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SELECTIVE FACTORS IN HUMAN SURVIVAL¹

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In ancient times, when that other Athens was the center of the culture, the art and the glory of Greece, it was boldly presumptuous for a crude outsider from less enlightened areas to bring a message to the Athenians. To speak where Demosthenes had spoken, to teach where Plato had taught or to build where Pericles had builded, was an assignment to an evangelistic enterprise of gargantuan proportions. If mine is a similar assignment, you are assured that I have not recently experienced any great light of inspiration and have suffered no impairment of vision that was unresponsive to optometric adjustment of my bifocals. But Paul came to an Athens that was in decline under the weight of Roman domination and I come to a center of learning surging with a burst of vigor that has recently humbled our basketball and swimming teams, and even challenges our long term supremacy on the football field.

It is an established practice for the retiring president of our Academy to render a rhetorical swan-song on this occasion. It is also more or less traditional that this final, unmusical effort consist of a restatement of the policies and prejudices for which the speaker has long been noted among his colleagues. It satisfies the ego of the speaker and may even impress his auditors, if his offering can be presented in the guise of a research project. Now scientific research, or at least most biological research, is characterized by three well-defined stages. First, there is the *pedal* or footwork stage which consists in the collection of materials or data as the basis for the remainder of the project. Some enthusiastic field men perform prodigious feats of pedal research and amass great quantities of unorganized materials for others to classify. The second stage of research is the *manual* or handling operations for the materials concerned. This involves preparation, classification or calculation, depending upon the nature of the material involved. The third stage is the *cerebral* or analysis aspect which involves the interpretation and application of the materials of the first two stages. It is sometimes surprising to note how much cerebration can be done with a minimum of pedal and manual activity. Ponderous researches of this type are usually held in high respect, despite the lingering suspicion that some of these efforts are less cerebral and more gluteal in nature.

The pedal part of my investigations which shall serve as a basis for later discussion were collected by the distribution of a simple questionnaire to my students in a course dealing with Human Heredity and catalogued under the title *Eugenics*. This one semester, no prerequisite course, has been offered each semester of the college year for the past twenty years. The questionnaire has been submitted for seventeen years for the collection of this information:

¹Presidential address delivered at the Annual Meeting of the Ohio Academy of Science at Ohio University, Athens, Ohio, April 16, 1954.

VITAL STATISTICS QUESTIONNAIRE

Name _____ Age _____
 Living _____ Living _____
 Number of your brothers Dead _____ Number of your sisters Dead _____
 Number of your father's brothers reaching maturity (20 yrs.) _____
 " " " " sisters " " " " _____
 Number of your mother's brothers " " " " _____
 " " " " sisters " " " " _____
 Age of parents at marriage: Father _____ Mother _____
 Education (*common school, high school, or college*) of parents:
 Father _____ Mother _____
 Occupation of Father _____
 Remarks or explanations: _____

This blank has been filled by and collected from 1025 students. Seventeen years of counting and calculating can be summarized thus:

Students' families average.....	2.61
Parents' families average.....	4.41

Decline in one generation..... 1.8 children.

Older parents (especially older mothers) have fewer children than younger parents.

Size of the family varies inversely with the education of the mother.

W. S. Thompson of the Scripps Foundation for Population Studies obtained similar information from 931 Miami students thirty years ago and found:

Students' families averaged.....	3.5
Parents' families averaged.....	5.81

Decline in one generation.....2.31 children.

The fact that our average student family size over seventeen years was much smaller than that recorded by Thompson from a single sampling in 1924 might suggest a progressive decline in size of students' families over our period of study. Such was not the case since our smallest student family average (2.2) was in 1947 and our largest (3.57) was in 1948. Our great drop in the size of parents' families (5.81 to 4.41) is to be correlated with the fact that many of the students of Thompson's study are the parents of our recent respondents.

I now follow the standard lecture procedure of digressing from my introductory theme to present a general picture of the basic facts of selection in nature.

Every modern species of plant or animal, in fact every variety and every individual now in existence, represents the present expression of a line of living organisms extending back in unbroken succession to that mysterious and undefined period which marks the beginning of life on our planet. I realize that present investigations, relative to the possible synthesis of living particles through the action of desoxyribose nucleic acid molecules, offer an intriguing speculation as to the continuing origin of organisms at the lowest order of the life scale, but currently we shall subscribe to time-honored cliché which states that "All life comes from life." Any organism alive today stands at the apex of a line of life that has, thus far, solved the problems of survival. That engineering marvel which is your modern automobile is the result of thousands of changes and modifications but all *living* things have been tried and selected from countless millions through untold ages.

We marvel at the prolificacy of nature when we give consideration to the nine million eggs of a single codfish, the burden of winged seeds born by a single maple tree, the dance of mating mayflies over miles of lake and shore, or a migration of grasshopper hordes which darken the sun. Yet in spite of these prolific

reproductive potentials, the cod scarcely hold its numbers, the seeds of the maple reach sterile ground, the usual destination of a mayfly is the maw of a fish and the grasshopper hosts perish by the ton on unfriendly plains. This story can be repeated with slight variations for most species of the plant or animal kingdoms where the constant formula is overproduction, natural selection and survival of those few individuals which escape the hazards of existence.

As a representative animal in the living world, *man* has never been free from these laws of natural selection. In his primitive state he certainly passed through cycles where a strong arm and a thick skull were decisive selective factors. If we can picture ancient man as dwelling in cold, damp caves or under overhanging cliffs, having a minimum of sanitation and surrounded by a depreciating food supply, he was certainly attended by every type of vermin and parasite which modern medicine recognizes and subject to all the ailments now associated with these loathsome vectors. The selective factors of this period of human evolution would also be concerned with the ravages of hunger and disease, the fierce brawls attending mate selection and the frequent contests with cave-dwelling bears or wolves where crude weapons made an equal chance for the status of victor or vanquished. In ancient historical times, disease was a more powerful weapon than the sword, but we can only conjecture on the nature of many of the ancient plagues and pestilences. The "glance of the Lord" that melted the Assyrian hosts of Sennacherib before Jerusalem may have been dysentery, cholera or bubonic plague, and the Carthaginian armies of Hannibal most certainly found the malarial mosquitoes from the Pontine marshes more formidable enemies than the disordered legions of Rome. The selective agents of ancient historical times spanned the Dark Ages and reached the modern period with little diminution of their potency. One-fourth of the population of London perished from a single epidemic of plague in the 17th Century and pioneers of our area knew epidemics of smallpox and diphtheria of destructive proportions. Near the end of World War I the fearful sweep of influenza claimed more lives from the civilian populations of the contending nations than were lost by the military forces of all combatants. Medical men were helpless before the older plagues but the work of Jenner, Pasteur and Koch gave powerful weapons of defense to the nineteenth century and the recent discoveries in the field of antibiotics makes modern medicine an efficient selective factor in human survival. Given another century of comparable progress and the contagious diseases of childhood will become as infrequent and as disreputable as are body lice today. Contests for mates we still have but such are usually peaceful, or if otherwise,juries are lenient. No longer does man fear the invasion of wild beasts into his domain. He puts his trust in a high-powered rifle or sets a mouse trap.

We note the conquest of the selective factors that plagued our ancestors and hail a new system of medicine which seeks to preserve every human being from the moment of conception to the last feeble squeak of the age-worn mechanism. But before we become too enthusiastic over our new-found freedom from the bonds of natural selection, let us remember that not selection but *survival* is the key word in the perpetuation of a species or lesser group in a population. It should be noted that all selection which results in survival is *natural* selection. Man may change the character of his herds or his crop plants and he may devise medical agents to check or even prevent the operation of disease-causing agencies in human population, but these efforts are without value if the populations so benefited are not continued through reproduction. The pioneer grandmother who lost five children to diphtheria but raised seven to maturity now has a modern descendant whose *one* child has been vaccinated, inoculated, X-rayed, tuberculin tested and blood grouped before he enters college. If he survives traffic hazards and fraternity hazing, he is still the representative of a declining group in our population, a class that presents the most effective selection of all times,

the failure to reproduce at a survival level. No other selective factor can possibly be so fatal as *not being born*.

It has previously been indicated that any individual alive today is the present representative of an unbroken line of evolution. It should be further noted that the continuity of this line depends upon continued reproduction of the species, class or individual concerned. Any individual that dies without issue is just as extinct as a dinosaur, a mastodon or a passenger pigeon but the saving factor in individual extinction is the fact that the component units of any particular individual's hereditary makeup (the *genes* of the students of Biology) are still present in corollary lines of reproductive individuals. Our concern is therefore not centered so much in individuals (they are expendable) as in that *group* of our population wherein we find collections of the best human traits. The inheritance of superior traits has been amply demonstrated by a series of investigators from Galton in the 1870's, through the findings of Terman in the 1920's, to more recent studies of parent-child I.Q. correlations. Since general intelligence is a multiple factor inheritance, a statistical analysis of parent-child relationship in mental ability show typical regression toward average norms but the general verdict finds that "like begets like" in *mental*, as well as physical traits. It is the common experience of teachers to find recurring examples of superior ability in the same family, and the observation of multiple abilities in the same individual sometimes make it difficult to decide *where* a generally superior pupil should enter contests for scholastic honors. Our present search for superior ability in science is matched by the efforts of others who seek superior abilities in athletics, music, and general scholarship. Never before in all the history of Ohio have the traits of her junior citizens been so efficiently recognized and classified. If these "gems of purest ray serene" are not brought from the unfathomed depths of obscurity to be polished by the abrasive action of public acclaim, it is not the fault of those who labor to organize basketball and baseball tournaments, track meets, music festivals, science days and scholarship tests. It is no accident that many of our Junior Academy contestants who are here today will also be representing their respective schools in other fields of competitive endeavor. That the winners in these contests will receive offers of scholarships or other inducements to enter our colleges is a foregone conclusion. We commend our colleges for presenting these inducements and express a regret that more and better offerings are not available.

Since the rewards offered do not approach the cost of a college career, there will be a selection in the acceptance of these scholarships. Parental aid may enable a student to go to college where the family finances will permit such aid, but the determination of the student may be firm enough to spur him to find the means of financing at least the beginning of a college career. If the family finances will be strained by the expense of a four-year college course, it is obvious that this expense will not stand frequent repetition; therefore, if the student comes from a family where the parents have planned a college career for their children, the family will be small. This observation corresponds with our findings of 2.61 children per family for the parents who had *one* child in our group. The decline of 1.8 children in one generation is the selective price of college for this group.

You may ask why we should be concerned over this declining rate of reproduction in the parents of our group or the failure of these graduates to replace themselves. College students have always been drawn from non-college parents more frequently than they have been produced by college graduates. These wells of supply for the desirable traits which we seek should produce in the future as they have in the past, the leaders which our complex civilization demands. This attitude was justified when selective pressures were inoperative and students came to us on their own initiative. Our present system of locating the best in every field of physical performance, artistic ability and scholastic endeavor com-

compares to putting a high speed irrigation pump on a well that formerly gave forth its yield by the bucketful. Before we "miss the water", we must learn to conserve. There is no more logical system of conservation of our genetic heritage than that of putting it back into circulation through the continued reproduction of those who have demonstrated their possession of that superior heritage.

Most of the students who are chosen by our several agencies will complete a college course, many of them with a distinctive record. The sifting selection of a college career offers few difficulties but they will be harrassed by a more rigid selection beyond their graduation. We shall examine the results of these selective factors and attempt an analysis of their operation. In 1947 Gamble made a survey of the 1921 and 1922 graduates of 76 colleges in the United States. These graduates showed an average of 1.75 children per male graduate and 1.39 children per female graduate, 25 or 26 years after college. If we average the figures (apologies to our statisticians) we get 1.57 children per couple where at least one marriage-mate is a college graduate. There are those who would account for the low average reproductive rate of college women by the assumption that many women have elected college and the career over the choice of marriage and family. This girl may attend *your* college but I have not found her in our institution. Without naming specific Ohio colleges which appear in this 1947 listing, it may safely be said that no college or university in our state could *maintain*, much less increase, its enrollment if it depended upon the children of its graduates.

In the peak year of 1950, the colleges of our nation graduated over 432,000 young men and women. This figure is expected to remain fairly stable through the fifties but it will rise sharply in the next decade. For the purpose of future reference, we can assume that our graduates will average 400,000 for the 1950's and these graduates will fail to replace themselves in the population by at least *one* child per graduate. A rate of reproduction which will maintain a group in the general population is an elusive figure. It is apparent that a reproductive rate of *two* children per family will not maintain due to selective losses before the children, in turn, reach the age for reproduction. Replacement figures vary from 2.1 to as high as 3.7 children per family. Since children are not born as fractions, we may state that a family of 3 children is no more than a maintenance number, especially if those children are to be subjected to the hazard of a college education. Colleges are absorbers of population, not producers of citizens for the state from which they draw their sustenance. To coin a phrase after the manner of the most eminent phrase maker of our generation, "Never have so many received so much and returned so few." Since all educational institutions receive some sort of public support we are all *state* institutions. That nebulous state contributes to education at all levels from kindergarten to graduate schools. The continuity of the state is the first duty of the citizen and the perpetuity of the intellectual elements of that state is the first duty of those with superior hereditary endowments.

The reasons for the decline of our group are beyond a full analysis in my offering but pertinent arguments may be noted. I once presented this general theme before a group of graduate students of science and received the somewhat astonishing statement that graduate students were a select group who should be removed from the drudgeries of reproduction in order to make their fullest intellectual contribution to society. This spirit of the cloister might be tolerated if it were not for the fact that we have deposited our best hereditary genes in this post-graduate section of our college population and we feel that we are entitled to a biological return on our investment.

Biological sterility among intellectuals is known but certainly the fertility of college graduates is no lower than that of our general population. I find no cause for modifying the charge which Festus hurled at Paul to read, "Much learning doth make thee *sterile*," as it is directed at our intellectual end-products.

Delayed reproduction may present problems for the obstetrician that are less likely to be encountered in younger mothers but modern medical knowledge can cope with these problems in most cases.

Social and economic factors carry much weight with all college people. The lure of the career for married graduates involves social pressures that are definitely contrary to the restrictions of home-making and family-rearing. A planned economy requires a definite budget for modern living, and the prospect of three or more children fades before the demands for better homes, better cars and the multitudinous gadgets of modern existence. Some of my critics, having harkened to the neo-Malthusian cries of Voght, Burch and other population alarmists, would say that it is folly to bring children into a world that faces the dire consequences of overpopulation. No nation, past, present or future, ever had or can have an overabundance of superior citizens. The problems of overpopulation demand superior intellects for their solution and the nation that starts a reduction program with her best stocks is more foolish than he who initiates treatments for a headache with decapitation.

I have had students respond to my pleas for survival in this fashion. "Why bring children into a mad world that is bent on destroying itself?" My answer to that question is the statement that *general acceptance* of such an attitude would destroy more potential future leaders than all the modern weapons of destruction. We are inclined to consider war as the most destructive selective force of modern times. Great Britain still mourns the loss of 400,000 of her finest young men in a six-weeks campaign in Flanders in the early part of World War I. These young men, volunteers from the colleges and the best homes of the nation, left vacancies in the leading families of the kingdom that are still felt by a nation that struggles against internal dissensions as her prestige as a world power declines. Yet when *our* college graduates fail to replace themselves by at least one child per couple, it means a loss of our nation's finest stock, not by 400,000 in one bitter contest on a foreign field of battle, but by 400,000 this year, last year, next year and annually until we convince our intellectuals that survival is of paramount importance. I repeat, no other selective factor is so fatal as not being born.

Those who are charged with the welfare of our state might well say to us, "Send these, our superior children, back to the simplicity of their village and rural homes where they will multiply and perpetuate their virtues rather than impart to them that higher education which will eliminate them from the human stream." NO! We shall not receive that charge. The children of our state will come to us and we shall teach them the glories of our literature, the truth and power of our science, the heritage of our history and their rights and privileges in a free nation. As we teach them all these good things, may we also give them by precept that which we fail to show by example—the *will* to survive.
