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OCCASIONAL PAPERS ON EUGENICS
NUMBER FOUR

PSYCHOLOGICAL
APPROACHES TO THE
BIOGRAPHY OF GENIUS

BY

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PSYCHOLOGICAL APPROACHES
TO THE BIOGRAPHY OF GENIUS
PART ONE¹

PROBABLY few words have acquired a greater variety of connotations than "genius". On this occasion I shall disregard the numerous meanings attached to the word in the first two thousand years of its history and call attention only to common usages in modern English.

In a popular sense genius is often used to designate some kind of mystical gift that cannot be explained by the ordinary laws of human nature. The scientist, of course, rejects this usage. Havoclock Ellis and others have used the term as practically synonymous with eminence. Galton, while employing the criterion of eminence, follows Samuel Johnson in defining a genius as one who is endowed with superior intellectual ability. This definition is essentially identical with that given in Warren's *Dictionary of Psychological Terms*, 1934, and is the one I prefer.

The *sine qua non* of genius is the ability to acquire and to manipulate concepts, the shorthand symbols without which abstract thinking cannot proceed. However, there are many levels of aptitude for concept mastery and the question arises where genius may be said to begin. We have at one extreme Dr. Fields' laboratory rats which required thousands of trials and a good part of their lives to learn to respond to triangularity in visual stimuli; that is, to acquire one crude concept. At the other extreme are the Newtons and the Aristotles. The intermediate levels range upward through infra-human intelligence, average human intelligence and the superior grades that permit higher and higher levels of abstraction. Any line that may be drawn to demarcate genius is purely arbitrary. Whether one restricts the term to the ablest in many millions, in a few thousand or in a few hundred, does not matter provided the facts are stated.

Another problem is that of identifying the individuals who qualify at a particular level of genius chosen for investigation. I have referred to the criterion of eminence. Unfortunately, eminence as measured by popular acclaim or even by space in biographical dictionaries is influenced by other circumstances than intellectual achievement. The population it affords is the result of innumerable selective factors which vary from age to age and from culture to culture. The genius

¹ Presidential address before the Pacific Division of the American Association for the Advancement of Science, Seattle, June 18, 1940.

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who survives as such has successfully run the gauntlet of premature death, the inanities of formal education, the social and ethical pressures of his immediate environment, and the more general cultural influences that have given direction and content to the civilization in which he was born. To study only the biographies of historic characters gives us a one-sided picture in that it tells us nothing about the potential geniuses who failed to achieve greatly. To complete the picture it is necessary not only to investigate the life histories of eminent persons but also to inaugurate researches that will proceed in the opposite direction. That is, we should identify early in life those individuals who are intellectually gifted, secure quantitative measures of their mental and physical traits, then follow their careers through life.

For twenty years parallel studies in these two directions have been in progress at Stanford University. On the one hand, the mental development of 300 eminent individuals has been traced backward to childhood; on the other hand, the development of more than thirteen hundred intellectually superior subjects has been followed in the forward direction from childhood to early maturity. It is possible to give you this evening only a few highlights from these two lines of investigation.

I

I shall first review some of the more recent approaches to the biographical study of eminent persons. As you well know, the highly original publications of Francis Galton between 1869 (*Hereditary Genius*) and 1889 (*Natural Inheritance*) stimulated many interesting investigations on the origin and qualities of great men. Unfortunately, the methodology of these studies soon became stereotyped along statistical lines, with failure to take advantage of progress in individual psychology. It has long seemed to me that the writing of a biography is as much a psychological as an historical undertaking and that biographers fail as often from lack of psychological insight as from any other cause. Not infrequently an otherwise competent biographer overlooks crucial facts in his subject's mental life or else interprets them in ways that are psychologically unsound. It was a striking example of such erroneous interpretation that led me to apply to the Commonwealth Fund for a grant to finance a research on the early mental development of historical geniuses. At that time my study of California gifted children was under way and the possibility of cross-illumination from the two lines of approach seemed promising.

The erroneous interpretation referred to was found in Karl

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Pearson's *Life, Letters and Labors of Galton*. In a discussion of Galton's intellectual precocity Pearson had presented an extraordinary array of documentary evidence regarding his subject's early accomplishments. Francis learned to read at the age of two and a half years and wrote a letter before he was four that has been preserved. By the age of five he could read "almost any English book" and some French, could cast up any sum in addition, had mastered all the multiplication table except the 9's and 11's, knew the table of English money and could tell time by the clock. Now it happens that all of these and several other dated performances of Galton have been standardized by psychologists on unselected children of different ages, and that the mental age necessary for each performance is known. By the use of such norms it is possible in the case of Galton to estimate with considerable assurance the lowest I.Q. that would account for the facts. This was unquestionably in the neighbourhood of 200, a figure not equalled by more than one child in 50,000 of the generality.¹ Yet Pearson was so unaware of the significance of the performances he had described as to assert: "I do not think we can say more than that Francis Galton was a normal child with rather more than average ability."

The research for which funds had been provided was carried out by Catharine Cox and two assistants. The first task was to select a group of eminent subjects in such a way as to avoid the bias that is sure to enter when selection is subjective and haphazard. Cox began with Cattell's list of the 1,000 most eminent individuals of history as determined by the space devoted to them in biographical dictionaries. Taking the 500 most eminent of Cattell's list, she eliminated from this group those born before 1450, those who belonged to the hereditary aristocracy or nobility, and a few others, arbitrarily, whose eminence had little or no basis in intellectual achievement. This left her with 300 subjects.

Cox and her assistants combed the biographies of these subjects for data on early mental development as indicated by interests, education, school standing and school progress, friends and associates, reading, production and achievement. Special attention was given to evidence from documentary sources. The material thus assembled ran to 6,000 typed pages. The evidence for each subject was then examined independently by three psychologists who were intimately acquainted with age norms of mental performance. Their task involved two things: (1) estimation of the minimum I.Q. that would account for a subject's childhood performances, and (2) a rating of the reliability of the evidence on which the I.Q. estimate

¹Lewis M. Terman, *Am. Jour. Psychol.*, 1917, pp. 209-15.

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was based. The averages of the three estimates for all individual subjects were the primary data for this part of the study.

It must be emphasized that the I.Q. as reckoned is an estimate of the lowest I.Q. that could reasonably account for the recorded facts; the actual childhood I.Q.'s of historical geniuses are of course indeterminate.

For the entire group the estimated minimum I.Q.'s ranged from 100 to 200, with an average of 155. The average is more than three standard deviations above the mean of the generality. Low estimates in the range of 100 to 120 I.Q. occurred only when there was little biographical information about the early years. The mean was highest for philosophers (170), and next highest for poets, novelists, dramatists and revolutionary statesmen (160). The lowest was for soldiers (125), the next lowest for artists (140) and musicians (145). The mean for scientists (155) was identical with the mean for the total group.

It will be understood, I trust, that I.Q. estimates of this kind are not to be taken too literally. For a majority of the subjects the information on which the estimates were based was far short of what could be desired. However, despite all inadequacies of the data I believe that the author's main conclusion is warranted: namely, that the genius who achieves highest eminence is one whom intelligence tests would have identified as gifted in childhood. The author warns us that the converse of this does not follow; we may not conclude that every child who tests high will become eminent. Her data suggest that those who do achieve greatly are characterized not only by superior intellectual ability but also "by persistence of motive and effort, confidence in their abilities and great strength or force of character".

That personality traits are influential in determining both the level and the direction of achievement cannot be doubted. We shall see later that this is certainly true of the gifted children I have studied. However, one must also take account of the part played by chance. For a given type of achievement to be possible one must be born not too far from a given time and place. It is an interesting game to try to imagine how differently any list of eminent persons might read if every one now in it had lived a generation or two earlier or later. The soldiers would nearly all bear strange names, perhaps a majority of the statesmen, especially revolutionary statesmen, and doubtless many of the writers and scientists.

Apart from time and place of birth, there are other chance factors in vast number that are capable of shaping the life of a gifted youth. Newton at 15 had left school and was tending his mother's farm; but

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for the timely visit of an uncle who had attended Cambridge it is unlikely that he would ever have received the education that made possible his great discoveries. Victor Cousin was bred in the gutter and was illiterate at the age of 10 when he happened to befriend a bully's victim in a street fight, with the result that the latter's mother sought him out and gave him an education. Faraday left school at 13, and at 14 was apprenticed to a bookbinder. It was the reading of an article on electricity in an encyclopaedia given him to bind that first stimulated his interest in science. Even this would probably have got him nowhere had not Humphrey Davy been near to lend a helping hand.

In a study like that of Cox, special interest attaches to certain eminent persons who have been cited as examples of childhood backwardness. In every one of these cases the facts clearly contradict the legend. Goldsmith was characterized by Samuel Johnson as "a plant that flowered late", and a childhood teacher said of him in her old age, "never was so dull a boy". Actually Goldsmith was writing clever verse at the age of 7 years and at 8 was reading Ovid and Horace. His I.Q. was probably 140 or higher. Sir Walter Scott is said to have been a dunce when he attended the Musselburgh School. The facts are that he never attended this school, that when only 7 years old he read widely in poetry and in his prose at this age used correctly such words as "melancholy" and "exotic", that by age 10 he had collected a small library of ballads and that at 13 he lay awake nights reading Shakespeare when he was supposed to be asleep. His I.Q. was at least 150.

Other alleged dullards represent a type often encountered in the old-fashioned Latin school, i.e. the youth who hated Latin and Greek but had a natural talent for science. Liebig, the founder of physiological chemistry, was the despair of his language teachers. At 15 he left school and was apprenticed to an apothecary because he wanted to be a chemist. At 17 he managed to enter a university and at 20 was awarded the Ph.D. degree. John Hunter, British surgeon and anatomist, left Latin school at 13 and spent four apparently idle years roaming the woods and fields, "watching the ants, the bees, the birds, the tadpoles, and caddis-worms, pestering people with questions about which nobody knew or cared anything". Alexander von Humboldt and his brother Wilhelm, two years older, were privately tutored along the usual classical lines. Wilhelm liked languages and was early recognized as gifted; Alexander, caring only for nature, was considered mentally slow. Both became eminent, but Alexander outstripped his brother.

In the cases just cited one notes a tendency for the direction of

later achievement to be foreshadowed by the interests and pre-occupations of childhood. I have tried to determine how frequently this was true of the 100 subjects in Cox's group whose childhood is best documented. Very marked foreshadowing was noted in the case of more than half of the group, none at all in less than a fourth. Macaulay, for example, began his career as historian at the age of 6 with what he called a "Compendium of Universal History", filling a quire of paper before he lost interest in the project. Goethe's literary juvenilia are perhaps the most remarkable that have ever been preserved. Ben Franklin before the age of 17 had displayed nearly all the traits that characterized him in middle life; manual skill, scientific curiosity, religious heterodoxy, wit and buffoonery, political and business shrewdness and ability to write. At the age of 70, when on a diplomatic mission in England, he dug up an article which he had written in his teens, published it practically without change, and created a political sensation. At 11 Pascal wrote a paper on sound and was so interested in mathematics that his father thought best to deprive him of books on this subject until he had first mastered Latin and Greek. Pascal secretly proceeded to construct a geometry of his own and covered the ground as far as the 32nd proposition of Euclid. At 14 Leibnitz was writing on logic and philosophy and composing what he called "An Alphabet of Human Thought". He relates that at this age he took a walk one afternoon to consider whether he should hold the doctrine of substantial forms.

In working with data of this kind the investigator must of course be wary, for even under the pen of a conscientious biographer the childhood period is likely to be coloured by the halo of adult achievement. The evidence, however, is indisputable in the case of nearly all the musicians, and hardly less convincing in the case of mathematicians and artists. There are few great poets who did not show unusual poetic talent before the age of 15.

We can go further and say that the literary style of a poet's juvenilia usually resembles that of his mature productions. Let me illustrate by a single example. I shall read to you a few lines from two poems, both of romantic content and both written at the age of 14. I am sure you will have no difficulty in guessing which was written by Alfred Tennyson and which by Samuel Johnson.

THE BRIDAL

The lamps were bright and gay
On the merry bridal-day,
When the merry bridegroom
Bore the bride away!
And the chapel's vaulted gloom

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Was misted with perfume,
"Now, tell me, mother, pray
Why the bride is white as clay,
Although the merry bridegroom
Bears the bride away."

TO A YOUNG LADY ON HER BIRTHDAY

This tributary verse receive, my fair,
Warm with an ardent lover's fondest prayer,
May this returning day forever find
Thy form more lovely, more adorn'd thy mind;
All pains, all cares, may favouring Heaven remove,
All but the sweet solicitudes of love!
May powerful nature join with grateful art,
To point each glance and force it to the heart!
O then, when conquer'd crowds confess thy sway,
When ev'n proud wealth and prouder wit obey,
My fair, be mindful of the mighty trust:
Alas! 'tis hard for beauty to be just. . . .

In the first you recognize the light rhythm, alliteration, and pretty jingles so characteristic of Tennyson, and in the second the ponderous periods of Sam Johnson and his predilection for big words. What could be more Johnsonese than the line "all but the sweet solicitudes of love"? Or than the adage with which the verse ends: "Alas! 'tis hard for beauty to be just"? Johnson's writings and his conversation throughout his life were peppered with adages borrowed or improvised.

The early interests and displays of special talent by Cox's subjects were often disregarded in the vocational guidance given them by parents and teachers. In no less than 20 of the 100 cases whose childhood is best known there was pressure to turn the subject into another field than that in which eminence was achieved. The destiny that half of these had to escape was the legal profession. Balzac's parents tried for five years to starve him into submission that they might make a lawyer of him. Dumas (père) was first destined for a military career, later for the priesthood and was finally apprenticed to a notary. When Victor Hugo was 19 his father offered him an allowance if he would relinquish literature for a more substantial profession. Victor preferred to live in a garret and write. Coleridge's father wanted his son to be a parson, but fortunately the father died and the boy was reared by an uncle who recognized literary genius when he saw it.

The guidance of gifted children is made more difficult by their versatility. Intellect by its very nature is highly general, and it follows

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that to one who is intellectually superior many fields of achievement are possible if the requisite interests and drives are present. The versatility of a few geniuses has received considerable attention, but the less spectacular cases are overlooked. People like to believe that the genius as a rule is no better than the rest of us except in one particular. The facts are very different. Except in music and the arts, which draw heavily on specialized abilities, there are few persons who have achieved great eminence in one field without displaying more than average ability in one or more other fields.

A few years ago, one of my students, Ralph K. White, made a study of the versatility of Cox's 300 geniuses.¹ Using the biographical information assembled by Cox, White and another psychologist rated each subject on the ability shown in 23 different fields. The results indicated that a majority of the subjects displayed more than ordinary ability in 5 to 10 fields. The mean versatility index was highest for non-fictional writers, statesmen and philosophers (around 7.5); somewhat lower for scholars, religious leaders, scientists, poets, mathematicians, novelists and dramatists (around 6.7); much lower for soldiers and artists (4.3 and 4.0), and lowest of all for musicians (only 2.7).

White further analysed his ratings to see what abilities tended to appear together. It was found, for example, that science, mathematics, invention and handwork form a rather closely-knit group; poetry, novels and drama another. Philosophy, social theory, history and languages form a third but less compact structure. Religious leadership is allied with politics and administration, while musicians stand pretty much alone. One of the most interesting relationships is that between art and the science cluster. Leonardo da Vinci is here the supreme example.

Another approach to the biography of genius is by way of psychoanalysis, which investigates the motivational dynamics that shape the individual personality. The contributions from this direction now make up a vast literature difficult to appraise. To any but the most orthodox Freudian much of it will appear highly extravagant and far-fetched. Some of the contributions, however, appeal to the psychologist as in line with common observation. One does not have to accept the elaborate superstructure of symbolism erected by Freud to be convinced that psychoanalysis has profoundly influenced modern theories of personality. There are few psychologists who longer doubt that the crucial influences shaping the lives of some persons stem from their childhood experiences: for example, from parent-child conflicts or attachments, from sibling relationships, from

¹ Ralph K. White, *Jour. Social Psychol.*, 1931, pp. 460-89.

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the sense of not being wanted or from frustration in its myriad forms. It is impossible to understand the unsexed personality of John Ruskin without knowledge of his parental attachments, the rebellious spirit of Lord Byron without knowledge of his deformity and of his maternal conflicts, or the messiah complex of John Wesley without knowledge of the mother-inspired ideal to which he was moulded by family pressures. The phenomenon called Hitler surely is not to be explained in terms of extraordinary intellectual endowment, but rather in terms of personal frustrations, displaced hatreds and fanatical aggressions.

I believe there is factual basis for Lasswell's suggestion that the role of rebel or agitator is sometimes only a continuation of the child's fight against parental tyranny. Emma Goldman, with psychological insight unusual in autobiographies, calls attention to the possible relationship between her career as anarchist and the brutalities she suffered from her father in childhood; she did not think it accidental that one of her foremost associates among the anarchists had a similar background of domestic tyranny.

Lange-Eichbaum, a German psychiatrist, has emphasized the importance of inner conflicts and tensions of whatever kind as stimulants to great achievement. He believes that without such irritants no one ever puts forth his maximum effort; that the personality happily adjusted to its environment and never stirred to action by opposition or frustration is foredoomed to obscurity. Examining from a psychiatric point of view the lives of a large group of historical geniuses this author concludes that the more eminent the subject the more marked the evidence of inner conflict bordering on the psychopathic. One would like to see this conclusion checked by a research commission composed of historians, psychiatrists and psychologists working with an objectively selected population.

In evaluation of these various approaches to the study of historical geniuses I wish to go on record as believing that all of them have merit enough to justify their further cultivation. At the same time, anyone who has attempted to draw conclusions from the fragmentary information that can be gleaned from biographical works is painfully aware of the limitations of his material. One's interpretations are at best only tentative and suggestive, lacking always the finality of positive proof. It is a relief, accordingly, to turn to the investigation of living subjects who may be studied first-hand at successive age levels with unlimited opportunity for correlating factual data in the individual's life history.

By the study and follow-up of intellectually superior children we can find out what such individuals are really like in early life and what kind of men and women they become. Data which I had been able to secure from tests and observations of about 100 gifted children between 1910 and 1920 suggested that many of the traditional beliefs on these points contained a preponderant element of superstition. It was obvious, however, that to secure anything like conclusive evidence would require an expensive study of a large and representative group of subjects.

By good fortune a grant was obtained from the Commonwealth Fund for an investigation of the desired scope. In 1922 a school population of more than a quarter of a million was sifted by methods which brought to light practically all the children capable of earning an I.Q. of 140 or higher, a score that is attained by only five or six children in 1,000. More than 1,050 subjects of this degree of intellectual superiority were located in the elementary grades and about 400 in high schools, a population large enough to yield reliable statistical constants and sufficiently free from sampling bias to provide a sound basis for generalization. What is true of this group should be true of any similarly selected group in any comparable culture.

Let it again be noted that the gifted child is here arbitrarily defined as one whose score in tested intelligence is equalled by about one child in 200 of the school population. Obviously the term "genius" can be applied to subjects of this grade of mental superiority only in a very liberal sense. The population studied by Galton was twenty times as highly selected, since it included only the most eminent in 4,000 of the generality. The American "Who's Who" population is ten or twelve times as highly selected as my gifted group, and Cattell's galaxy of 1,000 starred scientists is over a hundred times as aristocratic. It is necessary to hold these comparative figures in mind in order to appraise justly the life achievements of the subjects I have studied.

The data secured for this group in 1922 include for a majority of the subjects two intelligence scores; twelve scores from a four-hour test of school achievement; scores from three tests of character, personality and interests; 34 anthropometric measurements; the results of a one-hour medical examination; ratings by parents and teachers on 25 personality traits; and a large amount of case-history information supplied by parents, teachers and field assistants. What is the gifted child like when we find him?

The medical examination and anthropometric measurements showed the typical gifted child physically superior to the average. The tests of personality and character yielded scores far superior to those of average children of corresponding age. In school achievement the gifted subjects scored almost as high as in I.Q. A majority of them had in fact acquired a good mastery of the curriculum as far as two, three or even four school grades beyond that in which they were enrolled.

Marked unevenness in achievement was rare. Whereas the mean intelligence quotient of the group was about 150, the mean achievement quotients in reading, arithmetic, language usage, spelling, science information, literary information, historical information, and aesthetic information, were all in the narrow range between 137 and 152. The relative uniformity of these average scores establishes beyond question that a high degree of versatility is the rule in a group of this kind.

This is where our biographical study of gifted children began in 1922. It has now been under way long enough to give some indication of the probable life achievement of such a group. The thousand who were below high-school age in 1922 now range from 22 to 32 years, with a median of about 27. The 1922 high-school subjects range from 29 to 37, with a median of 33. I am still in contact with more than 95 per cent. of the original group.

For several years after 1922 the subjects were followed by information blanks that were filled out and mailed to me annually by the parents and teachers. In 1928 a second grant from the Commonwealth Fund made it possible to have field assistants re-test most of the subjects and obtain a large amount of additional information through interviews with parents, teachers and the subjects themselves. The next follow-up was conducted chiefly by mail in 1936-7, but a liberal grant from the Carnegie Corporation a year ago has made it possible to keep three research associates in the field since last September testing and interviewing the subjects. As not all of the new data have yet been statisticized, most of the figures I shall report will be in round numbers subject to later corrections that will not materially affect the picture.

First a few vital statistics. The mortality rate of the group to date is below that of the generality of corresponding age. The same is true of the insanity rate. The incidence of suicide approaches more closely that of the generality.

At the present time nearly 71 per cent. of the members of the group are or have been married, the proportion being about the same for men and women. The divorce rate is below that of the

generality in California of corresponding age. Among those who have married, 43 per cent. of the men and 35 per cent. of the women married college graduates. The mean intelligence score of the subjects themselves is well above that of their spouses, but the latter also test high.

The group by 1940 had produced about 783 offspring. Tests given recently to 384 of these who are above the age of two years, have yielded a mean I.Q. of approximately 127, which represents about the expected regression towards the mean of the generality.

Has the intellectual superiority shown by this group in 1922 been maintained? In terms of intelligence test scores the answer is, on the whole, in the affirmative. The re-tests given during the past year showed a majority of the subjects close to the 99th percentile of the generality. This is true even of those whose careers have not been particularly successful. Although there are exceptions to the rule, the intellectually gifted individual can be identified almost as accurately in the third elementary grade as at age 30.

With regard to educational achievement, the average member of the group enters high school at 13 and college at 17. Nearly 90 per cent. enter college and of those entering about 80 per cent. graduate. Although averaging more than a year younger than their classmates, they engage more extensively in extra-curricular activities, receive more student-body honours and are several times as likely to graduate with distinction.

Approximately two-thirds of the men who graduate, and half of the women, go on for graduate work. Of some 300 men who have completed their graduate studies, about 50 have received a Ph.D. degree, about the same number a medical degree, about 85 a law degree, and about 35 a degree in engineering or architecture. Less than one-tenth as many women as men have obtained a graduate degree beyond the M.A. For the sexes combined the incidence of higher professional degrees is perhaps twenty or thirty times as great as for the general population.

In appraising the life achievements of these subjects it is necessary to take account of the severe economic depression that has spanned most or all of their adult years. This circumstance has made harder the way of many and has diverted some permanently from their educational goals.

The averaged earned income of the men at age 30 is around \$3,000 a year. About a dozen of the men are earning between \$10,000 and \$15,000 a year. In general, the women who are gainfully employed earn only about half as much as the men, and the maximum reached by women is only about one-fifth the maximum for men. Income,

however, is a poor measure of achievement, particularly in the case of young men just starting on their professional careers. Some of the most promising members of the group are at present (1940) earning less than \$2,500 a year.

Turning to other indications of achievement we find that about 50 of the men and a dozen of the women are teaching in colleges or universities. Seven of these are already executive heads of departments.

Publications by the total group number hundreds of articles in professional or technical journals, at least 20 books, and a vast number of short stories, popular articles and poems. The books include text-books, scholarly treatises, a semi-popular book on invention, five volumes of fiction and two books of poems. Eighty or more patents have been issued to men of the group, none to any of the women.

As a relief from impersonal statistics I will cite briefly a few examples of individual accomplishment. The list could be multiplied many times in length.

1. A professor in one of the physical sciences and head of his department in a great university. Has published three text-books, more than 50 research articles, and has taken out more than a score of patents. Well known nationally and internationally.
2. A professor of physiology in a state university and head of his department. Has devised new techniques for heart diagnosis which he has been called upon to demonstrate in leading medical schools of this and other countries. At the age of 36 has 52 publications to his credit.
3. A brilliant student who took his master's degree at 20 in classical literature, then turned to business and at 27 became chief investment analyst for a forty-million-dollar educational foundation.
4. A musical composer of international reputation, nurtured in poverty and totally unschooled until the age of 17. He is the author of three books and dozens of articles on musical theory. In the last three years alone he has composed 60 major orchestral works, written a book on melody and learned two foreign languages.
5. An aeronautical engineer who at 32 is co-ordinator of research in a ten-million-dollar aeronautical laboratory.
6. An artist in the middle twenties who is an important member of Walt Disney's staff with a salary of \$1,000 a month.
7. A woman who has shown exceptional talent in several

fields. Between the ages of 7 and 15 she wrote a vast quantity of poetry, some of which was rated by professors of English as equal to the best juvenilia of eminent English poets. After graduating from college at 17 she wrote a novel, studied painting for a time, then turned to sculpture and was for three years the sole pupil of one of the best known sculptors in Europe. She bids fair to become eminent in this field.

8. A woman of 28 who has a Ph.D. degree in English and has published a volume of poetry that won high praise from critics. Like Number 7, she began writing poetry in early childhood and produced several juvenilia that compare favourably with those of eminent authors.

9. A woman who was awarded the degree of doctor of science by the Pasteur Institute at age 25 and is engaged in medical research.

10. A woman who received the A.B. degree in engineering at 19, a graduate degree in mining engineering at 21, and a doctorate in metallurgy at 24. She is assistant to the director of a research laboratory of a large steel firm.

We have seen in the case of historical geniuses that the direction of adult accomplishment is often foreshadowed during the early years. In order to find whether this is true of my gifted group the records of men in the various fields are being compared with respect to childhood hobbies, school marks, achievement test scores, amount and kinds of early reading, trait ratings by parents and teachers, early social adjustment and other variables. Although the analysis has not been completed, the data are showing more than chance agreement between some of these variables and the field of adult achievement. This is particularly true of those who have accomplished the most. Achievement in music, literature and art is almost always foreshadowed in some degree.

The range of success in my group is very wide for both sexes and at the present time extends downward to occupations as humble as those of policeman, carpenter, gardener, gas station operator, department store floor-walker, store clerk, house-to-house canvasser, small rancher, seaman, telephone operator, typist and filing clerk. The question arises what factors other than intelligence are important determiners of achievement in such a group.

One, obviously, is sex. Although the women equal or excel the men in school achievement from the first grade through college, after school days are over the great majority cease to compete with men in the world's work. If they do not marry at once they accept

whatever kind of respectable employment is at hand. After marriage they fall into the domestic role and only in exceptional cases seek other outlet for their talents. The woman who is a potential poet, novelist, lawyer, physician or scientist usually gives up any professional ambition she may have had and devotes herself to home, husband and children. The exclusive devotion of women to domestic pursuits robs the arts and sciences of a large fraction of the genius that might otherwise be dedicated to them. My data strongly suggest that this loss must be debited to motivational causes and to limitations of opportunity rather than to lack of ability.

Since the achievement of women is so largely determined by extraneous circumstances and is in any case so difficult to estimate, my investigation of the causes of success and failure has been confined to the male group. Three psychologists, working independently, examined the records of 600 men and rated each subject on life success. The criterion of "success" was the extent to which a subject had made use of his superior intellectual ability. The judges were instructed to give very little weight to earned income.

On the basis of these ratings the men were tentatively classified into three groups, composing roughly the highest fourth, the middle 50 per cent. and the lowest fourth. The highest and lowest fourths, or the A and C groups as we have called them, were then compared with respect to test scores of 1922 and 1928, family records, home environment, case histories, health data, trait ratings and many other items of information, in the hope that by reading the records backwards, so to speak, some light might be thrown on the factors that influence achievement.

The educational and occupational records of these two groups present a vivid contrast. Of the A's, 98 per cent. entered college and 90 per cent. graduated; of the C's, 70 per cent. entered and only 50 per cent. graduated. Three-fourths of the A's but only a fifth of the C's completed one or more years of graduate work. Among those graduating, nearly one half the A's but only 4 per cent. of the C's were elected to Phi Beta Kappa or Sigma Xi. Half of the A's but only 10 per cent. of the C's had received appointment to scholarships, fellowship or assistantships. In professional or semi-professional pursuits were 96 per cent. of the A's as compared with 28 per cent. of the C's. Although salary had been given little weight in the success ratings, the average earned income of the A's was two and a third times that of the C's.

Let us turn next to the childhood records and test scores of the two groups to see what facts or circumstances are associated with differences in life accomplishment. We note first that during the

elementary school years the A's and C's were about equally successful. Their average grades were almost identical, and the average scores on a four-hour achievement test were only a trifle higher for the A group. In high school the groups began to draw apart as a result of lower grades in group C, but it was not until the college period that the slump of this group assumed alarming proportions. The slump cannot be blamed upon extra-curricular activities, for these were almost twice as common among the A's as among the C's. Nor can it be attributed to intellectual deterioration, for on every mental test, from 1922 to 1940, the average score of the C's has been only a few points lower than that of the A's. In a population so highly selected for intelligence that each person is in it rates within the top one per cent. of the generality, the differences in success must necessarily be due chiefly to non-intellectual factors.

For one thing, the family backgrounds of the two groups differed markedly. Nearly twice as many A parents as C parents had graduated from college, and a similar difference was found between the siblings of A's and C's. Fathers of the A's were far more often in the professional classes. The important point here is that the educational tradition was stronger in families of the A group. In line with this is the fact that the Jewish element is three times as large among the A's as among the C's. The Jewish child is under heavy pressure to succeed, with the result that he accomplishes more per unit of intelligence than do children of any other racial stock.

Significant differences between the groups were found in the childhood data on emotional stability, social adjustments and various traits of personality. The case histories and trait ratings obtained from parents and teachers in 1922 reflect these differences clearly. All the 1922 trait ratings except those for health averaged lower for the C group. That is, fifteen or more years prior to the classification of these subjects on the basis of adult achievement, teachers and parents had been able to discern personality differences that would later characterize the two groups.

The A-C differences are further evidenced in the marital records. The incidence of marriage is higher in the A group and the age of marriage is lower. Moreover, the A's marry better than the C's; the A spouses score higher in intelligence tests and include nearly twice as large a proportion of college graduates. Especially significant is the contrast in marital adjustments, for the incidence of separation or divorce is only a third as high in the A group as in the C group. This difference extends even to the parents of the two groups, the incidence of separation or divorce being only half as great for A parents as for C parents.

The A-C differences in marital adjustments appear to be symptomatic of more basic differences in emotional stability and integration of personality. With the aid of funds from the National Research Council a special study is being made of marital adjustments in the entire gifted population. This has shown that the A group scores higher than the C group not only in present marital happiness, but also higher in a test designed to measure general happiness of temperament, or what might be called aptitude for happiness.

The facts just reported appear to be in direct opposition to the Lange-Eichbaum theory that great achievement is associated with emotional tensions which border on the abnormal. In my gifted group success is associated with emotional stability rather than instability, with absence rather than presence of disturbing conflicts, with happiness of temperament and with freedom from excessive frustration. This does not necessarily mean that the Lange-Eichbaum theory has been disproved. It is conceivable that the personality factors which make for ordinary achievement under ordinary conditions are different from those which make for eminence of a superlative order. The two approaches agree in the conclusion that beyond a certain high level of intellectual ability success is largely determined by non-intellectual factors and that the number of persons who are endowed with abilities equal to great achievement is immensely greater than the number who will attain eminence.

Looking forward to the future, I regard it as unlikely that more than three score of my 1,450 subjects will attain to a national reputation or that more than a dozen or so will become really eminent. It would be surprising if even one of them a hundred years hence should be found among the thousand most eminent persons of history. In sheer intellectual ability, however, I am sure that my group overlaps Cattell's thousand most eminent persons of history. Although the group certainly contains no intellect at all comparable with that of a Newton or Shakespeare, I believe it contains many who are intellectual equals of Washington, the nineteenth most eminent in Cattell's list, and perhaps some who are not intellectually inferior to Napoleon, the most eminent man of all time.

These specific estimates are of course not amenable to objective proof. They are offered merely as illustrations of a larger truth that no one can doubt who has studied either a group of historical persons or a group of living gifted subjects: namely, that genius and eminence are far from perfectly correlated. Why they are so poorly correlated, what circumstances affect the fruition of human talent, are questions of such transcendent importance that they should be investigated by

every method that promises the slightest reduction of our present ignorance. So little do we know about our available supply of potential genius; the environmental factors that favour or hinder its expression; the emotional compulsions that give it dynamic quality; or the personality distortions that make it dangerous! And viewing the present crisis in world affairs who can doubt that these things may decide the fate of a civilization?

PART TWO¹

SINCE the above address was written the careers of the California gifted group have been followed to 1946. The results obtained from 25 years of work with the group are to be published this year as Vol. IV, *Genetic Studies of Genius* (Stanford University Press). The following are a few facts about the present status of the group.

The mortality rate and the insanity rate are both still below that of the generality of comparable age, and the delinquency rate is extraordinarily low.

About 85 per cent. of both sexes are or have been married, a rate far above that of the generality of United States college graduates. The mean intelligence score of the spouses who have married into the group equals that of the average college graduate but is nearly a standard deviation below the mean of the gifted subjects themselves. The marital adjustment (including the sexual adjustment) compares favourably with that of 800 couples in a non-gifted group. A test of aptitude for marriage given in 1940 predicted later divorce or separation (to 1946) about as well as scholastic aptitude tests predict college grades.

The offspring now number more than 1,500, including 36 deceased. Unless the reproductive rate increases considerably during the next few years the fertility of the group will not be sufficient to maintain the stock. However, as previously noted, the average quality of the offspring is very superior. The percentage of mental deficiency is about half that in the general population, and the percentage with I.Q. of 150 or above is many times that in the generality. The sex ratio of offspring is 111 boys to 100 girls.

Graduate professional degrees *above the M.A.* have been taken by 234 of the men and 54 of the women. Of these, 82 were law degrees, 73 were doctorates (Ph.D., Sc.D., Ed.D.), and 54 were medical degrees.

More than a third of the men and a sixth of the women who attended college had to earn half or more of their expenses, and the total amount thus earned in the undergraduate years was nearly three-quarters of a million dollars. The total stipends from scholarships and fellowships in both undergraduate and graduate years was \$350,000. Evidently such stipends would have had to be more than three times as great as they were to provide the financial assistance that was needed.

¹ An Addendum on February 21st, 1947.

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By 1945 about half of the men were engaged in professional occupations, and nearly a third were in the semi-professional and higher business pursuits. The proportion in these two higher occupational groups is about six times as great as in the generality of employed males in California.

The average earned income of the men for the calendar year 1944 was \$4,713; of the women employed full time, it was approximately \$2,500. The maximum for women was \$9,200; for men, \$84,000. More than 13 per cent. of the men reported earned incomes of \$10,000 or over, and nearly 8 per cent. reported \$15,000 or over. High incomes were most frequently reported by business executives or owners, physicians or surgeons, lawyers, and writers for screen or radio. Many in these occupations earn three or four times the salary of the most highly paid professors in colleges and universities.

Although nearly half of the gifted men were between the ages of 30 and 40 when America entered the war, 42.5 per cent. of them saw military service. By the end of the war close on 75 per cent. of these had become commissioned officers. The highest rank attained in the army was that of brigadier general; the highest in the navy was that of captain (of a destroyer).

The A and C groups referred to in my address were made up in 1938 on the basis of rather inadequate data. In 1941 new A and C groups were made up on the basis of very extensive data obtained in the field follow-up of 1940. This time the A group was limited to the 150 most successful men and the C group to the 150 least successful, each group constituting about 20 per cent. of the men whose careers could be evaluated. These new A and C groups were compared on more than 200 items of information. The results were similar to those of the earlier A-C comparisons, but the contrasts between the groups stood out even more clearly.

In 1940 nearly all the gifted subjects were rated on 14 personality traits by themselves, by their parents, and (if married) by their spouses. This was before the present A and C groups were made up. Comparison of the A and C men on these ratings revealed that all three sets of ratings were in agreement as to the traits in which the A's were outstandingly superior. These traits were, in order of greatest difference, Perseverance, Self-confidence, Integration toward goals, and Freedom from inferiority feelings.

The status of the 1940 A and C groups was again reviewed on the basis of follow-up data obtained in 1945. At that time all but two or three of the A men were still among the 20 per cent. most successful. A good many of the C's had considerably improved their position, but none of them had reached A status. The average earned income

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reported by the A's for the calendar year 1944 was \$7,187 as against an average of \$3,571 reported by the C's.

The proportion who entered military service was 41 per cent. of the A's and 36 per cent. of the C's. The proportion in military service who became commissioned officers was 85 per cent. of the A's and less than 25 per cent. of the C's.

By the end of 1945, 93 per cent. of the A's and 76 per cent. of the C's were or had been married. The divorce incidence is now exactly twice as high for the C's as for the A's. The mean number of offspring for those who had married is 1.7 for A's and 1.2 for C's. The significance of such facts for eugenics is obviously very great.

I have compared the careers to 1945 of my 150 gifted A's with the careers of 309 former U.S. Rhodes scholars of approximately the same age range. In the professional class we find 85 per cent. of the Rhodes men and 80 per cent. of the A men. More of the Rhodes men are in education and government service, but more of the A men are in journalism and medicine.

Of those teaching, only 24 per cent. of the Rhodes men as against 41 per cent. of the A men have attained the rank of Professor or Associate Professor in colleges or universities. Listed in *Who's Who* are 3.5 per cent. of Rhodes men and 4.7 per cent. of A men. Listed in *American Men of Science* are 11.3 per cent. of Rhodes men and 12.7 per cent. of A men. No Rhodes man has been elected to membership in the National Academy of Sciences, and only one of the A men.

Everything considered, the Rhodes men and A gifted men have been about equally successful. However, when the Rhodes men are compared with the total group of 800 gifted men they make by far the better showing. This is hardly surprising. My gifted subjects were selected in childhood on the basis of a mental test score equalled by one child in 150 or 200. The Rhodes scholars were selected at college graduation on the basis of their brilliant scholarship records and favourable personality traits, each being presumably the most promising among thousands of the generality. Moreover, the average amount of schooling obtained by the Rhodes men greatly exceeded the average for the total group of gifted men, and somewhat exceeded the average for the gifted A's.

It is impossible here to give an account of the many notable achievements of individual members of the gifted group. I will close this already-too-long addendum with a few facts regarding the recent contributions of five men.

During the war one was director of a huge government research laboratory which employed hundreds of scientists, spent many

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millions of dollars, and created anti-radar devices which were used in vast quantities by the army and navy and definitely shortened the war.

Another, at the end of the war, became director of one of the great laboratories devoted to atomic research.

One during the last year of the war was head of a million-dollar project for the Office of Strategic Services, in connection with which he directed the research of more than a hundred experts in the various fields of social science.

One, as an army major, was chief of psychiatric therapy in one of the leading combat theatres of the war, and later as psychiatrist at the Nuremberg prison made the official psychiatric examinations of the 22 top-ranking Nazi prisoners.

A professor of physiology in one of the large universities conducted during the war what is perhaps the most important research that has ever been made on the physical and psychological effects of near-starvation, the results of which are to be published in several volumes.

Plans are being made to insure the continued follow-up of the entire gifted group at least until 1970, by which time the ultimate fertility of the group and its sum total of accomplishment can be more accurately assessed. Enough has already been learned to demonstrate that children of I.Q. 140 or above are potentially a nation's most precious asset. The demonstration that this is true should be well worth the \$150,000 which the research here described has cost to date.

OCCASIONAL PAPERS ON EUGENICS

1. EUGENICS IN PROSPECT AND RETROSPECT
By C. P. Blacker, 1945
2. INTELLIGENCE AND FERTILITY
By Sir Cyril Burt, 1946
3. THE TREND OF NATIONAL INTELLIGENCE
By Godfrey Thomson, 1947
4. PSYCHOLOGICAL APPROACHES TO THE
BIOGRAPHY OF GENIUS
By Lewis Terman, 1947