION OF THE PSYCHOLOGICAL SCORES OF THE DEFICIENT AND NON-DEFICIENT DROP-OUTS DURING THE SCHOOL YEAR 1946-47, FROM THE ENGINEERING DEPARTMENT OF MICHIGAN STATE COLLEGE

Decile	Deficient			Non-deficient		
rank	f	df	d^2f	f	df	d^2f
10	7	70	700	15	150	1500
9	7	63	567	7	63	567
8	10	80	640	12	96	768
7	10	70	490	13	91	637
6	5	30	180	10	60	360
5	6	30	150	9	45	225
4	7	28	112	3	12	48
3	7	21	63	15	45	135
1 & 2	12	18	27	9	14	21
Totals	71	410	2929	93	576	4261
Score unknown	50			47		

APPENDIX K

TABLE LVII

COMPARISON OF PSYCHOLOGICAL EXAMINATION RANKS OF THE DROP-OUTS WITH THOSE OF THEIR RESPECTIVE GROUPS

Deficients		Statistic	Non-deficient	
Drop-outs	Group		Drop-outs	Group
71	183	n	93	258
5.77	6.986	Mean decile	6.20	7.452
2.828	2.455	σx	2.72	2.60
.3355	.1815	σM_x	.282	.1615
1.216		$M_1 - M_2$	1.252	
.381		σdif_{m_x}	.3245	
2.19		F t	3.87	

Difference of Means of drop-outs = .43

Standard error of the difference of the Means = .438

t ratio = .98

APPENDIX L

TABLE LVIII

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Column 1.
Key to the sample in which the case was originally selected:
a — B_1 The first sample from Basic College with engineering preference.
b — B_2 The second sample from Basic College with engineering preference.
c — B_3 The third sample from Basic College with engineering preference.
d — E_1 The first sample from the School of Engineering.
e — E_2 The second sample from the School of Engineering.

Column 2.
The number of terms attendance at M. S. C.

Columns 3 - 8.
College grade point averages.

Column 9.
A. C. E. Psychological test scores as decile ranks.

Columns 10 - 12.
High school grade point averages.

Column 13.
Size of High School graduating senior class.

APPENDIX L

TABLE LIV

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Group	No. of terms	College work: Total 1&2	College work: Total Rem.	College work: Engineer 1&2	College work: Engineer Rem.	College work: Sc.&Math. 1&2	College work: Sc.&Math. Rem.	Psyc. test score	High school: Science	High school: Math.	High school: Total	Sen. class pop.
						Section 1.						
d	7s	2.06	2.72	2.67	2.54	2.27	2.33	10 9 10	2.00	1.82	1.65	—
b	3	1.54	1.16	2.50	3.00	1.75	1.50	8 3 5	1.67	2.42	1.84	259
a	3s	.83	1.71	.50	1.00	-.16	1.75	8 5 7	1.00	1.67	1.18	635
c	3	.50	1.40	.50	—	.00	1.00	5 6 6	1.00	1.25	1.58	29
c	3	1.57	2.00	1.50	2.00	.33	1.75	10 4 7	2.25	2.50	2.53	56
a	5	.85	1.90	.67	.67	1.00	.42	6 6 6	1.37	.00	.78	285
c	4s	1.87	1.16	—	1.50	1.67	.50	10 10 10	1.33	.84	1.06	26
d	5	1.61	1.05	1.00	1.26	1.67	.77	8 2 4	1.75	2.12	1.50	93
b	3	1.78	1.44	1.50	—	2.25	1.50	8 5 6	2.84	3.00	2.82	35
b	3	1.25	.94	.33	—	2.00	2.00	10 8 10	1.17	1.00	1.22	375
a	3	.70	.50	1.00	—	.75	1.00	10 3 6	1.16	1.43	1.40	403
c	3	2.21	2.27	2.33	2.83	1.67	1.00	6 10 9	2.33	2.28	2.33	242
b	3	2.45	1.33	1.50	.84	2.66	3.00	9 10 10	3.00	3.00	2.85	19
c	6	2.23	2.35	2.00	2.06	2.75	2.63	10 10 10	2.50	3.00	2.56	43
a	3	1.64	1.71	1.00	—	2.25	1.00	7 3 4	2.16	2.50	2.29	27
a	3	.85	2.18	1.00	1.00	.00	1.00	5 2 3	1.40	.67	.90	436
c	4	1.20	.13	1.00	1.00	1.25	.41	8 1 4	1.75	1.00	1.65	159
b	3	1.57	.50	1.16	1.33	2.00	—	5 5 5	1.40	2.00	1.91	362
d	8	1.36	1.34	.80	1.44	2.00	1.67	7 3 4	1.80	1.75	1.78	1000
c	4	1.42	.31	1.00	—	.67	.50	4 3 3	1.75	.75	.87	202
d	11	2.54	1.96	2.50	2.12	2.67	1.72	10 10 10	2.00	1.16	1.39	—
b	3	1.46	1.75	.50	—	1.42	1.00	- - -	1.75	2.00	2.20	174
d	12	1.80	1.31	2.00	1.38	1.75	1.10	10 10 10	2.25	2.12	2.12	—
g	3	1.70	2.00	2.00	—	1.75	1.33	7 5 6	1.83	1.67	1.85	52
c	6	1.20	1.46	1.00	1.00	1.16	1.55	5 4 4	1.50	1.00	1.43	146
d	8	1.58	1.30	1.00	1.18	1.80	1.51	8 7 8	1.84	1.75	1.76	182
c	3s	1.00	1.57	1.50	—	.33	2.00	9 8 8	1.16	.77	1.25	490
a	4	2.20	1.97	1.00	2.00	2.50	2.08	10 5 9	1.75	1.75	1.77	93
c	8	1.07	1.14	.80	.96	1.25	1.18	9 7 8	1.50	1.37	1.44	44
d	15	2.26	2.56	—	2.11	2.75	2.62	- - 10	2.62	3.00	2.86	—
c	3	1.00	1.00	2.00	—	1.33	1.33	7 7 7	2.00	2.42	2.36	250
b	7	.76	—	-1.00	-.20	1.12	.52	6 6 6	2.33	2.00	1.55	—
d	6	1.15	.91	1.33	1.55	1.30	.38	8 8 4	2.00	1.84	1.75	30
a	6s	1.27	1.06	—	.58	1.33	1.14	— — 7	1.50	.67	1.09	510
c	3	1.00	1.25	1.22	2.00	.00	—	4 6 5	2.25	1.67	1.50	58
a	5s	2.46	2.21	—	2.33	2.25	2.17	10 10 10	1.50	1.80	1.80	—
a	3	.89	.74	.50	.00	.21	.57	9 6 7	2.16	1.83	1.71	206

APPENDIX L

TABLE LIV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Group	No. of terms	College work: Total 1&2	Total Rem.	Engineer 1&2	Engineer Rem.	Sc.&Math. 1&2	Sc.&Math. Rem.	Psyc. test score	High school: Science	Math.	Sen. class Total Pop.
Section 1. (cont.)											
c	5	1.00	.86	1.00	.50	1.16	1.75	3 6 7	2.50	2.84	2.20 —
b	7	2.00	1.96	—	2.20	2.60	2.25	10 6 9	2.75	3.00	2.54 83
d	9	1.81	1.21	1.50	1.30	2.00	.50	- - 8	2.67	1.67	1.95 216
a	3s	1.00	.75	1.00	2.00	1.00	.00	9 9 9	2.33	1.37	1.80 259
c	3	1.21	1.16	1.50	1.00	.75	.50	10 010	1.50	2.00	1.39 408
d	9	1.48	1.00	1.10	.98	2.00	1.06	3 2 2	1.50	1.85	1.85 350
c	5	2.50	1.93	2.00	2.44	2.57	1.86	91010	2.67	1.87	2.18 240
c	6	1.27	1.64	1.00	1.54	1.50	1.25	91010	.50	.80	1.06 152
b	10s	2.54	1.27	—	1.26	2.37	1.34	610 9	2.00	1.16	1.81 26
c	5	1.69	1.47	2.00	1.67	2.25	1.26	101010	2.00	2.56	2.03 41
b	5	1.06	1.12	.00	.75	.82	.37	101010	1.33	1.67	1.50 66
d	15	1.74	.79	1.50	.72	1.75	.60	- - 6	2.67	2.00	2.10 44
b	3	2.47	1.71	—	1.00	3.00	3.00	7 3 5	2.17	2.37	2.18 786
d	9	1.39	2.37	1.00	2.00	1.50	2.43	101010	2.85	2.87	1.96 263
b	6	1.68	1.44	1.00	1.86	1.71	1.39	610 9	2.33	2.00	2.18 48
a	4s	1.72	1.96	1.00	1.50	2.08	1.76	8 5 6	2.50	2.25	2.23 331
Section 2											
a	3	1.00	1.20	1.50	—	1.00	1.00	10 810	1.50	1.57	1.54 —
b	3	1.00	.40	1.00	—	1.25	1.00	3 2 3	1.00	1.00	1.42 28
d	9	1.62	.92	1.45	.56	1.81	1.47	5 6 5	3.00	2.00	2.32 44
c	6s	1.30	2.35	1.00	1.00	1.75	2.30	7 5 6	2.84	1.50	1.65 55
a	3	.80	.50	1.00	-1.00	1.00	.50	9 5 7	1.75	2.00	1.87 254
c	3	1.31	.74	—	2.00	1.25	1.00	1 2 1	2.00	1.33	1.97 35
b	3	.67	1.20	2.00	1.00	-.33	.50	81010	2.67	1.80	1.94 11
e	8	2.47	1.14	2.50	.89	2.17	.92	101010	2.16	2.00	1.88 —
c	3	.17	-1.00	—	—	-.11	.00	5 1 2	1.17	1.50	1.18 63
b	3	1.73	1.50	2.50	—	2.25	2.00	10 1 5	2.75	2.38	2.30 408
a	5s	2.63	2.58	2.00	2.50	2.80	2.50	9 8 9	2.50	1.00	1.46 90
b	5s	1.37	1.87	1.00	1.67	1.50	.93	101010	3.00	3.00	2.65 348
d	4s	2.24	2.91	2.90	3.00	1.64	2.50	9 6 8	2.00	2.00	2.03 70
a	3	.77	3.00	—	—	.50	3.00	- - -	1.67	2.25	1.65 119
d	12	.96	1.51	1.00	1.42	1.00	1.55	10 6 8	1.50	1.85	1.47 28
b	3	1.21	1.05	1.00	1.33	.75	1.00	3 7 5	2.00	1.00	1.15 177
a	3s	1.17	2.00	—	—	.75	2.33	2 9 7	1.16	.80	1.53 89

APPENDIX L

TABLE LIV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Group	No. of terms	College work: Total 1&2	College work: Total Rem.	College work: Engineer 1&2	College work: Engineer Rem.	College work: Sc.&Math. 1&2	College work: Sc.&Math. Rem.	Psyc. test score	High school: Science	High school: Math.	High school: Total	Sen. class pop.
					Section 2 (cont.)							
a	3	.33	1.50	—	—	.25	1.00	5 4 4	.67	.42	1.00	137
c	3	.90	.20	—	1.00	.80	.66	3 5 4	1.00	.84	.74	311
d	5	1.77	1.31	1.50	1.46	1.84	1.27	101010	2.16	2.12	1.82	232
a	3	-.12	-.50	—	.67	.21	-1.00	9 3 5	.75	1.17	.79	49
d	12s	.61	1.00	1.00	1.03	-.33	1.06	7 8 8	.75	1.20	1.10	156
c	3	.52	1.10	00	1.00	.33	1.66	2 3 2	2.33	.50	.94	233
b	3s	2.10	1.63	—	1.50	1.85	1.50	91010	1.75	1.50	1.56	350
c	3	1.14	-.67	1.00	1.00	1.33	-1.00	5 5 5	1.00	.00	.50	90
b	4	1.10	.37	1.00	.17	1.25	1.00	8 5 7	1.80	1.60	1.61	91
d	2	.75	—	1.00	—	.50	—	9 7 8	.50	2.10	1.56	282
a	3	.70	-.40	—	—	.60	.00	7 2 3	1.00	1.84	.82	159
c	6	1.85	1.46	1.00	1.66	2.50	1.52	101010	2.00	1.87	1.89	426
b	3s	1.75	1.94	1.00	1.33	2.00	2.33	7 8 8	1.00	2.00	1.53	58
e	9	1.06	1.51	1.30	.90	.50	1.52	6 5 5	1.57	1.42	1.60	110
a	4	1.08	.60	1.00	—	1.17	1.50	4 6 5	1.16	1.00	1.11	274
c	3	1.57	1.14	2.00	2.00	1.28	1.00	9 2 5	2.00	2.84	2.50	43
b	3	.89	-1.00	—	—	.75	.00	4 6 5	.67	1.33	.74	140
d	3s	2.55	1.75	3.00	1.42	2.57	2.00	- -10	3.00	2.85	1.96	462
a	3	1.93	1.31	2.00	3.00	2.50	1.50	10 7 9	1.46	2.75	2.02	259
c	3	1.60	.91	1.50	1.33	1.16	.00	91010	2.33	2.25	2.34	457
b	5	1.28	1.04	—	1.00	1.30	1.10	101010	2.67	2.17	2.27	49
a	3	.85	.83	2.00	—	1.00	1.50	5 1 2	1.25	2.00	1.92	63
d	10s	.85	1.22	.90	1.24	.67	1.09	9 8 9	3.00	2.29	2.67	363
c	3	1.59	1.10	.00	1.00	.25	1.00	2 1 1	1.25	1.50	1.43	900
a	6	1.28	1.46	1.00	1.69	1.75	1.54	8 5 7	1.71	1.62	1.91	306
c	3	.63	.20	—	—	.66	.00	7 5 6	1.50	2.00	1.67	39
b	4	1.20	1.13	1.00	1.00	1.33	.85	8 4 5	1.25	2.12	1.76	107
a	3	1.10	1.83	—	—	1.60	2.00	9 7 8	.78	.84	.95	688
d	9s	.71	.90	.42	1.13	1.00	.56	- - 3	2.00	1.00	1.12	350
g	4s	1.52	2.22	1.00	1.50	1.50	2.40	10 010	2.25	2.00	2.05	50
a	5	1.08	1.00	—	1.00	1.00	.67	81010	.00	.71	1.32	213
b	3	1.21	1.70	.00	1.00	1.75	2.00	610 9	1.84	2.62	1.88	77
d	10	1.50	1.48	1.40	1.55	2.25	1.38	10 7 9	1.82	2.00	1.67	30
c	5	1.73	1.09	1.33	1.20	1.33	.79	81010	1.20	1.37	1.43	245
a	6s	1.55	1.36	1.00	1.56	1.57	.80	6 9 8	1.50	1.37	1.52	52
c	3	1.40	1.60	—	—	1.47	2.00	4 5 4	1.50	1.28	1.65	102

APPENDIX L

TABLE LIV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

No. of Terms Group	College work: Total 1&2	Total Rem.	Engineer 1&2	Engineer Rem.	Sc.&Math. 1&2	Sc.&Math. Rem.	Psyc. Test score	High school: Science	Math.	Sen. class Total pop
Section 3.										
a 3s	1.37	1.55	1.50	2.00	1.50	2.00	9 7 8	1.50	2.25 1.52	152
b 3s	2.07	1.87	2.00	2.00	2.50	2.50	10 6 9	2.00	1.42 1.50	44
a 6	1.08	1.19	1.30	1.50	1.00	1.20	1 1 1	1.87	2.00 1.60	76
d 9	1.48	1.34	1.00	.84	1.75	1.28	10 7 9	1.33	2.50 1.66	81
c 6s	1.28	.85	1.00	1.41	1.50	.69	4 1 2	3.00	2.00 2.56	82
c 7	1.00	1.29	1.00	.87	.78	.92	7 5 6	1.33	1.87 1.46	255
c 3s	1.16	1.80	2.00	3.00	1.00	2.00	10 910	1.33	1.50 1.31	143
a 4	1.00	.10	1.50	-.50	.75	-1.00	8 5 6	1.00	1.50 1.31	398
c 6	1.20	1.20	—	1.06	1.40	.96	3 1 2	2.75	1.83 1.94	163
b 3	1.07	1.47	.86	2.17	.67	.00	101010	1.00	.84 1.28	242
a 3	2.08	2.00	2.00	1.00	3.00	3.00	- - 8	1.67	2.00 1.94	263
c 3	.63	1.87	1.00	3.00	1.00	1.66	6 1 2	2.00	2.56 1.68	157
c 3s	1.40	1.84	—	2.00	1.48	2.00	4 2 3	.71	.25 .64	439
a 5	1.79	1.42	—	1.50	2.50	1.14	- - 6	1.85	3.00 2.30	122
a 5	2.00	1.93	3.00	2.00	1.83	2.20	10 6 9	2.00	2.28 2.27	147
c 3	2.18	3.00	2.00	2.16	3.00	3.00	- - -	3.00	3.00 2.84	436
b 4	1.00	.75	1.00	.67	1.00	.38	10 7 9	1.00	1.85 1.69	53
a 3	1.18	1.20	—	—	1.33	1.50	10 3 6	1.67	2.83 2.18	68
c 5	2.00	1.09	2.00	1.33	2.25	1.04	10 5 8	1.50	1.00 1.14	350
c 4	.91	1.66	—	1.00	1.00	1.00	4 4 4	1.30	1.00 2.22	—
a 6	.82	.96	.00	.73	.50	.61	9 7 8	2.16	2.16 2.22	103
a 3	1.17	1.20	—	2.00	1.28	1.00	10 810	.50	2.00 1.47	107
d 13	1.65	1.38	1.60	1.52	1.50	.88	10 7 9	1.50	1.43 1.53	—
a 3	1.63	1.50	—	—	1.71	1.00	9 8 9	.48	.60 .83	146
a 3s	2.64	2.57	3.00	—	3.00	3.00	101010	3.00	2.60 2.26	74
c 6	1.41	1.70	1.00	2.00	2.00	1.75	10 710	1.25	2.00 1.87	702
c 3s	1.70	2.00	—	—	2.00	2.33	9 3 4	1.67	1.83 1.94	92
b 3	1.92	1.71	—	—	1.67	1.50	91010	2.00	.50 1.32	—
d 7	1.56	1.56	1.50	1.37	2.50	1.63	7 5 5	2.00	1.25 1.66	170
e 10s	1.12	1.08	.70	1.52	1.25	.58	10 2 6	1.33	2.12 1.21	92
c 3	.63	—	2.00	—	.50	—	7 8 8	2.00	2.00 2.00	91
b 6s	2.00	1.04	.40	1.60	-.33	1.20	4 3 3	1.00	1.00 1.25	232
c 10	-.10	1.08	-.20	1.26	-.50	1.06	5 3 3	1.00	1.37 1.38	93
d 10	2.42	2.08	1.71	2.06	3.00	2.22	10 910	2.17	2.50 2.03	370
c 3	1.11	.62	—	—	.80	.50	10 3 6	.25	1.00 1.00	436
d 3	1.22	1.22	1.36	1.08	1.00	1.50	7 3 4	2.50	2.40 1.97	76
e 10	1.67	1.75	1.00	1.60	1.75	1.87	6 8 8	1.50	2.00 1.59	65

APPENDIX L

TABLE LIV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Group	No. of terms	College work: Total 1&2	College work: Total Rem.	College work: Engineer 1&2	College work: Engineer rem.	College work: Sc.&Math. 1&2	College work: Sc.&Math. rem.	Psyc. test score	High school: Science	High school: Math.	High school: Total	Sen. class pop.
Section 3. (cont.)												
c	4	1.51	.10	—	1.00	1.18	-.08	10 910	1.50	1.25	1.25	993
e	8	1.07	1.54	.70	1.62	1.00	1.33	5 4 4	1.17	1.84	1.25	52
b	3s	.69	2.50	1.00	.00	.17	2.00	6 8 7	2.17	1.00	1.87	—
b	5s	2.05	1.25	—	1.25	2.14	.56	101010	1.83	1.62	1.83	279
c	8	1.19	1.27	2.00	1.66	1.00	.91	10 5 8	3.00	2.42	2.47	152
d	7	1.23	1.84	1.10	2.04	1.25	1.80	10 7 9	1.83	1.72	1.72	97
c	3s	1.60	1.80	—	—	.25	1.00	2 6 4	.33	.67	.98	216
g	4	.45	.57	1.00	1.33	.50	-.10	4 3 3	.25	.25	.47	90
d	12s	1.48	1.00	1.23	.81	1.75	1.08	9 6 8	2.70	2.80	2.30	14
a	3	.71	-1.00	—	—	1.33	.50	7 3 5	2.33	1.84	1.68	16
e	11s	1.08	1.15	1.50	1.39	-.11	.44	3 1 2	1.25	1.12	.90	93
b	3	1.21	1.16	2.00	1.00	1.70	1.50	10 6 9	1.84	2.50	2.32	337
b	6	2.82	1.81	1.00	1.33	3.00	1.89	101010	2.80	2.80	2.06	73
d	9	1.16	1.59	1.20	2.14	1.10	1.25	- - 7	2.50	1.88	1.61	282
a	3	1.38	.71	2.00	1.00	1.00	.00	8 3 5	2.20	2.12	2.21	728
a	3	1.10	1.20	2.00	1.00	1.67	2.00	10 4 7	1.25	2.12	1.32	786
Section 4.												
d	6s	1.89	1.71	2.84	1.86	2.10	1.69	10 5 8	2.50	2.25	2.10	—
c	6	1.79	2.00	2.00	1.64	1.67	3.00	- - -	2.00	2.00	1.91	152
b	6	1.35	.94	1.50	1.25	1.75	.72	5 7 7	1.17	1.60	1.24	705
b	3	1.20	1.26	—	—	1.15	.90	2 5 3	2.17	1.25	1.58	94
c	3	1.15	1.73	—	—	1.00	2.90	10 4 7	1.15	1.67	1.35	216
b	6	.86	1.33	.70	1.54	.33	1.00	4 6 6	1.75	1.20	1.27	83
b	3s	2.90	3.00	—	—	2.80	2.67	91010	3.00	2.67	2.90	590
d	4s	2.28	2.37	2.10	2.69	2.50	2.00	9 6 8	2.33	1.84	1.64	354
c	3	.53	-.75	1.00	.50	.23	-1.00	3 1 1	1.84	1.33	1.48	66
c	3	.58	.40	.00	.50	-.33	1.00	1 1 1	1.50	1.00	1.76	337
d	10s	.88	1.16	1.00	1.25	.71	1.12	7 7 7	.75	1.62	1.32	130
d	6	2.05	2.05	1.60	2.38	2.25	1.95	101010	2.74	2.50	2.37	91
a	3s	1.73	1.80	1.00	1.00	2.55	2.00	9 7 8	.62	1.00	.60	439
b	3	.67	1.40	—	—	.40	.50	1 3 1	1.17	1.56	1.45	72
d	8	1.68	1.61	1.30	1.54	1.60	1.61	8 6 7	1.33	2.12	1.52	91

APPENDIX L

TABLE LIV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Group	No. of terms	College work: Total 1&2	College work: Total Rem.	College work: Engineer 1&2	College work: Engineer Rem.	College work: Sc.&Math. 1&2	College work: Sc.&Math. Rem.	score	High school: Science	High school: Math.	High school: Total	Sen. class pop.
					Section 4. (cont.)							
a	9	1.10	1.32	.70	.80	1.21	1.01	3 5 4	2.16	1.83	1.62	31
e	6	1.50	1.17	1.37	1.00	1.78	1.05	- - 3	3.00	2.42	2.50	55
b	3	1.20	.50	1.00	1.00	1.50	-1.00	6 9 8	2.50	2.67	2.37	52
a	3	.77	.80	.50	.50	1.25	1.00	10 3 7	1.67	1.62	1.58	239
c	3	1.00	1.75	—	1.00	1.30	1.42	9 7 8	1.33	1.56	1.66	187
c	3	1.27	1.66	.50	1.00	2.00	1.00	101010	2.00	1.50	1.58	18
b	5	1.44	.93	1.00	1.25	1.50	.65	5 3 4	1.00	1.00	1.03	282
e	10	1.98	2.40	2.00	2.62	2.25	2.36	101010	3.00	3.00	2.83	158
a	3	1.22	2.33	—	1.00	.80	1.67	4 9 8	1.84	1.50	1.81	49
c	3	1.79	2.40	—	2.00	2.50	2.25	8 8 8	2.50	2.84	2.58	95
d	16	1.26	1.38	1.00	1.92	1.75	1.00	- - 1	2.00	2.00	1.86	23
d	5s	1.43	1.07	1.63	1.26	1.30	1.55	6 5 5	1.25	1.86	1.65	361
a	5	1.86	.88	1.00	.80	2.80	.50	109 10	2.25	2.12	1.60	96
c	5	1.46	.98	1.50	.77	2.00	1.08	7 6 7	1.67	2.25	1.85	116
d	5	1.45	.25	1.30	.80	1.50	-.11	7 8 8	2.16	2.50	1.93	58
c	3	.92	1.31	1.00	.00	.00	1.00	4 3 3	1.25	1.25	1.02	259
b	3s	1.23	1.00	1.00	1.00	1.42	1.00	10 910	2.35	2.87	2.28	58
e	11	1.30	1.15	1.20	1.24	1.25	1.00	6 6 6	2.33	1.84	1.75	41
a	6	1.25	.42	—	.83	1.50	1.08	9 3 6	1.50	1.80	1.48	49
c	6s	.61	1.56	.70	.33	.33	.66	5 5 5	1.00	1.80	1.00	452
c	3	1.92	1.52	1.35	1.50	1.67	1.00	- - 7	2.00	2.75	2.33	55
d	5s	.77	1.63	.56	—	.40	.58	5 5 5	1.16	1.67	1.51	164
b	3	1.25	1.20	1.33	1.50	.75	1.50	7 7 7	2.00	2.50	1.59	—
c	5	1.40	-.03	—	-1.00	.50	-.33	8 8 8	2.17	1.14	1.18	67
b	3	1.83	3.00	1.50	1.50	2.50	2.50	10 8 9	2.00	2.25	2.22	121
c	3s	1.45	1.10	.00	.00	1.69	.60	101010	2.00	2.37	2.00	354
b	3	1.50	.75	—	—	1.00	.50	6 3 4	1.50	1.86	1.72	36
e	6	1.06	2.00	1.20	1.60	1.00	2.35	- - 9	1.80	1.87	1.97	334
e	16	.53	1.24	.70	1.32	-.30	1.11	- - 5	1.50	2.00	1.21	43
c	6	1.41	1.26	1.50	1.40	1.33	.66	10 7 9	1.33	1.28	1.34	363
b	3	1.45	2.20	—	2.00	.67	1.75	9 9 9	1.33	1.33	1.60	274
a	6s	1.79	1.78	—	1.67	2.00	1.25	5 6 4	1.50	2.40	1.58	65
c	6s	1.22	.86	.50	.84	1.00	.80	- - -	1.33	1.00	.98	82
b	3	2.17	2.40	—	—	2.50	2.50	10 710	2.67	3.00	2.45	130
e	10	1.24	1.95	.80	.88	1.50	.71	- - 9	1.67	1.72	1.90	40
e	7	1.77	1.46	1.80	2.00	2.00	1.25	9 8 9	3.00	2.17	2.66	32
b	5	.68	.39	.00	—	.75	.00	5 6 5	1.67	1.62	1.58	17
b	2	-.90	—	1.00	—	-1.00	—	9 9 9	.50	.80	.89	398

APPENDIX L

TABLE LIV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Group	No. of terms	College work: Total 1&2	College work: Total Rem.	College work: Engineer 1&2	College work: Engineer Rem.	College work: Sc.&Math. 1&2	College work: Sc.&Math. Rem.	Psyc. Test score	High school: Science	High school: Math.	High school: Total	Sen. class pop.
						Section 5.						
d	10	1.89	1.32	1.67	1.25	2.25	1.54	101010	2.00	1.67	2.65	—
a	7	1.00	1.22	.50	-.20	1.00	1.50	7 4 5	1.33	1.84	1.83	258
c	3	1.73	1.43	1.50	1.00	1.71	1.85	10 910	2.25	2.57	2.36	73
b	4	1.27	.70	1.67	1.00	1.47	.00	10 8 9	1.00	1.43	1.21	269
c	3	1.10	1.80	—	2.00	1.16	2.50	8 7 8	1.33	.84	1.12	69
d	10	.82	1.09	1.00	1.18	.28	.97	9 7 8	3.00	2.14	2.40	4
d	9	1.15	1.26	.28	.89	1.50	1.32	9 8 9	1.75	1.88	2.00	280
b	3	1.25	1.40	1.00	1.00	1.50	2.50	4 5 5	1.75	1.62	1.72	280
e	9	1.80	1.35	1.30	1.29	2.21	1.46	6 7 7	1.33	2.37	2.15	311
a	3	1.35	1.33	2.00	.67	1.20	—	10 910	2.25	2.00	1.62	237
c	3	1.93	1.66	—	—	2.16	2.00	- - -	2.12	1.67	1.25	134
d	10	.29	1.32	.28	1.48	-.50	1.25	- - 9	2.50	1.60	1.12	23
a	3	1.71	1.17	1.00	.50	1.75	2.00	8 9 9	1.00	1.50	1.55	51
e	10	2.18	1.43	1.75	1.67	3.00	1.42	- - 8	1.33	1.50	1.32	6
d	10	1.81	1.28	.80	1.46	2.22	1.22	7 8 8	1.84	2.00	1.75	276
c	6	2.18	2.20	2.00	2.07	2.57	2.31	101010	3.00	2.75	2.76	155
b	7	1.00	1.27	.70	.80	1.33	1.14	5 3 4	1.00	1.00	1.03	532
c	4	1.50	.82	1.00	.78	1.00	.00	510 9	2.67	2.00	2.14	66
d	11s	.62	.93	.70	1.00	-.50	1.21	10 7 9	1.50	1.70	1.58	26
e	6	2.66	2.34	3.00	2.00	3.00	2.45	10 7 9	3.00	2.56	2.62	164
a	5	1.37	.93	1.00	—	2.00	.85	8 7 7	1.50	1.16	1.64	432
c	3	.60	.25	—	.00	.75	-1.00	7 8 8	1.33	.67	1.08	—
a	5	.53	.64	1.00	2.33	.27	.00	9 1 3	.67	.43	.70	170
b	4	1.68	1.69	1.50	1.88	2.00	1.65	10 910	1.25	1.71	1.57	207
a	3	1.50	2.00	1.50	1.00	2.00	2.00	91010	1.67	1.00	1.62	35
b	3	1.50	1.50	1.00	1.00	1.20	1.33	9 9 9	2.00	2.33	2.21	26
d	6	.97	.29	.90	1.00	1.50	.24	2 1 1	1.67	2.42	1.24	91
a	5	1.40	.84	1.50	2.00	1.14	.40	- - -	2.00	2.33	1.55	405
b	5	1.07	1.01	1.00	-.84	1.25	1.23	10 8 9	3.00	2.00	2.08	276
b	5	1.21	.86	1.57	.75	1.50	.57	9 5 7	1.17	2.00	1.37	156
d	6	.96	1.05	.72	1.50	.50	.86	1 4 2	1.81	1.84	1.71	59
e	9	2.05	2.16	1.75	1.96	2.00	2.77	9 3 6	2.50	2.14	2.05	45
b	3	1.25	1.40	—	—	1.42	.50	8 8 8	2.00	.50	1.46	5
d	7	1.40	.73	—	.90	1.31	.80	7 9 9	2.25	2.75	2.22	125
a	4s	1.67	1.25	1.00	1.46	1.60	.64	91010	1.67	.28	.81	210
d	8	1.51	1.36	1.45	1.25	1.95	1.63	8 2 4	1.25	1.25	1.62	984

APPENDIX L

TABLE LIV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE NON-DEFICIENT GROUP

Group	No. of terms	College work: Total 1&2	College work: Total Rem.	College work: Engineer 1&2	College work: Engineer Rem.	College work: Sc.&Math. 1&2	College work: Sc.&Math. Rem.	Psyc. test score	High school: Science	High school: Math.	High school: Total	Sen. class pop.
					Section 5. (cont.)							
a	3	1.22	.20	—	—	1.25	.50	2 5 4	1.00	1.28	.97	71
c	3	1.51	1.20	1.50	2.00	1.50	1.57	9 4 6	2.67	3.00	2.24	45
d	13	1.22	1.09	1.14	1.18	1.00	.79	3 7 5	1.00	1.70	1.00	344
c	3	.88	.69	2.00	.84	.73	.25	9 7 8	.50	1.00	.72	94
b	4s	1.60	1.75	2.00	1.50	1.80	2.25	10 8 9	2.00	1.75	1.82	22
a	3s	.61	.93	.00	1.00	.62	.42	- - 4	1.25	1.43	1.12	189
e	5	1.70	2.06	.40	1.87	2.17	2.00	10 4 7	2.00	3.00	2.17	—
a	3s	.88	1.37	—	—	.95	1.00	- - 6	1.75	.87	1.47	348
a	5	1.54	1.68	—	1.17	1.75	1.40	101010	1.25	2.00	1.55	120
a	3s	1.40	1.00	—	2.00	1.43	.50	7 7 7	2.00	2.12	2.00	210
c	3s	.90	.75	—	1.00	.84	.00	- - 4	1.00	1.16	1.03	68
b	3s	1.30	.62	1.50	2.00	1.00	.50	10 910	2.57	2.62	2.57	195
a	3	1.95	2.05	1.00	3.00	2.42	2.42	7 6 7	2.33	2.57	2.57	130
d	6	1.05	1.43	.62	1.53	1.00	.87	5 2 3	1.25	.62	.93	303
e	9s	2.62	2.20	2.30	2.17	3.00	2.10	8 7 8	2.67	3.00	2.58	135
a	4	1.17	1.40	1.00	1.00	1.25	1.50	10 6 8	1.00	.75	1.41	338

APPENDIX M

TABLE LV

A SUMMARY OF THE ESSENTIAL DATA FROM THE DEFICIENT GROUP

Column 1.
The number of terms observed. s —— summer school.

Column 2.
Science Make up to date. s — sub-college work, eg. refresher and college preparatory work. b — basic college, eg. 131-3 and 121-3. a — no make up attempted to date. Numbers, eg. 1, 2, 3 etc. refer to the term in which the make up was completed.

Column 3.
Mathematics deficiency in units of high school credit.

Column 4.
Mathematics make up. s — math 90 or refresher math.
a — math 100n. b — math 100b. c — math 100c.
t — math 102.

Columns 5 - 10
College grade point averages.

Column 11
American Council Psychological Examination ratings in deciles.

Columns 12 - 14.
High school grade point averages.

Column 15.
Size of the high school senior class.

APPENDIX M

TABLE LV

A SUMMARY OF THE ESSENTIAL DATA FROM THE DEFICIENT GROUP

No. of terms Science	Math. make-up Science make-up	Math. def.	Grade point averages: College work — Total terms 1&2	Total terms Rem.	Engineering terms 1&2	Engineering terms Rem.	Science & Math. terms 1&2	Science & Math. terms Rem.	Psyc. test score O.L.T.	High school — Science Math.	High school — Senior class size Total
					Physics "special"						
7 n	n	n	2.40	2.28	2.00	2.55	3.00	2.20	101010	2.20 2.90 2.23	101
9 n	1	b7	1.65	1.81	—	1.33	1.62	2.22	8 5 6	2.50 2.25 2.23	331
8 n	n	b1	2.18	1.53	2.10	1.77	2.75	1.50	6 2 3	1.50 2.17 2.08	41
5 n	n	a1	1.33	1.15	1.00	.00	1.80	1.33	9 3 5	2.00 1.83 1.90	125
5 n	n	n	1.54	1.33	1.33	1.58	.72	1.39	6 7 7	1.50 1.33 1.38	35
6 n	n	n	1.50	1.71	1.00	2.13	1.63	2.00	7 5 6	1.50 1.87 1.35	33
8 n	n	n	1.00	1.17	.00	1.18	.80	1.00	5 9 8	.75 .62 1.00	117
3 n	½	n	1.48	1.73	1.45	1.67	1.75	2.50	10 8 9	.50 1.60 1.11	101
6 n	½	a1	1.61	1.33	.50	.87	2.22	1.15	10 910	3.00 2.60 2.32	29
12 n	½	b1	1.50	1.90	.50	1.72	2.00	1.74	10 5 8	2.00 3.00 2.45	82
6 n	½	bt2	.68	1.37	.60	.61	.75	1.45	91010	2.33 1.00 .93	371
3 n	½	at3	1.00	.25	—	—	1.00	.50	9 3 5	.60 .67 .87	323
5 n	1	a1	1.42	1.51	2.00	—	1.43	1.50	7 5 6	.50 1.00 1.06	42
6 n	1	a1	1.70	1.21	1.00	1.00	2.30	1.06	10 910	2.50 2.50 2.31	31
3 n	1	a2	1.50	2.00	1.00	—	1.50	2.33	10 8 9	2.50 2.50 1.77	38
5 n	1½	asb3	.50	1.03	—	.50	1.25	1.37	3 3 3	.25 1.00 .50	—
5 n	2	sab3	1.00	1.04	.00	1.50	1.00	.71	4 5 4	1.00 1.50 1.12	66
4 sl	n	a2	1.78	1.80	—	—	2.00	2.38	6 1 3	2.40 1.86 1.89	201
4 sl	n	a1	.77	1.40	—	1.33	.67	1.50	9 9 9	2.67 1.33 1.70	119
5 sl	½	b1	2.60	2.12	2.00	1.83	2.85	2.65	910 9	2.25 2.40 2.19	71
6 sl	½	e1	1.00	1.72	—	1.96	1.00	2.67	5 3 4	1.75 2.25 2.03	99
4 sl	½	t3	1.02	.60	1.00	.33	1.00	.67	8 8 8	2.00 1.00 1.46	—
3 b2	n	n	1.00	1.57	—	—	1.16	1.00	10 6 8	1.14 1.14 1.54	630
3 b2	n	n	1.63	.40	1.00	1.00	1.75	.50	9 8 8	1.00 1.50 1.10	55
3 b2	n	a1	1.50	2.00	—	—	2.00	2.50	4 5 4	3.00 2.83 2.52	25
3 b2	½	n	.79	1.28	—	—	2.00	1.00	8 7 8	1.50 1.84 1.27	320
3 b2	½	b1	1.45	1.25	—	2.00	1.42	1.00	5 1 2	2.25 2.60 2.60	32
5 b2	½	ab2	1.07	1.13	—	1.33	1.16	.67	4 8 7	1.25 .80 1.06	188
3 b3	1	ab2	2.30	2.33	—	—	2.60	2.50	10 910	2.50 3.00 2.62	26
3 b3	n	n	1.10	1.80	—	—	1.50	1.00	10 7 9	.75 1.17 .90	125
5 b3	½	a2	1.00	1.00	—	—	1.00	.33	2 7 4	.80 1.00 .71	106
3 b3	1	bta3	1.63	2.00	2.00	—	1.33	1.67	2 6 4	1.25 2.00 1.53	168
4 b3	2	asb2	1.10	.72	1.00	1.00	1.00	1.20	8 5 7	1.20 1.75 1.28	354

APPENDIX M

TABLE LV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE DEFICIENT GROUP

No. of terms			Math. make-up	Grade point averages										
				College work							High school			
	Science make-up			Total terms		Engineering terms		Science & Math. terms		Psyc. test score	Science	Math.		Senior class size
		Math. def.		1&2	Rem.	1&2	Rem.	1&2	Rem.	Q.L.T.			Total	
							Physics							
10s	n	n	n	1.60	1.18	1.10	1.59	1.65	.84	8 6 7	2.00	2.25	2.28	363
7	n	n	n	2.86	2.67	2.00	2.60	3.00	2.68	91010	3.00	2.57	2.26	274
5	n	n	n	1.36	1.36	2.00	1.50	1.67	1.50	8 4 6	2.00	2.42	2.16	171
3	n	n	n	2.32	1.81	2.50	2.00	2.63	2.00	10 8 9	3.00	2.62	2.12	310
4	n	n	n	-.10	.80	1.00	—	.50	.50	6 1 1	2.00	2.00	2.00	93
6	n	n	n	1.38	1.04	2.00	1.25	2.00	.65	10 8 9	1.67	2.70	1.96	65
6	n	n	n	1.35	1.23	—	1.08	2.00	1.43	8 1 3	1.25	1.67	1.58	208
11	n	n	n	1.08	1.06	.91	1.57	2.00	1.00	4 4 4	1.00	2.00	1.37	389
7	n	n	n	1.15	.69	2.00	1.08	1.25	.52	6 7 7	.50	1.43	1.31	370
4	n	n	n	1.00	1.09	1.00	1.11	1.00	.61	9 4 6	.75	1.16	1.30	263
10	n	n	n	1.82	1.97	1.00	1.79	2.22	.92	- -10	1.50	2.00	1.30	200
6	n	n	n	.60	-.14	—	.00	.50	-.60	9 9 9	1.00	1.00	1.09	200
3	n	n	al	.50	.77	1.00	-1.00	.00	1.00	5 7 6	1.75	.56	1.08	334
3	n	n	n	.89	.00	—	—	.—	-1.00	4 9 7	.00	.50	1.03	39
8	n	n	n	1.08	1.15	—	1.23	1.20	1.20	2 2 1	1.25	1.17	1.03	132
5	n	n	n	2.03	2.10	1.00	1.67	2.76	2.22	7 4 5	1.00	1.20	.95	510
5	n	n	n	1.54	1.13	2.50	1.80	1.50	1.18	9 5 7	.75	1.14	.81	125
8	n	n	n	1.63	.68	2.00	.74	2.00	1.28	7 5 6	.25	1.12	.80	157
3	n	n	al	.75	-.33	1.00	—	.75	-.50	8 5 6	.50	.38	.77	21
6	n	n	n	1.05	1.11	—	1.67	2.00	1.08	4 4 4	1.50	.33	.72	90
5	n	[illegible]	n	1.48	1.68	—	1.00	2.50	1.62	3 3 3	2.00	2.20	1.94	5
11	n	[illegible]	rb5	.87	1.00	.00	.95	.66	.70	4 6 6	3.00	2.00	2.56	11
5s	n	[illegible]	b3	2.33	1.73	1.50	1.95	2.85	1.48	91010	2.50	2.20	2.37	200
3	n	[illegible]	al	1.10	.36	—	1.00	1.33	.00	3 5 4	1.75	1.00	1.46	66
3	n	[illegible]	cl	1.10	.00	—	—	1.25	1.00	6 4 5	2.00	1.33	1.21	136
4	n	1	ra2	1.33	1.30	2.00	1.00	.67	1.33	10 5 8	1.75	1.75	1.74	82
3	n	1	ba2	1.73	1.73	1.06	1.54	1.57	2.00	101010	1.50	2.00	1.21	366
5	n	1	ba2	1.14	.67	—	1.33	1.00	.33	7 5 6	.50	1.00	1.12	388
6	n	1	ab4	.94	1.08	1.00	1.41	.75	.75	5 7 7	2.00	3.00	1.90	290
6s	n	1	b4	1.24	1.00	1.00	.86	1.00	.97	9 8 8	.50	.50	.91	—
13	n	2	sab3	2.20	1.62	1.00	1.67	3.00	1.82	10 8 9	3.00	3.00	2.90	23
3	n	1½	asb3	.57	1.67	—	—	.33	1.00	10 8 9	1.00	1.75	1.44	—
5	n	2	sab3	1.50	1.13	—	1.33	2.00	1.75	4 8 6	1.50	3.00	1.50	15

APPENDIX M

TABLE LV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE DEFICIENT GROUP

No. of terms	Science make-up	Math. def.	Math. make-up	Grade point averages: College work: Total terms 1&2	Total terms Rem.	Engineering terms 1&2	Engineering terms Rem.	Science & Math. terms 1&2	Science & Math. terms Rem.	Psyc. test score Q.L.T.	High school: Science	Math.	Senior class size: Total
				Physics (cont.)									
3	n	1½	tb3	.25	.20	—	—	-.33	.50	6 5 5	.40	.33	.63	119
4s	al	½	bl	1.09	1.25	—	—	1.16	1.00	8 8 8	1.00	1.40	1.47	145
4	sl	2	sa2	.54	1.32	1.50	1.00	.00	1.50	3 4 4	1.00	2.00	1.67	102
8	s4	2	sab6	2.18	2.38	—	1.40	2.00	2.62	8 8 9	3.00	3.00	3.00	55
3	bl	n	n	1.41	1.60	1.00	2.00	1.86	1.50	9 3 5	1.00	2.00	1.07	28
3	bl	½	al	1.00	.80	—	—	.86	.67	5 6 6	.00	.33	.55	—
3	b2	n	n	2.06	1.57	—	1.00	2.16	2.50	6 7 7	3.00	3.00	2.86	12
3	b2	n	at3	.91	1.80	—	—	1.20	1.00	4 2 3	2.00	2.33	2.15	12
3s	b2	n	n	1.86	1.68	1.00	3.00	1.80	1.00	10 910	1.25	2.17	2.08	—
3	b2	n	ba3	.96	1.00	—	—	1.12	1.00	10 4 7	2.00	2.12	2.01	24
3	b2	n	n	1.93	2.06	1.00	1.00	2.00	2.33	101010	2.00	1.75	1.90	730
3s	b2	n	n	1.62	1.51	—	1.00	1.83	1.00	3 5 4	1.75	1.71	1.70	350
3	b2	n	al	.90	1.40	—	—	.60	1.00	9 8 9	2.00	2.00	1.65	356
3	b2	n	n	1.50	2.20	1.50	.00	1.75	2.00	6 3 4	1.50	1.72	1.56	156
3	b2	n	bl	1.18	1.40	—	2.00	1.86	1.00	9 3 6	2.00	1.71	1.44	314
3	b2	n	a2	.44	.00	—	—	.20	-1.00	4 4 4	1.50	1.16	1.31	386
6	b2	n	n	.77	1.08	—	1.00	.82	.46	101010	.50	1.33	1.26	317
3	b2	n	ba2	1.36	1.42	1.00	1.00	1.50	1.25	10 910	.50	.71	.93	239
3	b2	n	n	1.41	1.80	—	—	1.00	1.00	5 5 5	2.00	1.00	.91	495
3s	b2	n	n	1.16	1.00	—	1.00	.85	1.00	5 4 4	.50	.50	.90	134
3	b2	n	n	.72	-1.00	—	—	.55	-.60	9 6 7	1.25	1.00	.77	—
3	b2	n	n	.90	.00	—	—	1.20	-1.00	4 3 4	1.50	.50	.69	274
3	b2	½	n	-.14	-.30	—	.00	-.40	1.00	8 4 5	1.75	1.16	1.60	—
3	b2	½	bl	1.37	2.00	—	—	1.40	1.75	4 5 5	3.00	2.67	2.77	7
3s	b2	½	al	1.42	.80	—	—	1.66	.00	6 2 4	1.50	1.80	1.50	—
3	b2	½	tb2	.80	-1.00	.00	—	1.75	1.00	9 2 4	1.00	1.40	1.30	53
6	b2	½	bl	1.38	1.39	1.00	1.67	1.57	1.18	8 7 8	1.00	1.00	1.00	138
3	b2	½	tl	.60	-1.00	2.00	—	.25	-1.00	5 2 3	1.00	.84	1.15	202
3	b2	½	b2	.23	.50	—	—	.50	-1.00	7 5 6	.25	1.00	1.00	42
3	b2	1	al	.25	-.33	—	—	-.33	.00	3 6 5	.50	.00	.10	135
3	b2	1	bt3	1.27	1.75	—	1.00	1.16	1.75	8 8 8	1.25	.75	1.12	361
3	b2	1	ab2	1.98	1.75	1.00	—	1.67	1.50	4 7 5	2.50	2.00	2.15	5
3	b2	1	ba2	.40	.00	—	—	.40	.33	8 4 5	1.00	1.25	1.31	47

APPENDIX M

TABLE LV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE DEFICIENT GROUP

No. of terms	Science make-up	Math. make-up		Grade point averages: College work — Total terms 1&2	Total terms Rem.	Engineering terms 1&2	Engineering terms Rem.	Science & Math. terms 1&2	Science & Math. terms Rem.	Psyc. test score Q.L.T.	High school: Science	Math.	Senior class size
		Math. def.										Total	
Physics (cont.)													
3	b2	1	ac2	1.10	1.35	—	—	.75	1.00	8 6 7	.50	1.00	.75	61
3	b2	1	ab3	.97	1.20	—	1.00	.80	.50	101010	2.00	1.00	1.88	16
2	b2	1½	a3	1.30	1.80	2.00	1.00	1.50	.00	3 7 6	2.50	2.33	1.69	9
3	b2	1½	ab1	.33	-1.00	2.00	1.00	.00	-.50	7 4 2	2.00	1.33	.88	203
3	b2	1½	sb2	.89	1.12	—	—	.67	1.00	5 7 6	2.00	.33	1.67	—
3	b2	1½	as2	1.10	.20	—	—	1.00	.33	7 7 7	1.00	1.00	1.09	367
3	b2	1½	a2	.45	-1.00	2.00	—	.00	-.50	2 3 3	1.00	.50	.84	300
3	b2	2	sbc2	1.00	.67	—	—	1.20	1.00	101010	2.00	2.50	1.52	236
4	b2	n	n	1.67	1.55	1.50	1.00	1.60	1.73	101010	1.50	.83	1.33	371
3	b3	n	ab3	.90	.80	—	—	.84	.67	8 3 5	1.00	.33	.89	171
5	b3	½	ba2	1.37	1.27	2.00	1.67	1.00	1.00	10 4 8	.00	.00	.74	125
6	b3	1	ab2	1.50	1.52	1.00	1.81	1.83	1.17	4 3 3	.75	1.00	1.00	—
3	b3	1½	sb2	1.33	1.60	—	—	1.50	2.00	7 2 4	1.00	2.00	.91	—
5s	b4	n	n	.80	.98	—	1.16	.71	1.20	1 2 1	1.50	2.43	1.83	—
5	b4	½	a1	1.20	1.63	1.00	1.41	1.50	1.47	5 7 7	.25	.50	.81	26
5s	b4	1	ab3	1.47	1.78	—	1.58	1.62	1.73	5 5 5	1.50	1.00	1.35	160
6	b5	n	n	1.64	1.51	1.50	1.00	1.78	1.51	5 7 7	2.00	1.71	1.93	36
5	b5	n	n	1.23	.78	—	.50	1.21	.50	10 5 6	—	1.37	1.20	234
5	b5	n	b3	1.30	1.38	—	.89	1.50	.77	10 6 9	1.00	1.00	1.22	464
4s	b5	½	t3	.40	-1.30	1.00	.00	.20	-.20	2 3 2	1.50	1.00	1.31	103
6	b5	1	bt3	1.10	1.25	2.50	1.80	.50	1.04	101010	2.00	1.00	1.22	537
Science														
3	n	n	n	1.50	2.37	—	—	2.50	—	10 910	1.50	3.00	2.40	85
3	n	n	n	1.41	1.38	—	1.00	1.30	1.00	6 5 5	1.00	2.37	2.31	207
8	n	n	n	1.62	1.94	.70	1.65	1.93	1.75	101010	2.00	2.00	2.26	91
3	n	n	n	1.74	1.20	1.50	1.00	1.30	2.00	- - -	2.50	2.25	1.88	305
10	n	n	n	.58	1.82	.53	1.22	.70	1.65	4 6 5	.67	1.28	1.58	50
9	n	n	n	2.10	2.10	2.40	2.16	2.60	2.86	9 4 6	1.50	1.60	1.50	—
8	n	n	n	1.33	—	—	—	1.25	—	9 4 7	1.00	.60	.48	74
3	n	n	b1	1.45	1.56	.00	1.00	1.53	2.00	5 2 3	.50	1.00	1.80	114
3s	n	n	ab3	.87	2.25	—	—	1.00	1.00	8 8 8	1.00	1.00	1.00	350
3	n	n	ab2	1.53	.00	—	.00	1.67	1.00	9 9 9	1.00	.00	.40	—
3	n	1	bt3	1.00	1.40	.50	—	2.00	1.50	8 5 6	1.50	2.00	2.30	426

APPENDIX M

TABLE LV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE DEFICIENT GROUP

No. of terms	Science make-up	Math. make-up	Math. def.	Grade point averages: College work: Total terms 1&2	Total terms Rem.	Engineering terms 1&2	Engineering terms Rem.	Science & Math. terms 1&2	Science & Math. terms Rem.	Psyc. test score Q.L.T.	High school: Science	Math.	Senior class size
												Total	
Science (cont.)													
4	n	n	n	1.25	1.42	1.27	2.10	1.30	1.31	10 7 9	2.50	3.00	1.96	52
3	b1	n	b1	.95	1.67	.00	1.00	1.05	1.50	10 5 8	3.00	1.50	1.67	472
3	b1	n	n	2.06	2.00	—	2.50	2.00	1.00	81010	1.25	.50	1.15	—
3	b1	n	n	1.41	1.75	1.00	1.00	1.00	-1.00	81010	.50	.75	1.10	125
3	b2	n	n	1.61	1.91	—	—	1.50	2.00	9 8 9	3.00	2.83	2.70	23
3	b2	n	n	.78	1.33	1.00	—	.00	1.33	101010	2.00	1.86	1.87	40
3	b2	n	n	1.47	1.34	—	1.00	1.33	1.50	8 8 8	2.00	2.30	1.83	62
3	b2	n	n	.44	.40	—	—	.60	-1.00	8 6 7	1.50	1.56	1.75	27
3	b2	n	n	1.16	1.00	—	—	1.50	1.50	10 910	1.00	1.71	1.58	228
3	b2	n	n	1.20	.00	—	—	1.20	1.00	4 3 3	1.00	1.62	1.44	286
3	c2	n	n	1.25	.62	—	1.00	1.00	2.00	9 5 7	2.00	1.75	1.40	189
3	b2	n	n	1.67	1.81	2.00	2.00	1.50	2.50	101010	1.00	1.12	1.33	450
3	b2	n	a2	1.60	1.50	—	—	1.80	2.00	4 5 4	2.00	1.25	1.59	120
3	b2	1	t1	1.47	.40	—	.00	.92	1.00	8 4 6	1.00	2.50	1.43	—
3	b2	1	b1	.11	-1.00	—	—	.40	.50	9 6 8	1.00	.25	.71	250
3	b2	n	n	2.00	1.75	3.00	—	2.40	2.50	101010	2.50	2.85	2.10	334
8	c3	1	ab0	1.17	1.30	1.20	1.35	.77	1.23	2 4 3	1.33	2.30	2.06	354
6s	c3	n	n	.99	1.09	.90	1.50	.82	1.12	5 2 3	2.00	2.50	2.00	46
3s	b3	n	n	.90	1.00	—	.00	.80	1.30	10 910	1.75	1.67	1.97	—
4	b3	n	n	1.07	1.03	—	2.00	1.20	.33	9 4 6	1.50	1.72	1.73	49
3	b3	n	n	.55	1.08	1.00	—	.50	1.00	5 6 5	1.00	.85	1.12	152
3	b3	1	b1	1.14	2.06	2.00	—	1.00	1.33	4 1 2	1.50	1.75	1.75	300
6s	b4	n	a1	1.11	.43	1.00	.14	2.00	.41	7 7 7	.50	.86	1.13	377
6	b5	n	n	.96	.34	—	1.00	.83	.61	9 4 2	1.50	1.75	1.30	104
6	b5	n	n	1.16	.95	2.00	1.83	1.50	1.12	6 5 5	.00	.50	.97	144
5	b5	1	ab1	1.50	1.70	1.50	1.83	2.12	1.55	7 6 6	3.00	3.00	2.53	82
7	b5	1	ba2	1.07	1.02	.00	1.73	1.67	.79	4 5 4	2.00	1.50	1.87	18
7s	b6	n	n	1.80	1.00	2.00	1.33	.50	1.14	10 4 7	1.00	1.67	1.42	334
4s	b6	1½	stb4	.75	.96	—	1.00	.50	.90	810 9	2.60	2.00	1.58	120

APPENDIX M

TABLE LV (continued)

A SUMMARY OF THE ESSENTIAL DATA FROM THE DEFICIENT GROUP

No. of terms	Science make-up	Math. make-up		Grade point averages: College work: Total terms 1&2	Total terms Rem.	Engineering terms 1&2	Engineering terms Rem.	Science & Math. terms 1&2	Science & Math. terms Rem.	Psyc. test score Q.L.T.	High school: Science	Math.	Senior class size
		Math. def.										Total	
Physics plus another science													
6	n	n	n	2.33	2.33	3.00	2.78	2.60	2.02	91010	3.00	3.00	354
3	n	n	n	1.36	2.20	2.00	2.00	1.00	1.50	3 6 4	—	1.57	183
6	n	n	a3	1.16	1.43	—	1.73	1.00	1.32	5 7 6	—	1.00	126
6	n	n?	as3	.90	1.01	—	1.50	.83	1.00	6 7 7	1.00	1.00	207
8	n	1	ab3	1.23	1.09	1.00	1.40	.95	.81	4 4 4	1.50	1.25	133
3	n	1	t1	1.00	.40	—	—	.67	.33	9 7 8	1.00	1.50	—
6	n	2	n	1.75	1.80	1.83	1.78	1.74	1.67	10 7 9	2.50	3.00	688
3	b1	n	ab2	1.00	.80	—	1.00	1.36	2.00	9 3 6	—	2.33	77
3	b1	n	n	1.31	1.75	—	—	.82	1.00	101010	1.50	.75	53
3	b2	1	at3	1.16	.50	—	—	1.00	1.00	8 7 8	2.00	1.75	688
5	b2	3	ssa	1.00	1.04	—	.00	.50	1.00	9 8 8	2.00	2.00	231
5	b3	2	sab2	1.09	1.31	—	1.08	1.25	1.00	10 6 8	—	.50	300
3	b3	n	n	1.30	2.42	—	—	1.75	2.00	8 3 5	2.00	2.50	200
3	b3	½	ac2	-.25	-1.00	—	—	-.50	-1.00	5 5 4	.00	.16	309
3	b3	1	at3	1.12	1.17	—	3.00	1.67	1.50	9 5 7	—	2.00	115
4	b3	1	abt3	1.10	1.50	—	—	1.00	1.20	81010	1.00	1.50	—
3	b?	1	a1	1.47	.80	1.00	.00	1.25	1.50	3 3 3	1.67	1.00	334
4	n?	2	a1	.50	-.10	1.00	—	.33	.50	7 3 4	—	1.00	319
6	b5	2	sab4	1.30	1.52	—	1.57	1.00	1.60	9 9 9	1.25	.00	555