

Differential Fertility

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DIFFERENTIAL FERTILITY

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THE PROBLEM

THERE has been a great dearth of adequate data from which to determine the relative degree to which the different social and economic classes of any human population reproduce themselves. This is particularly true for the population of the United States. At the same time the problem is clearly one of first class importance both theoretically and practically. It is the reproductive activity of the persons now living which determines the constitution of the population of the next generation to an overwhelming degree. Especially is this true in any country where there is naturally, or by legislative restriction, a limited immigration.

The pioneer attempt at an adequate statistical approach to the problem of differential fertility amongst the several social classes in a human population was that of Heron (1906). Using the correlational calculus he reached the following conclusions:

As far as the present investigation goes it demonstrates I think conclusively that for the London districts there is a very close relationship between undesirable social status and a high birth-rate. In districts where there is overcrowding, where there is a superabundance of the lowest type of labour, where it is needful to employ many young children in order to earn daily bread for the family, where infantile mortality is greatest, there the wives of reproductive ages have most children. Where there is more culture and education as shewn by a higher proportion of professional men, where there is more

leisure and comfort as shown by a higher percentage of domestic servants, where the traders who appeal to the improvident and thriftless are fewer in number, there the birth-rate is least. Again, where there is more general pauperism, where signs of bad environment like phthisis are prevalent, where pauper lunatics are most plentiful, there the birth-rate is highest. Cancer alone of the undesirable physical conditions dealt with so far seems more prevalent in the prosperous and cultured districts and to be associated with a lower birth-rate.

Nor is the higher birth-rate of the undesirable elements compensated by the higher death-rate. The net fertility of the lower status remains higher than that of the superior status.

The relationship between inferior status and high birth-rate has practically doubled during the last fifty years, and it is clear that in London at least the reduction in the size of families has begun at the wrong end of the social scale and is increasing in the wrong way. I have brought forward evidence enough to shew that the birth-rate of the abler and more capable stocks is decreasing relatively to the mentally and physically feebler stocks.

Broadly speaking these conclusions have been confirmed by all subsequent students of the problem, and have become incorporated into the accepted body of present sociological doctrine. I shall make no attempt at an exhaustive list of the literature. The following citations sufficiently support the point, and will lead the inquiring reader into the further literature: Brown, Greenwood, and Wood, 1920; Cattell, 1915-17; Cobb, 1912; Crum, 1914; Darwin, 1922; Elderton *et al.*, 1913; Fürst and Lenz, 1926; Gini, 1926; Hart, 1924; Hewes, 1911; Hill, 1913; Holmes and Doud, 1918; Johnson and Stutzmann, 1915; Lenz, 1926; Marshall, 1913; Near-

ing, 1914; Onslow, 1913; Pearson, 1909, 1910; Popenoe, 1917; Phillips, 1926; Savorgnan, 1923; Schiller, 1926; Spiegelberg, 1924; Sprague, 1915; Terman, 1925; Weinberg, 1909; Whetham, 1909.

Holmes (1921) sums the case up in the following words (p. 140):

The elements of the population that are of subnormal mentality exhibit at present the highest degree of fecundity. This is the general verdict of most students of the birth-rate of different classes of the population. The higher death-rate of the subnormals probably does not offset completely their greater fecundity. . . . The classes in the higher social strata . . . in general have a birth rate which cannot fail to lead to extinction. This much is clearly indicated from a variety of sources, while the springs of our defective inheritance have shown no manifest signs of drying up.

There have appeared in recent years a considerable number of studies on the fertility of groups of college and university graduates. The results have been generally held to be alarming in greater or less degree. Such socially desirable folk are not reproducing at anything like the rate desired by the conscientious eugenicist.

But college graduates almost certainly do not include quite all the socially desirable people in the world. What is needed before a final alarmed judgment is reached is a fairly representative cross-section of all the different sorts of people composing the population. Brown, Greenwood, and Wood (1920) end their careful and enlightening study with these words (p. 205):

The sociological implications of these results are left for the discussion of others. Here the personal impression is recorded that the analysis of the sample of middle class families has led to no result incompatible with the conclusions drawn by Professor Karl Pearson and his collaborators from wider data of a different kind.

Whether these results, or any results of wider analysis, suggesting that neglect of eugenic principles is leading to a steady deterioration of the race are

likely to influence the reproductive habits of the educated classes or social legislation designed to modify those habits, is a question we need not attempt to answer.

Reading between these lines, and also reading their first conclusion (p. 205): "In the first place, it is plain that there is no essential difference between the fertilities of women who have and of women who have not received a university education. Such differences of effective fertility as appear can be fully explained by differences of age at marriage," there arises some conviction that these English authors would be in sympathetic agreement with the second sentence of the preceding paragraph.

SOME NEW DATA

In the last issued report on natality from the United States Census Bureau (Birth Statistics, 1923) there is a table (numbered 10, pp. 171-181) which makes available some new and welcome data regarding differential fertility in this country. Once more the student of human biology is deeply indebted to the wisdom and insight of Dr. William H. Davis, who so ably and intelligently directs the collection and tabulation of the vital statistics of the United States. It is my purpose now to discuss briefly certain aspects of this new material. A preliminary report of this study, in which I was aided by Dr. John Rice Miner, has been published elsewhere (Pearl, 1926).

The data apply to the United States birth registration area *exclusive* of Delaware, Maine, Massachusetts, New Hampshire, Rhode Island, and Indiana. That is, the figures include California, Connecticut, Illinois, Kansas, Kentucky, Maryland, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Utah, Ver-

mont, Virginia, Washington, Wisconsin, and Wyoming.

The original table provides the following information: The births, number of children born, and living, and average number born and living, to mothers of 1923, by occupation and age of father. The occupations of the fathers are grouped into the following main classes, with a number of smaller sub-divisions in each main class:

1. Agriculture, forestry, and animal husbandry.
2. Extraction of minerals.
3. Manufacturing and mechanical industries.
4. Transportation.
5. Trade.
6. Public service (not elsewhere classified).
7. Professional service.
8. Domestic and personal service.
9. Clerical occupations.

When one considers carefully the sub-divisions under these nine main heads the usual difficulty with official vital statistics is at once encountered. Economically and socially differentiated groups are included in some particular general class from the remainder of which they are, in these respects, sharply set apart, in reality. But it is reasonably obvious that economic and social factors and forces are among the most important elements in determining the biologically significant environment of human beings, as they exist here and now. Relative wealth virtually determines the character of the immediate physical environment in which men live. Furthermore, economic and social position are significantly correlated with the amount of physical labor which individuals perform, and this has been shown (Pearl, 1924) to be biologically important.

In view of these considerations it was deemed necessary to reconstitute the main occupational classes, as given in the original document cited, so that they

might conform at least somewhat more closely to significant reality. The general plan followed in this reconstitution of the classes was to take out of classes 2, 3, 4, 5, and 6, all subgroups in which the persons composing the subgroup enjoyed a distinctly and obviously higher economic and social position than the average of the main class as a whole from which they were removed, and put them into a reconstituted class 7. This procedure involved the following transfers: Operators, officials, and managers from Class 2, Extraction of minerals; builders and building contractors, and managers, superintendents, manufacturers, and officials from Class 3, Manufacturing and mechanical industries; captains, masters, mates, and pilots, and officials and superintendents (steam and street railroads) from Class 4, Transportation; bankers, brokers, and money lenders, commercial travelers, insurance agents and officials, and real estate agents and officials from Class 5, Trade; and officials and inspectors (city and county), and officials and inspectors (state and United States) from Class 6, Public service.

These transferred sub-divisions were then all put with Class 7, Professional service, as originally constituted. This latter class, as reconstituted, then includes not only professional men in the strict sense but the capitalists, officials, and managers, whose economic and social status is more like that of the professions than the other classes, so far as it was possible to treat them separately. In some cases this was not possible, as in the class Retail and wholesale dealers. Importers and exporters, and many of the retail dealers would be of the same economic and social class as the occupations which have been included with Professional service, but a majority of the class are probably small shop-keepers, and it

was therefore thought best to leave them under Trade, on the ground that probably a smaller error would be involved in so doing than in adopting the alternative procedure.

The net upshot of this manipulation is to leave all the main occupational classes except 7 composed chiefly of laborers, more or less skilled, but still persons whose living depends upon the daily performance of more or less routine tasks, *in contrast to* the persons composing the reconstituted class 7, who, in the large, get their living rather more by the exercise of their wits than of their muscles.

In order that there may be no misunderstanding the names of the main occupation classes which have been altered by the above described procedure will be printed in *italic* type throughout the remainder of this paper. This typographical usage will serve to indicate that the statistics so printed are for the *reconstituted* classes, and not for the classes originally so named in the official report.

The next and final point of method to be considered before coming to the results is that of age. The desideration in all studies of fertility is, of course, the completed family. In the present case, as usual, this desideration cannot be precisely attained from the available data. General consideration of the problem, and careful examination of all the figures themselves as given in the original report, led finally to the decision to deal analytically with the data for fathers aged 45 and over. This procedure will probably give as close an approximation as it is possible to get, from these or similar records extracted from the official standard birth certificate of the United States, to the unknown average size of completed family for the different occupational classes. In the textual portion of the original report from which the data are taken is

the following statement (p. 20): "Particular attention is called to the data for fathers aged 40 to 49 years as these on the whole probably represent completed families." It is only after very careful consideration that I have ventured, in the treatment of the material here, to depart from the implication of the statement quoted. That 40 is too low a limit seems to be indicated by the figures themselves. In a majority of cases in the detailed tables the average number of children ever born is higher in the age group 45-49 than in the group 40-44. Again the detailed figures indicate that the inclusion of fathers over 50 in the group does not sensibly alter the averages which would be obtained by dealing with the age period 45-49 alone.

FERTILITY BY OCCUPATIONS

Table 1 presents the first set of basic data which we shall need in the discussion.

Before discussing at all the results of this table, it is necessary to consider some of the important peculiarities of the data. In the first place, if the figures of column (d) could be regarded as representing exclusively completed families, which they almost but not quite can, they would still give an erroneous impression of the gross fertility of the several occupational classes, for the following simple reason. All the data in the table are derived from the experience of women who were mothers in 1923. That is to say, they were women who were fertile in that particular year. No other women are included. No sterile matings appear, and no matings of generally low fertility throughout the mated life, except the few in which the female chanced to have a baby in 1923. That there are very few of such low fertility matings included is evident if it is recalled that we are here dealing only with families in which the father

was 45 years of age or over in 1923. In general the vast bulk of men who engender a baby when they are 45 years old, or over that age, are probably persons whose whole marital history has been characterized by relatively high fertility, as compared with the rest of their same social class.

The net result is that the values in columns (d) and (e) of table 1 somewhat exaggerate the true average fertility of the whole population of the same age in

tional classes, as given by these data, are not safely comparable. The only essential difficulty with the figures is that the universe of discourse which they encompass is a definitely limited one, and we cannot safely generalize beyond these bounds.

With these limitations in mind it is easily deduced that the mothers of children born in 1923 by fathers aged 45 years or over, on the basis of column (d) of table 1, had total average progenies up to

TABLE 1

Children born to mothers of 1923, by fathers aged 45 years or over, by occupation of father, in reconstituted general classes of occupations

OCCUPATION OF FATHER	TOTAL BIRTHS (a)	TOTAL NUMBER OF CHIL- DREN EVER BORN (b)	TOTAL NUMBER OF CHIL- DREN LIVING (c)	MEAN NUMBER OF CHIL- DREN EVER BORN (d)	MEAN NUMBER OF CHIL- DREN LIVING (e)	MEAN NUMBER OF CHIL- DREN DEAD (f)	PER CENT OF CHILDREN DEAD (g)
Agriculture, forestry and animal husbandry.....	41,825	289,140	251,833	6.91	6.02	0.89	12.9
Extraction of minerals.....	4,117	32,677	26,609	7.94	6.46	1.48	18.6
Manufacturing and mechanical industries.....	32,875	216,996	179,601	6.60	5.46	1.14	17.3
Transportation.....	4,480	27,002	22,997	6.03	5.13	0.90	14.9
Trade.....	6,771	34,885	30,389	5.15	4.49	0.66	12.8
Public service.....	949	5,189	4,374	5.47	4.61	0.86	15.7
Professional service.....	5,828	24,366	21,672	4.18	3.72	0.46	11.0
Domestic and personal service.....	2,424	12,820	10,799	5.29	4.46	0.83	15.7
Clerical occupations.....	1,677	7,149	6,296	4.26	3.75	0.51	12.0
Totals.....	100,946	650,244	554,570	6.44	5.49	0.95	14.8

the various occupational classes. The probable magnitude of this exaggeration will be discussed farther on. The figures represent the average size of family of a selected sample only of the total population in each class, *the basis of the selection being high and probably historically continued fertility*. This means that, in the best case, we can only discuss from these data relative and not absolute fertility values. I see no reason to suppose that the relative fertility of the most fertile portions of the populations in the several main occupa-

and including the 1923 birth, which stood in relative positions according to the occupations of the fathers as shown in table 2. These relative sizes of average families are shown graphically in figure 1.

From these data it is seen, in the portion of the population here under discussion, that when the average size of family produced by a mother of 1923 in her total reproductive life up to that time, by a father who fell in the *Professional* class and was 45 years of age or over in 1923 is taken as 1.0, the average size of family

produced from the mothers of 1923 by fathers who fell in the occupational class *Extraction of minerals*, and similarly aged 45 years or over in 1923 was 1.9. In general it appears that the relative average size of family in the different occupational classes in the case where we are dealing throughout with the selected more fertile moiety of the population, is in good general accord with what we have learned to expect from earlier studies in England and other countries. The professional, capitalistic group exhibits the lowest average size of family, and the labor groups, whether in factories, farms, or mines, the highest.

But from a racial viewpoint the matter

TABLE 2
Relative average size of family

<i>Professional service</i>	1.00
Clerical occupations.....	1.02
<i>Trade</i>	1.23
Domestic and personal service.....	1.27
<i>Public service</i>	1.31
<i>Transportation</i>	1.44
<i>Manufacturing and mechanical industries</i>	1.58
Agriculture, forestry, and animal husbandry...	1.65
<i>Extraction of minerals</i>	1.90

needs to be pushed farther. There are a great many more farmers, or factory laborers, for example, in the whole population of the Registration Area than there are professional men. Let us next examine this aspect of the matter with some care. Table 3 lists the main occupational classes (reconstituted) in the same order as does table 2. In table 3, column (a) gives the number of males in each class who were 45 years of age and over at the time of the census of 1920. These are reduced in column (b) to relative figures, taking the reconstituted *Professional service* class as 1.00. Column (c), headed "Number of more fertile families in group, 1923," is a repetition of column (a) of

table 1. This, it will be recalled, gives the number of births to mothers of 1923 in that year, by fathers who were 45 years of age or over. As has already been pointed out, those families within each

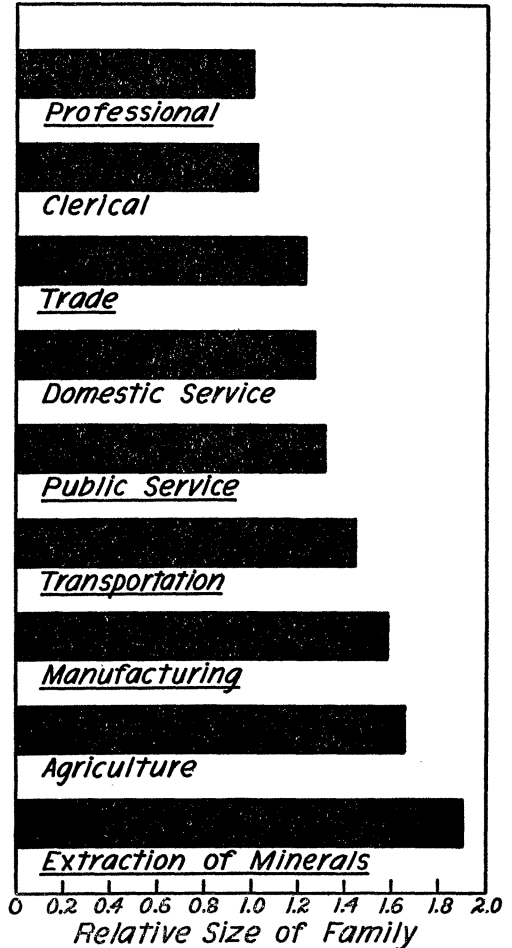


FIG. 1. BAR DIAGRAM SHOWING RELATIVE AVERAGE SIZE OF FAMILY EXPERIENCED BY MOTHERS OF 1923 IN THEIR REPRODUCTIVE LIVES UP TO THAT DATE, ACCORDING TO OCCUPATION OF FATHERS WHO WERE, IN 1923, 45 YEARS OF AGE OR OVER

occupational class, in which the wife had a baby in 1923 and in which the husband was at the time 45 years of age or over, represent on the whole the more fertile families in the group, taking the whole reproductive life together. Except

for small corrections, which ought to be made for multiple births and perhaps for illegitimate births, the number of births to these mothers and fathers, as given in column (c), gives the number of such "more fertile" families in the group. Column (d) gives the relative values of the figures in column (c), the *Professional service* class being again taken as 1.00. Column (e) is a repetition of column (b) of table 1. It gives the total number of children ever born in the "more fertile"

0.34 of a male of corresponding age in Clerical occupations; 1.00 in *Trade*; 0.47 in Domestic and personal service; 0.23 in *Public service*; and 0.79 in *Transportation*. In these six occupational classes more-fertile families, as defined above, occurred in about the same proportions relative to the *Professional service* class taken as 1.00 in both instances, as column (d) and the dash line of fig. 2 show. This means that in these six occupational groups more-fertile families are represented

TABLE 3
Absolute and relative figures for population and fertility

OCCUPATIONAL CLASS (RECONSTITUTED)	MALES AGED 45 AND OVER IN GROUP, 1920 (a)	RELATIVE PROPORTIONS OF ITEMS IN COLUMN (b)	NUMBER OF MORE-FER- TILE FAMILIES IN GROUP, 1923 (c)	RELATIVE PROPORTIONS OF ITEMS IN COLUMN (d)	TOTAL NUMBER OF CHIL- DREN EVER BORN TO FAMILIES IN COLUMN (e)	RELATIVE PROPORTIONS OF ITEMS IN COLUMN (f)
<i>Professional service</i>	624,180	1.00	5,828	1.00	24,386	1.00
Clerical occupations.....	215,188	0.34	1,677	0.29	7,149	0.29
<i>Trade</i>	626,321	1.00	6,771	1.16	34,885	1.43
Domestic and personal service.....	296,480	0.47	2,424	0.42	12,820	0.52
<i>Public service</i>	141,265	0.23	949	0.16	5,189	0.21
<i>Transportation</i>	480,095	0.79	4,480	0.77	27,002	1.11
<i>Manufacturing and mechanical industries</i>	2,011,722	3.22	32,875	5.64	216,996	8.90
Agriculture, forestry, and animal husbandry.....	1,899,128	3.04	41,825	7.18	289,140	11.86
<i>Extraction of minerals</i>	167,172	0.27	4,117	0.71	32,677	1.34
Totals.....	6,461,551		100,946		650,244	

families recorded in column (c). Finally, column (f) gives the relative values of the data in column (e), the *Professional service* class being taken as 1.00.

The relative figures of table 3, Columns (b), (d), and (f), are shown graphically in figure 2.

The results exhibited in table 3 and figure 2 are of a good deal of interest, and in some ways unexpected. Broadly what the figures show is that:

1. For each male 45 years or over in the class *Professional service* in 1920, there was

in about the same relative proportions to each other, as occupied males of corresponding age in the classes as a whole. This is only approximately true, because the figures of Column (a) are for 1920, and those for (c) for 1923. But the general consonance of the relative figures for the six classes named will probably not be significantly disturbed by this consideration.

2. For every male 45 or over engaged in *Professional service* in 1920, there were 3.22 workers of corresponding age in *Manu-*

facturing and mechanical industries; 3.04 in Agriculture; and 0.27 in *Extraction of minerals*. But for every more fertile family, as here defined, in the *Professional service* class, there were 5.64 such families in the *Manufacturing* class; 7.18 in the *Agriculture* class; and 0.71 in the *Extraction of minerals* class. What these results mean is that families of more than average

in the more-fertile families is not widely different from the proportion, always relative to the *Professional* group as 1.00, in which the several occupations are represented in the general male population, so far as concerns the first six occupations in Table 3. This means that in these six occupations the total fertility up to 1923, in the more fertile group with

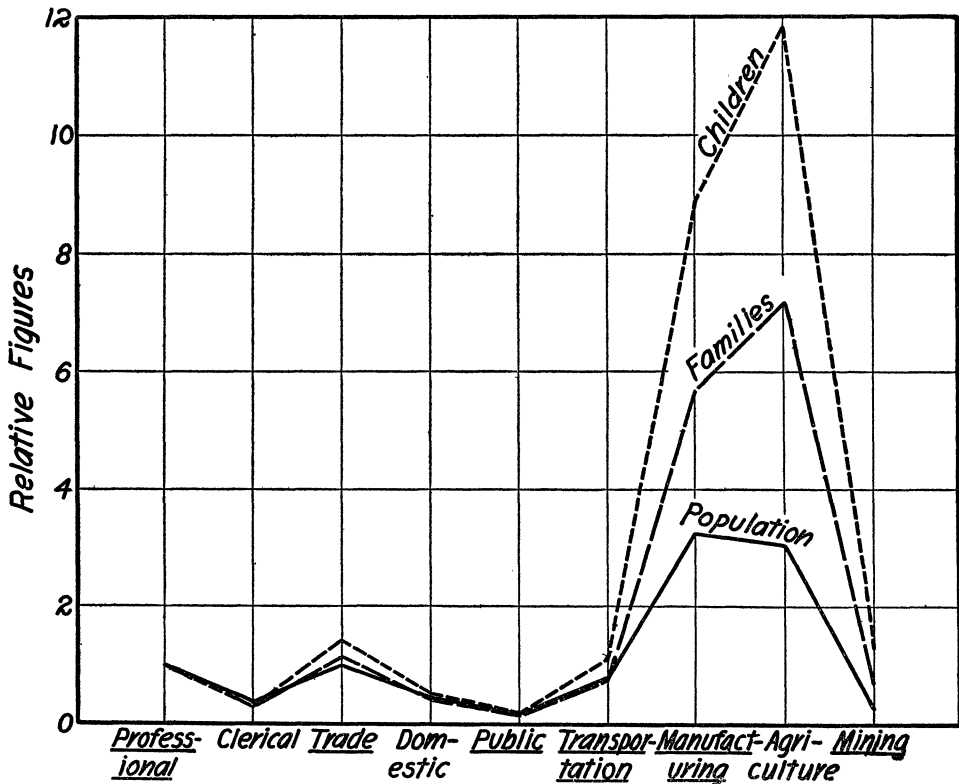


FIG. 2. RELATIVE POPULATION AND FERTILITY BY OCCUPATIONAL CLASSES

The solid line is the graph of column (b) of Table 3; the dash line of column (d); the dot line of column (f)

total fertility occurred in these three classes, in proportion to the male population of corresponding age, taking the *Professional* class as 1.00, from two to three times as often as they did in any of the six occupational classes discussed above.

3. The relative total number of children ever born, up to and including 1923,

which we are dealing, was nearly in simple proportion to the size of the groups themselves, having regard to age, and when the *Professional service* group is taken as 1.00 in each instance. But in the three occupational classes *Manufacturing*, *Agriculture*, and *Mining* the case is quite different. Whereas there were 3.22 times as many males aged 45 and over in the

Manufacturing class in 1920 as in the *Professional* class, the females mated to males in the *Manufacturing* class had produced, up to and including 1923, 8.9 times as many children as had the females mated to the corresponding portion of the males in the *Professional* class, in the same period. In 1920 there were 3.04 times as many males 45 years of age and over in the *Agriculture* class as there were in the *Professional*. But the total production of children up to and including 1923, by the more fertile moieties in the classes, had been 11.86 times as great in the

situation so far as strictly inter-class comparisons of the unit elements are concerned. But it does not permit entirely correct conclusions to be drawn in respect of the important question as to the proportionate contribution of each occupational group to the total population of the next generation. The proper base for the relative figures here is furnished by the *totals* of columns *a*, *c* and *e* of table 3, each taken as 100 per cent.

The results of treating the data in this way are shown in table 4 and fig. 3. While the general trend of figure 3 is

TABLE 4
Fertility of the occupational groups relative to the total population

OCCUPATIONAL CLASS (RECONSTITUTED)	PER CENT IN EACH CLASS IN 1920 OF MALES 45 AND OVER	PER CENT OF MORE-FERTILE FAMILIES IN 1923	PER CENT OF TOTAL CHILDREN EVER BORN TO FAMILIES IN COLUMN (b)
	(a)	(b)	(c)
<i>Professional service</i>	9.66	5.77	3.75
Clerical occupations.....	3.33	1.66	1.10
<i>Trade</i>	9.69	6.71	5.36
Domestic and personal service.....	4.59	2.40	1.97
<i>Public service</i>	2.19	0.94	0.80
<i>Transportation</i>	7.43	4.44	4.15
<i>Manufacturing and mechanical industries</i>	31.13	32.57	33.37
Agriculture, forestry, and animal husbandry.....	29.39	41.43	44.47
<i>Extraction of minerals</i>	2.59	4.08	5.03
Totals.....	100.00	100.00	100.00

Agriculture class as it had been in the *Professional*. In the *Extraction of minerals* class there were only 0.27 as many males 45 years of age and over as there were in the *Professional* class. But the production of children up to 1923 had been 1.34 times as great in the former class as in the latter.

So far we have considered the populations, more-fertile families, and total children ever born, of the several occupational classes, only in relation to the *Professional* group taken as 1.00. This procedure gives a correct picture of the

the same as that of figure 2, as it is in fact bound to be, figure 3 brings out an additional bit of information that is not shown by figure 2. What figure 3 shows is that in the first six occupational groups (*Professional*, *Clerical*, *Trade*, *Domestic*, *Public*, and *Transportation*) the more-fertile families in each group form a smaller percentage of the total number of more-fertile families than the males 45 years of age and over, in that same group, do of the total number of occupied males of the same ages. The single cross-hatched column is shorter, in every one

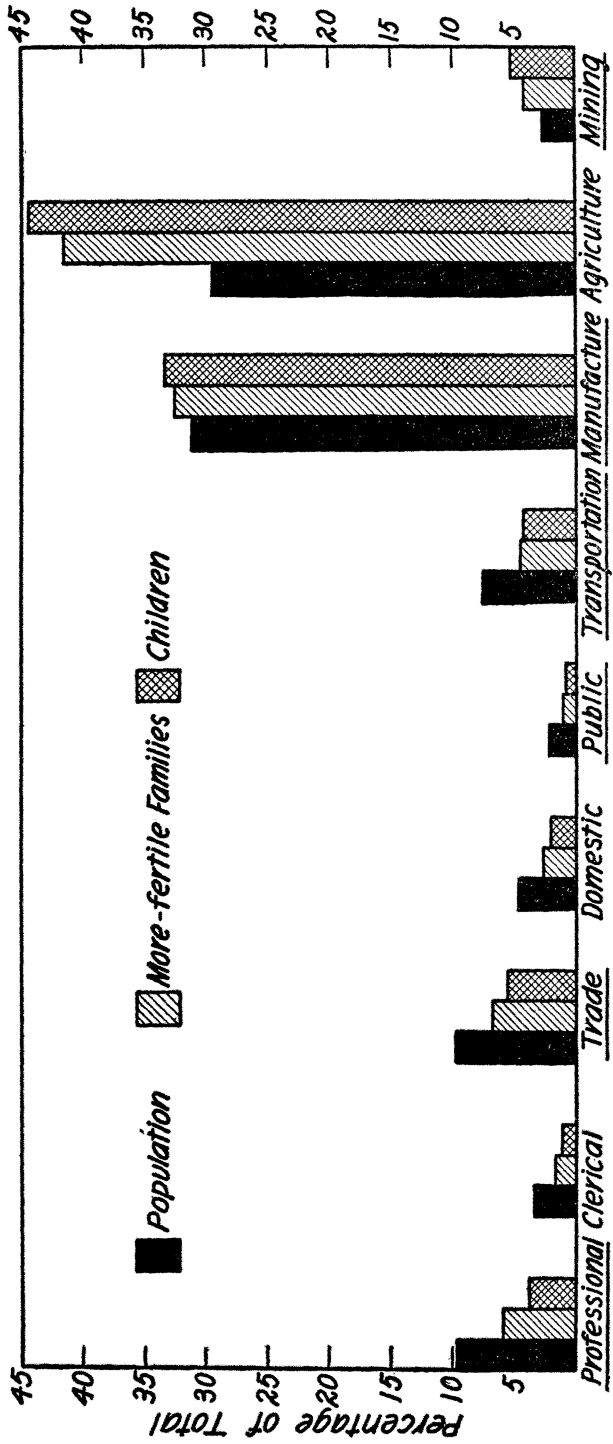


FIG. 3. GRAPH OF THE THREE PERCENTAGE COLUMNS OF TABLE 4

of these first six occupational groups, than is the solid column. Similarly in these same six occupational groups the number of children ever born in each group forms a still smaller percentage of the total number of children, than either the males 45 years and over or the more-fertile families in each group do of their respective totals. The double cross-hatched columns in these six occupational classes are shorter than either the solid or the single cross-hatched columns. These results mean that the men aged 45 and over in these six occupational classes have not contributed to the next generation in as high a proportion as their own representation in this generation.

The case is diametrically opposite for the last three occupational groups (*Manufacturing*, *Agriculture*, and *Extraction of minerals*). In these three groups the percentage of children ever born, and the percentage of more-fertile families is *higher* than the percentage of males 45 years of age and over in the total population of occupied males. In each of these three occupational groups the double cross-hatched column is taller than the single cross-hatched column, which in turn is taller than the solid column. The men aged 45 and over in these three occupational classes have contributed to the next generation more than their own proportionate representation in this generation. The excess contribution is particularly marked in the case of the farmers. It is convincing statistical confirmation of the conclusions reached by Pearl (1925) regarding the sexual activity of farmers, from an entirely different sort of data.

SOCIAL AND EUGENIC IMPLICATIONS

Summing the whole case up it appears that the great laboring groups, *Manufacturing*, *Agriculture*, and *Mining*, not

only have a higher proportion of more-fertile families per unit of population so occupied, than do the other occupational groups, but also they have a much larger average number of children per family. Put in another way the case comes to this: In our population it appears that the *Professional*, *Clerical*, *Trade*, *Domestic and personal service*, *Public service*, and *Transportation* occupational classes are reproducing themselves in such manner as not to maintain in quite its present status their relative representation in the population. But the heavy laboring classes, *Manufacturing*, *Agriculture*, and *Mining*, are reproducing themselves in excess of their representation in the population. From this excess must necessarily be supplied the deficiencies in the first six classes in the next generation, if these classes are to maintain about the same representation in the total population that they exhibit in the present generation.

What is the racial, social, and economic significance of this result? It has generally been viewed with great alarm. The fact that college graduates, from whom are necessarily recruited most of the *Professional* class, are not proportionately reproducing themselves has been more than once represented as a sort of national calamity. The arguments that this situation is wholly deplorable are so familiar that I shall waste no time in detailing them. Instead I wish briefly to direct attention to another view of the case—one which I have never seen stated before with any clarity, and one which I believe deserving of careful consideration.

In a theoretically ideal social organization there would obviously be an optimum number of persons engaged in each of the numerous differentiated occupations, which when integrated together are essential to the well-being and survival of the society as a whole. There is

theoretically an optimum number of teachers, lawyers, store-keepers, laborers, soldiers, and so on. But in actual human societies there is no extraneous, god-like determination of these optimum relative numbers in the occupational classes. Instead the actual existing number is determined by a process of natural selec-

of life of farmers is, on the average, somewhat greater than that of persons in occupations higher up the list, it is not so if attention is paid solely to *duration of economically productive life*. The old farmer is generally a retired farmer, so far as actual work at farming is concerned.

One other consideration also needs

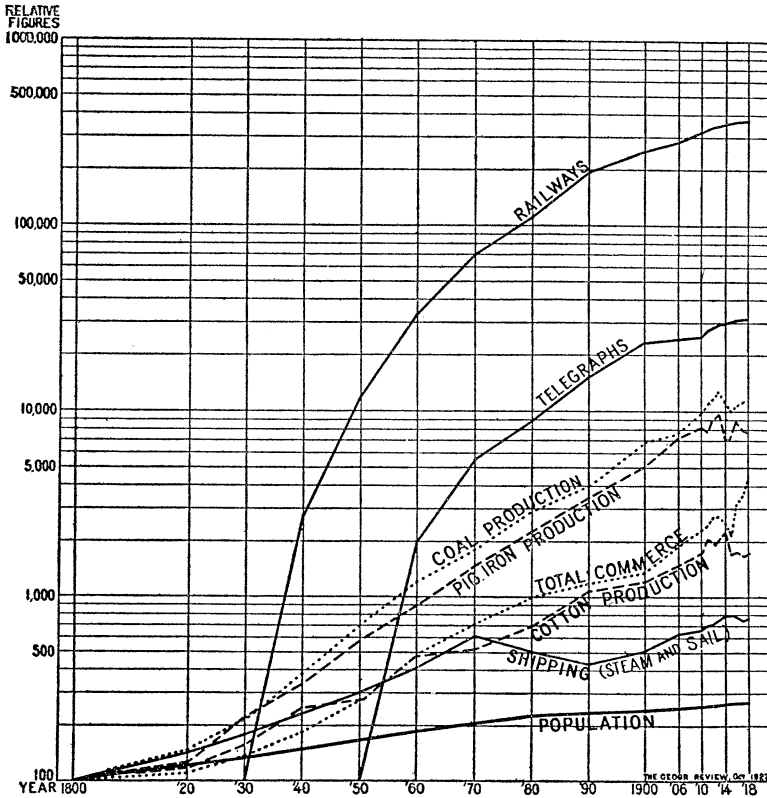


FIG. 4. THE PROGRESS OF POPULATION AND OF INDUSTRIAL PRODUCTION IN THE WORLD, DURING THE NINETEENTH CENTURY. (FROM PEARL, 1922.)

tion, in which process economic factors are probably the most important element.

But another factor comes also into the case. The human units wear out faster in some occupations than in others, and therefore need to be replaced faster. Roughly speaking the occupational classes are listed in table 3 in descending order of average duration of life. The only important exception is in the case of farmers. And in that case, while the total duration

attention. This is not only an industrial country, but a country in which the increase of prosperity and well being is almost solely dependent now, has been for some time in the past, and presumably will be for some time in the future, upon the continued *growth* of industry. This is shown clearly in figures 4 and 5. Figure 4 is taken from Pearl (1922), and figure 5 from Rylands (1926).

What figure 4 demonstrates, I think, is

that in order to permit the population to increase roughly two and a half times, and enjoy the standards of living which prevail at the present time, it has been necessary to increase coal and pig iron production from 50 to 70 times, the cotton production 20 times, the railway mileage 3000 fold, and so on. It is only because the organization of industrial processes, inventions, and scientific discoveries have made possible the growth of industry of all sorts at the rates indicated that human beings have been able to enjoy the standard of living that they have and do, and at the same time permit the population to grow as it has. Figure 5 in a slightly different way tells the same story.

The hard facts shown in figures 4 and 5 mean further that all along there has had to be an increasing production of laborers, skilled and unskilled, in the manufacturing and mechanical industries. Machinery alone does not make a profitable factory. There must be workmen to run the machines.

While figure 4 relates to world conditions figure 5 shows that so far as the most important and basic of the mechanical industries is concerned, the same conditions prevail to a striking degree in the United States, considered by itself.

Now, I suggest that the findings of this paper regarding fertility in this country are not widely divergent from what they theoretically ought to be if our society is to continue in general prosperity and well-being, and continue to grow in these respects. In short we *need* to have laborers reproduce faster than the first six occupations on our list, in order first to take up the greater human wastage in the laboring classes, and second to permit of continued industrial growth and prosperity. Probably a sound economic structure of the country as a whole is in a very real and considerable sense dependent

upon just this relationship. So far from being alarmed at the present situation, I am disposed to think that we should find serious cause for *real* alarm if it were markedly different from what it is. Though the biological processes involved are widely different in the two cases, the actual facts about differential human fertility are curiously reminiscent of what obtains among the social insects. A stable and economically sound society there, as with us, seems to demand an excess production of workers.

The facts set forth in table 4 plainly mean that some part of the next generation's supply of professors, doctors, lawyers, bankers, railroad presidents, and the like, will have to be recruited among the sons of the farmers and factory laborers of this generation. But what of it? Just precisely this relationship has always been true so far in the history of the world and probably will be true for a long time to come. And furthermore from just the same sources will have to be recruited some of the clerks, typists, small tradesmen, job-holders, brakemen, motor-men, and various other less lofty citizens.

In the United States the agricultural group has for a long time produced far more than enough children to maintain its own industry, as has been shown by McFall (1925). These farm boys in excess, so to speak, have contributed in no small measure to the highest intellectual, social, and economic classes of our population. In fact the agricultural class has demonstrated an especial fitness to contribute sound stock to other occupational classes. I am disposed to believe that time will show that the industrial class in our large cities is, in already measurable and probably increasing degree, doing the same thing. Let one observe the origin of the most brilliant and able students today

in city high schools, both classical and technical.

Wheeler (1926) has ably argued, and made a sound case, that the next emergent "level" above mind is the social. He says (p. 435):

One of the levels in which the situation, as it appears to me, is most open to investigation, is the social. Unfortunately the subject has been passed over by writers on levels with only a few vague remarks. Unfortunately, also, the science of comparative sociology has remained undeveloped. It has, in fact, fallen between two stools, because the sociologists have left the study of animal and plant societies to the biologists and the latter have been much less interested in these societies as such than in the structure or individual activities of their members. Apart from Forel and myself only a few investigators, like Espinas, Waxweiler, Petrucci and Deegener, have evinced a keen interest in nonhuman societies. Yet these, no less than human society, are as super-organisms obviously true emergents, in which whole organisms function as the interacting determining parts. Owing, moreover, to the loose and primitive character of the integration and the size of the components even in the densest societies, it is possible to ascertain the behavior of the parts and to experiment with them more extensively than with chemical and organismal wholes, since the parts of the latter are either microscopic or ultramicroscopic and are always so compactly integrated that analysis becomes very difficult and involves a considerable amount of statistical inference.

What may be said, with any critical insight, to be statistically known about differential human fertility indicates that in these phenomena we have an expression of a very subtle but far-reaching and extremely significant mechanism of self-regulation in the social super-organism. The falling birth rate and death rate and the type of occupational differential fertility discussed in this paper are primarily to be regarded, I believe, as adaptive regulatory responses—that is, biological responses—to evolutionary alterations in the environment in which human society lives. In this environment

the economic element is perhaps the most significant biologically. This is not the place nor the occasion for the elaboration of this theme. But one cannot but be impressed that the almost total neglect by eugenists of the obviously important influence of relatively simple economic factors upon the human situation with which they deal, and which they endeavor to account for in very far-fetched and highly inferential ways, is stupid.

Finally regarding the specific results set forth in this paper, I frankly do not see the usually alleged cause for eugenic alarm, for the reason that history demonstrates, I believe, that the superior people of the world have always been recruited from the masses, intellectually speaking, in far greater numbers than they have been reproduced by the classes. And in saying this I do not for one moment subscribe to the view that environmental influences have been the chief factor in the production of superiority. On the contrary I adhere firmly to Galton's view that heredity plays the principal rôle. But the almost infinite manifoldness of germ-plasmic combinations can be relied on, I think, to produce in the future, as it has in the past, Shakespeares, Lincolns, and Pasteurs, from socially and economically humble origins.

In order that there may be no misunderstanding it should be emphasized that what has been said in this paper relates entirely and solely to the *relative* or *differential* aspect of fertility, as between the several occupational classes, and *not* to the absolute fertility of the population as a whole or its component parts. That the population of the United States as a whole cannot go on increasing at its present rate per unit of time, and its component elements continue to enjoy the standards of living which they have in the past and do now, would seem to be obvi-

ous. This conclusion has been many times emphasized in recent years, by various students of the population problem, particularly East (1923), and the present writer (Pearl, 1922, 1924, 1925), both of whom have expressed, and still adhere to the view, that birth control is a rational and intelligent method of counteracting the evils of excessive population growth. There is nothing in the results or conclusions of the present paper which in the least conflicts with this prior conclusion. That the absolute levels of birth rate will continue to fall in all social and economic classes, as it has in the past, with increasing density of population, seems highly probable. All that is here argued is that a differential birth rate—a higher rate of reproduction in some social and economic classes than in others—is probably to be regarded as a biologically normal feature of the social and economic structure of large human groups, and that this fact is not necessarily a sound ground for eugenic alarm.

Finally to assume that this paper states that the unlimited reproduction of geneti-

cally unsound stocks is not a dysgenic menace, is simply a confession that the paper has not been read. It would, of course, be highly desirable if the reproduction of all stocks exhibiting traits universally admitted to be undesirable and known to be inherited, could be completely stopped. But it has yet to be demonstrated that either poverty or lack of membership in a social aristocracy are biologically inherited traits, though the inference is too often drawn that they are. The present paper is intended, in part, to show that the eugenic condemnation of whole social or economic classes, either directly or inferentially by the contention that only certain classes such as college graduates are eugenically desirable, is unwarranted by anything now known. While this is not the place to go into the matter in detail I am convinced that the current orthodox position of eugenics rests upon a fundamental genetic fallacy which largely invalidates some of its most important conclusions. This matter I hope to discuss in detail in the near future.

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