THE NATURAL HISTORY OF POPULATION

RAYMOND PEARL

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OF POPULATION

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BY

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To

MAJOR GREENWOOD

with affection and admiration

PREFACE

THIS book includes what appear to be some of the more significant results of the studies of human fertility in relation to the problems of population, which have been a major object of my interest and effort for a good many years. In particular, it is largely based upon the unique material that we have been able to collect and analyse during the last six years, because of the generous support that has been given to our work by the Milbank Memorial Fund in New York, for which it is a pleasure and privilege to express again our deep gratitude. The present book by no means exhausts the rich store of valuable data contained in that material—and still less does it tell the whole story of the natural history of population. Only a little beginning is made, in either respect. It is hoped that in due time another volume may appear, that will supplement this one, and carry the study further.

As to the general arrangement of this book the following may be said. In order that the reader wishing to follow the account straight through may not be put off the track by digressions, the notes have been relegated to a special section immediately following the text. In the text they are indicated by small consecutive superscript numbers.

To indicate bibliographic references in the text the author's name is followed by the last two figures of the year of the publication referred to, as Jones (28), meaning a paper or book by Jones published in 1928. Since any particular Jones is unlikely to have written papers in both 1828 and 1928, no serious confusion is likely to be caused by the omission of the century figures. In cases where there might possibly be confusion due to two Joneses with identical initials having operated scientifically a century apart, pains have been taken to indicate the century in the text reference.

Long, but essential, statistical tables that would cumber the text are put in Appendix I, and numbered with consecutive Roman numerals to distinguish them from the text tables that are indicated by Arabic numerals.

The bibliography, which contains only items cited in the text or consulted in the preparation of this book, occupies a separate section at the end, just preceding the Index. It runs to about 700 titles, but at that is only a fraction of the writer's working annotated bibliography on fertility.

I am greatly indebted, and deeply grateful for the help I have had from present and former members of the staff of the Department of Biology of the School of Hygiene and Public Health of the Johns Hopkins University in the preparation of the material embodied in this book. These include Dr. John R. Miner, Dr. Antonio Ciocco, Miss Sophia A. Gould, Mrs. Alan Bernstein, and J. F. Kish, in connexion particularly with the statistical work; Miss Hermine Grimm, who has for many years been a most efficient aid in bibliographical work; Mrs. Augusta K. Hibbitts, whose invaluable contributions to the enterprise are particularly noted in the text; and most important of all my wife, who has cheerfully interrupted a busy editorial life of her own to help in a thousand ways in the details of preparing the book for the press. A more devoted group of helpers than these no one could ever hope to have. To Dr. O. L. Tinklepaugh I am gratefully indebted for permission to borrow illustrations from his published work.

In such a mass of detail, statistical and otherwise, as is embodied in this book, it is too much to hope that all inadvertent errors have been caught up in the repeated checking to which the manuscript has been subjected. I hope there are no serious ones, and that my readers will be charitable about the minor ones.

R. P.

BALTIMORE,
September, 1938.

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CHILDREN who keep rabbits or guinea-pigs or white mice for pets rather quickly learn that there are three things which determine not only the numbers achieved by their entertaining playthings, but also the social success of the enterprise as a whole, however it may be appraised, and particularly when measured in terms of favourable or unfavourable parental reactions. These three things are births, deaths, and available space. There are, to be sure, other things to worry about, even in such simple and naïve excursions as these into the entrancing field that combines experimental biology with some of the prerogatives commonly looked on as reserved to the deistic control of destiny, but they are relatively less important. One among them, however, always keeps obtruding and making itself felt. This is the fact that the individual rabbits or guinea-pigs are different from each other. Some are better than others —smarter, prettier, or more lovable. But it is primarily upon births, deaths, and space that father and mother keep a watchful, and, alas, all too often a bilious eye.

The professional student of the problems of population does too. From births he computes natality rates, from deaths mortality rates, and relates both to each other and to the space that the population must necessarily occupy. It is these three variables that basically determine the size and doings of populations, whether of mice or men. Also, just as in the small-scale breeding operations, the distribution of those differences between individuals that define what is called the quality of the group is always a matter of concern in human populations. All this being so, it will be well to consider with some care at the start the biological meaning of these basic variables.[1]

There are three broad general forces or principles, philosophically considered, upon which the doings of all living things are based. Out of the inter-relations and integrations of these three arises the greater portion of the material, phenomenal and noumenal, with which the science of biology has to deal. These basic elements are:

First: The urge to individual personal *survival* here and now. This appears to be an attribute of all living matter. Its net accomplishments and final consequences in populations are quantitatively measured by death-rates.

Second: The urge to *reproduction* which again appears to be a property of all that lives. Its effectiveness in populations is quantitatively measured by birth-rates.

Third: *Variability*, once more common to all living matter, in both its genetic and somatic aspects, the one leading to the observed differences or variations between individual organisms, the other embodying the differences in the same individual at different times in its life.

Finally, it is to be remembered that it is impossible to discuss or even to imagine life or living things without taking into account the rest of the universe in which they exist. So then there must be added to the material for the discussion of any biological problem one more item. This is:

Fourth: The *environment* that conditions and in some degree determines all vital phenomena. In considering the biology of populations, one aspect of the environment is of particular importance, both theoretical and practical. This is available space. The number of organisms in the population taken in relation to available space determines *density*, a factor of major significance in population biology.

Let us now examine each of these four items in some detail.

2. *The Survival Urge*

The urge to survival may fairly be regarded as the most fundamental attribute of living things and is therefore placed first in the list. It may be well to point out at the start that in its essence this urge to survival is rather completely and uncompromisingly selfish. To the best of its ability the individual organism so conducts its affairs as to continue living just as long as possible, regardless of what other organisms may do or think about it. When extinction threatens, every resource is brought to bear to fend it off. Basically this is what underlies the struggle for existence. Out of it, associated with it, and because of it come great ranges of biological phenomena that have been departmentalized for combined reasons of convenience and pedantry. These include such things as food-getting, metabolism, and nutrition, cellular and humoral defence mechanisms furnishing immunity and resistance to disease, protective shelter-seeking and building, natural selection, and in good part evolution itself.

As a matter of observed fact, this survival urge is primal and deeply rooted. Whenever and wherever we see its fundamental selfishness apparently in abeyance or even much abated, and seemingly replaced by altruism or 'mutual aid', as it has been called, we may be fairly sure that one or the other of two things has happened. Either, as among the invertebrates (especially the social insects) and the lower vertebrates, the 'mutual aid' is not individually motivated but is a mechanistic group-consequence of caste differentiation and integration, with no more (and no less) of an altruistic element in it than there is in the cellular differentiation and integration in the embryonic development of the individual; or, as in man, and to some extent among his nearest relatives, complex psychological elements have been added to the picture in the course of evolution which may seem at times to overwhelm and obliterate the more primitive and deeply rooted biological urge. The most obvious of these added factors amounts really to a more enlightened self interest—that is to say, a belief that for the present, and until times get much worse, it will be likely to conduce more effectively to individual survival to play along with and help one's neighbours in the crowd.

This statement is, from the necessity of brevity, much too bald and apparently dogmatic in its form, and wants more explanatory elucidation and development than we can give it here. But it essentially conforms to at least a part of the reality. It is reasonable to suppose that the individual soldier ant is unaware of the fact that its activities and efforts are of benefit to the social group (the colony) to which it belongs. On the contrary, it seems likely that when it fights it does so because it is its inherent and entailed nature to do so. In fighting it is expressing its own will-to-live or urge to survival, and in the only way of which it is capable. On the human side, in thinking of the personal motivation of altruistic behaviour one may recall the position so clearly expressed in the speech of Brotteaux in *Les Dieux ont Soif*, perhaps the greatest novel Anatole France ever wrote. It is (I quote from Allinson's translation):

> 'What I am doing now, the merit of which you exaggerate,—is not done for any love of you, for indeed, albeit you are a lovable man . . ., I know you too little to love you. Nor yet do I act for love of humanity; for I am not so simple as to think . . . that humanity has rights . . . I do it out of that selfishness which inspires mankind to perform all their deeds of generosity and self-sacrifice, by making them recognize themselves in all who are unfortunate, by disposing them to commiserate their own calamities in the calamities of others and by inciting them to offer help to a mortal resembling themselves in nature and destiny, so that they think they are succouring themselves in succouring him.'

Man's behaviour, and particularly his social behaviour, is motivated by so complex a set of physiological and psychological factors, appetites, emotions, and reasons, as to be extremely difficult to disentangle in a particular instance. But it may safely be said that whenever he curbs his primal urge to personal survival he usually does it for secondary reasons superimposed upon his natural, protoplasmic will-to-live. Many of these reasons are, collectively, what we call social. They represent purposeful adaptations in what William Morton Wheeler (27, 28), whose recent death is an irreparable loss to both biology and sociology, has convincingly argued is the next emergent level above the individual organismal. In most human beings these secondary social adaptations of behaviour are still somewhat incomplete and imperfect, as clearly appears in times of great stress or danger. And the extent to which the highest forms of human altruistic social adaptations have real and enduring survival value has yet to be measured. It can be argued with some plausibility that they give the appearance of having some survival value, or at least of not being positively harmful, because they became even moderately widespread only during that recent portion of human history in which living has been relatively easy for all mankind. It has been relatively easy for two reasons: low density of population, in general; and rapidly increasing knowledge of applied science with its accompanying industrial developments. In a world where getting a living was easy, altruistic social relations were correspondingly easy. Instances and localities of a real struggle for existence between individual men (other than during sizable and persistent wars, or in the processes incident to the assumption of the 'white man's burden') have been rare in this world since the beginning of the nineteenth century. And few have ever seriously alleged that war is an altruistic enterprise; nor is it at all uncertain that the pleasures of 'civilizing' backward peoples are, like those of condescension, singularly one-sided.

So, then, the first significant point to be noted in the natural history of population is that all populations everywhere are composed of individuals bent on surviving as individuals just as long as possible. They do not want to die. Individually and collectively they resort to every device they can think of to put off for as long as may be the ultimately inevitable end. If it should be rationally demonstrated at this moment that the world's problems would be easier of solution if there were fewer people in it, and that a considerable social service would be rendered to mankind if a substantial number of men forthwith painlessly departed from it, one can be quite sure that only a corporal's guard would step forward as volunteers for euthanasia. Many might be convinced of the rationality of the idea in general, but would advance no fewer than a million reasons that some one else should achieve the glory incident to so noble a public service. Biologically their position would have much in its favour. For when man's instinct for individual survival completely ceases to influence his conduct all will be over and done so far as he is concerned as a species. No problem will fret him thereafter.

At the present time altruism, as a principle, has a significance in the biology of population of the first order of importance. This is so because it has led, by a very gradual process of development, to a body of societal attitudes and sanctions that result in the position accepted in a considerable number of countries, of which the United States and England are conspicuous examples, that it is the obligate duty of society to maintain and preserve in life and as members of the population all those mature individuals who are either unable or unwilling to get their own livings. This attitude obviously throws an ever-increasing burden upon the more fit and industrious participants in the whole social enterprise. In infra-human populations no such burden exists. The developed individual incapable of getting its own living simply dies. The weight of evidence indicates that essentially the same conditions prevailed among primitive men in the earlier stages of cultural evolution. We have examined briefly some of the reasons, at least, that probably have led to the alteration of the situation in the course of social evolution. But the essence of the matter, for students of population at the present time, is the physical impossibility of the indefinitely continuous and synchronous growth of *both* population and altruistic behaviour in a spatially limited universe. Later on in this book more will be said regarding this matter. But it seems desirable to have the problem clearly in mind from the start.

3. *The Reproductive Urge*

The urge to reproduce is second in power, if at all, only to that for survival. This basic attribute of living material, like the other, includes in its scope great ranges of academically labelled and pigeon-holed biological phenomena—of which among the more important are perhaps population growth, with its part in the struggle for existence, and natural selection; and heredity with its concomitants of development and growth. For heredity is most clearly to be apprehended as an aspect of reproduction. Living things do not merely reproduce; they reproduce *themselves*. This fact makes it clear that, philosophically viewed, the urge to reproduction is really a part—an extension, if you like—of the primal urge to survival. If the individual cannot ensure his own indefinite earthly immortality he can and does try his very best to see that his stirp shall keep on living forever and ever. Naturally this self-reproductive process tends towards social as well as biological stability.

Since death and birth present the ultimate biological antitheses it is naturally to be expected that man's attitudes and reactions about the processes leading to reproduction would be, as they are, in fact, widely different from those about the processes leading to death. He is opposed to the latter and fights against them. But, by and large, all human beings, after passing the early 'teens, are seized with an almost uncontrollable urge to multiply, and this in itself raises a whole flock of serious problems. It is not, of course, that all of these boys and girls deliberately and consciously are impelled to add more units to the already colossal totals of census office ledgers. Quite the contrary is the case, for the most part. But deep down in the biological roots of their beings is the overwhelming urge to dally with the physiological mechanisms that alone are capable of adding to census office figures. So it results over the world as a whole that the births each year outnumber the deaths.

There are various forces that operate to curb in man the completely exuberant expression of the overt consequences of this protoplasmic urge to multiply. Besides the technical biological ones bound up with peculiarities of the physiology of human reproduction, of which more will be said later, there are two factors of major importance that put the rate of human reproduction on a level far below that free and unrestrained multiplication that characterizes lower forms. The first of these is legal, the second hedonistic. As one element of social organization mankind demands that the legal rite of marriage—this rite taking many diverse but basically equivalent forms amongst different peoples—shall normally and in the regular course be a prerequisite to human reproduction. To be sure, this legal requirement is nowhere quite strictly enforced by the authorities nor adhered to by the subjects—even in the very moral United

States of America 1 baby out of every 25 to 30 odd born each year is illegitimate, taking the country as a whole. In some sections of the population the ratio rises to 1 in 4 or 5, so mightily does sin prevail in those parts. But even so it is obvious that the institution of marriage is a major restriction upon the copiousness of multiplicative activity seen in lower forms.

The second, or hedonistic, restriction is what is commonly called 'birth control'. Mankind discovered long ago that the normal physiological mechanisms of reproduction can be tampered with in a variety of ways, to the common end that, while the probability of a particular copulation resulting eventually in progeny shall be greatly diminished, the pleasurable sensations associated with the initial act shall not be lessened at all, or at least not to anything like the same degree. Again, there seems to be no doubt that this has become a restrictive factor on human reproduction of major importance, especially in modern urbanized and industrialized populations of high density.

The significance of the basic instinct for reproduction as an item in the natural history of population is so obvious that to delineate it would be the grossest sort of pedantry. But it is perhaps worth mentioning that the attempts to control it for social ends, and as a help to the solution of the problems population raises, appear to encounter difficulties similar to those already discussed in connexion with the urge to survival. Professional advocates of birth control emphasize the importance, potential or actual, of contraception as a social force for the amelioration of the quality of the race, and for the solution of economic and other problems that vex us. But, realistically viewed, it seems reasonably clear that up to now, at least, the great majority of those persons who have practised contraception in their wedded lives have been moved to do so by considerations not primarily having to do with the social welfare of mankind in general. Rather the motivation appears to have been in the main more on the selfish side—a desire on the one hand to have more fun out of life without having to pay for it, and a shrewd estimate that the chances of prolonged individual survival of self and children will be enhanced if there are not too many of the latter. To the human biologist, at least, it seems a formidable social task to persuade 'superior' people to have more babies and 'inferior' people to have fewer, so that the race may be improved.[2]

4. *Variability*

The third unique and universal biological principle, variability, has two aspects, as has already been pointed out. No two living organisms are exactly like each other in all particulars, and no single organism is precisely the same at any two moments in its lifetime. The first of these aspects is the only one that is conventionally called variability. It is mainly caused by the combined interaction of genetic shufflings and recombinations, and the environment. The second aspect of organic variability is usually and conveniently called adaptability. It is an odd and remarkable phenomenon. The unique thing is not that organisms are more or less fitted or adapted to the circumstances in which they find themselves. Inanimate objects of various sorts, and particularly that category of them that we call machines, are this. It is true that the adaptations of organisms and machines are brought about in different ways. But the fact of adaptation is present, and in principle identical, in both. We are, however, not concerned here with adaptation, but with self-started and self-controlled *adaptability*, which organisms have and machines lack. Organisms incessantly change and alter themselves to meet the fleeting changes in their circumstances. No living organism ever 'stays put'. When it does it is dead, and in dying has passed into a wholly different category of matter.

The process goes even deeper than change and adaptability in behaviour. The very material substance itself that makes up the living organism is constantly changing. What, then, does 'personal identity' connote? What we are pleased to call the same identical man at the age of 70 years is composed of extremely little, if any, of the same material substance that made him up when he was 10 years old. Probably there are few if any molecules in him at 70 that were there at 10. In the intervening years the only thing about him that has survived is his *pattern*, a sort of transcendental or spiritual wraith through which has flowed a steady stream of matter and energy. There is a profound truth embodied in Cuvier's old comparison of a living organism to a whirlpool. It is the pattern that is the essence of the business. It alone endures. And it is constantly altering and adapting itself to changing circumstances. Especially is this true and important of the psychological panel of the total pattern of the human organism. It is this aspect of adaptability, the capacity of organisms for change ending only with death, that seems to be more important in its social consequences than its teleological aspect, if, indeed, we are prepared to admit the reality of the latter at all, as some are not.

The principle of variability, marked by differences between individuals, is an important element in the natural history of population in respect of both of its aspects that have been discussed. In one of these aspects it gives the outward and visible signs of what the eugenists call the 'quality' of populations. In the other, it props and sustains, and in truth constitutes about the only realistic biological basis for the visions of a better world that earnest well-wishers hope to bring about by altering the present deplorable habits of mankind through 'population policies' and other uplifting enterprises. The general idea is that if men are adaptable why not utilize this pleasant trait to make the world over. For politicians and reformers alike, the adaptability aspect of variation is God's major biological benison.

5. *The Environment of Man*

This adaptability aspect of variation naturally leads directly to the fourth and final basic element in the biological foundation upon which it is proposed to erect the discussion of the natural history of population; namely, the environment. The *effective* environment of any particular living organism is in part determined by the pattern of that organism, just as truly as the pattern of the organism is, in part at least, determined by the environment. For a particular man, and for a group of similar men, but not for any mouse, the relative honesty of his banker and the docility of his child are highly important elements in the effective environment. And what makes them so is not the bankishness of the banker, nor the childishness of the child, but the pattern of the particular man of whom we are speaking—a pattern not shared by the mouse. In short, the relation between organism and environment is everywhere and always mutually reciprocal, and as man is the most highly differentiated and manifoldly diverse in his capabilities of all organisms, so also is his effective environment the most complicated.

More extensively and more effectively than any other organism, he *makes his own environment*. He is constantly altering it in the hope of making it better. But such is the interplay of the contradictory biological elements in his nature that he dislikes and resists any enforced alteration of his environment by any one else than himself or the group of people similar to himself to which he belongs. The social and political consequences of these opposing attitudes are far-reaching and encompass within their range the greater part of our communal troubles in this imperfect world.

The number of separate and distinguishable elements that go to make up human environments, if not infinite, is at least indefinitely large. But for practical working purposes the most important of them, as judged by their effects upon human life and living, may be classified with sufficient detail for present purposes as follows:

The Significant Effective Environment of a Particular Human Being, or a Particular Group of Human Beings, Includes:

I. *As Physical Elements*:

1. Earth (the lithosphere in all its manifold aspects—topography, nature and quality of soil, mineral resources, &c.).
2. Air (the atmosphere, with all its meteorological and climatic implications, as well as the obligate biological necessity for human respiration).
3. Water (the hydrosphere, fundamentally related to life processes, and of manifold particular utility to human living).
4. Material things men make (tools, machinery, and human artefacts generally).

II. *As Biological Elements*:

5. Other human beings in the same group, and
6. Other human beings in other groups (these two items, 5 and 6, together constituting the 'social environment').
7. Plants, and
8. Animals other than man (these two items, 7 and 8, together constituting the sources from which human beings derive, indirectly and directly, the material substance and the energy for their living).
9. Ideas (constituting a unique and powerful element of the human environment as distinguished from that of any other organism).

A little consideration of the matter makes it apparent that the nine categories of this classification, and the man (or group of men) whose environment they constitute, mutually and reciprocally affect each other. The atmosphere alters the lithosphere (erosion); man alters the atmosphere (heating houses, 'air-conditioning'); the lithosphere alters the hydrosphere (rainfall distribution); plants alter animals (adaptively); ideas alter plants (agriculture and genetics); and so on. There is no need to multiply examples of the obvious fact of the mutual and reciprocal functional inter-relationship between man and the several elements of his environment. It is a fundamental characteristic of the order of nature, as philosophers from Aristotle to Lawrence Henderson have noted. As J. G. Frazer (10) says (p. 281) of man generally:

> 'External nature certainly acts on him, but he reacts on it, and his history is the resultant of that action and reaction. To leave out of account either of these mutually interdependent elements, the external and the internal, is to falsify history by presenting us with an incomplete view of it.'

The full implications of the reciprocally determinative influences of organism and environment seem, however, to have been generally somewhat less than adequately valued in the last century's development of biological thought, and certainly an extremely inadequate amount of first-rate research has been put in upon the matter. This is partly an obvious consequence of the trend given to biological philosophy by Darwin, Galton, Mendel, Weismann, Bateson, and Karl Pearson, with their emphasis upon the entailed or endowed element in the whole biological picture. In human biology particularly, the role played by heredity has come to take on many of the aspects of religious dogma. Indeed, it has been urged that eugenics should be overtly espoused and developed as a religion. And all this has been going on in a world where consciously planned and directed alterations of environmental conditions have had far-reaching and profound biological effects upon whole populations. The history of communal or public health in England, taken in all its aspects, furnishes a body of material in many ways unique for the careful and philosophic consideration of the theoretical biologist to which he has paid but little attention. For the most significant part of that history William Farr, that greatest of vital statisticians ever to have lived, has furnished him with a precisely quantitative record, imbued with the penetrating intelligence that perceives clearly what it is important to record in biological history and how it may most usefully and effectively be set down. Partly under the stimulus of Farr's records and partly as a result of less obviously motivated evolutionary forces, England altered the environmental conditions under which its population lived. The biological results were far-reaching and profound. And in their production any conscious attempt to alter the germ plasm, and probably any actual alteration of it, played at the most but a small part.

Public health has been taken as an example of the point because it is the most conspicuous and best documented of all. But the same thing in principle is exemplified in other and diverse fields. Quite apart from its effect upon the health of the workers, the alteration of the environmental conditions of factory labour enormously increased the efficiency of production. This in no wise changed the innate and entailed characteristics of the workers as organisms. John Doe still remained a smarter and generally better animal intrinsically than Richard Roe, as he was at the start. But the environmental changes did, on the whole and statistically, narrow the productive efficiency gap between the Does and the Roes. Biologically, the point can be and has been generalized. Every geneticist knows that the final expression in the individual of each hereditary determiner is conditioned by the environmental circumstances under which its development is undergone. Yet, and this is a point especially to be emphasized, very little has been done in the way of attempting to analyse thoroughly and penetratingly the biological effects of environmental conditions upon human beings.

6. *The Size of Populations*

The natural history of population rests upon the four basic biological variables that have been discussed, and upon their integrated inter-relationships. Because this is so, attention has been focused on them at the start. The next step is to proceed to a more detailed analysis.

It is evident that in the numerical maintenance of the size of populations, and in their growth, natality is the positive prime mover and mortality is the negative force acting in the opposite direction. If, and so long as, natality and mortality are equal the size of the population without migratory movements in or out will remain constant; if natality is greater than mortality it will tend to increase in size; and if mortality is greater than natality it will tend to decrease. It is evident in theory as well as in fact that in the aggregate the forces of natality are naturally and normally more powerful in a statistical sense than those of mortality. The reproductive capacities of animals generally extend over considerable fractions of their individual lifetimes, while each living thing dies only once. Populations of plants and animals other than man tend generally to be held constant or to increase at a rather slow rate in time by the operation of the so-called 'checks and balances' of nature; which is to say by the operation of a multitude of factors tending generally to curb the full potential capacity for reproduction. In human populations, particularly during the last three centuries, man by his own intent, in part, and also by behaviour not consciously planned to that end, has greatly altered the play of these natural checks.

The relatively short time-fluctuations in the movement of population that can be produced by altering the previously established balance between natality and mortality can be very great. Famines, floods, and epidemics can produce such results, with mass migration in some cases injected as

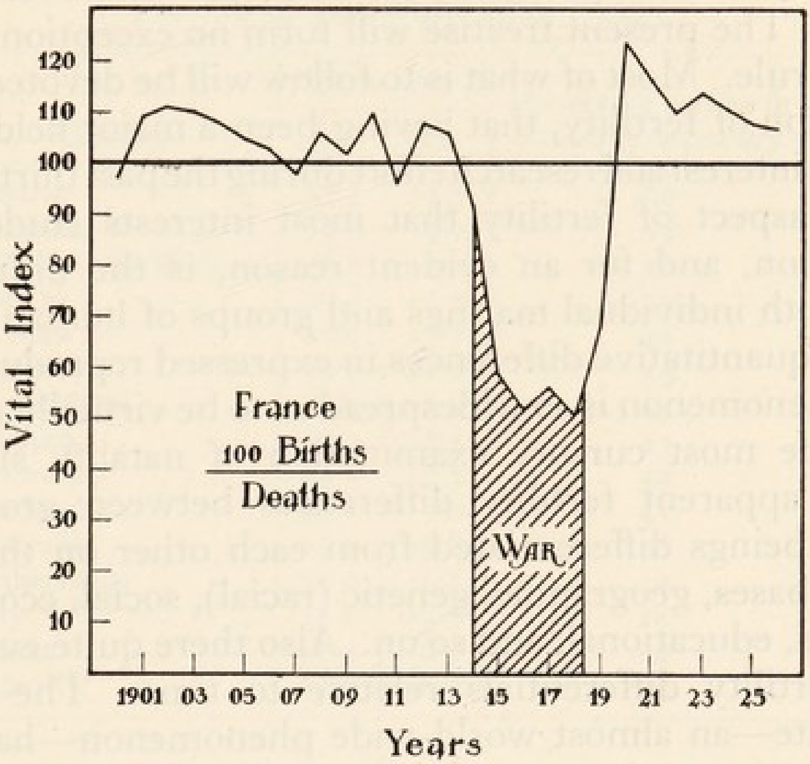


FIG. 1. Vital index (100 births ÷ by deaths) of population of France during 20th century.

an auxiliary factor. The story of the population of Ireland in the mid-nineteenth century is an example. War can produce marked temporary fluctuations of this sort, as is shown by Fig. 1.

Other social and economic events may produce violent temporary local population fluctuations. A current example is to be seen in Vienna (Anon., 37). In that city in 1935 there were reported 25,205 deaths and only 12,179 live births. More than twice as many died as were born. Bad economic conditions have led to a waning of the marriage rate and to an increasing proportion of childless marriages. Such immigration as there is brings in few minor children.

7. *Differential Fertility*

While it is true that the examination of all questions of population must always keep in mind the balance of the forces of natality and mortality, it is also true that practically all students of population devote much more of their analytical attention and effort to the former than to the latter. This is because reproductivity is the prime mover in the matter. The present treatise will form no exception to this general rule. Most of what is to follow will be devoted to the discussion of fertility, that having been a major field of the writer's interest and research effort during the past thirty years.

The aspect of fertility that most interests students of population, and for an evident reason, is the differential one. Both individual matings and groups of human beings exhibit quantitative differences in expressed reproductivity. This phenomenon is so widespread as to be virtually universal. The most cursory examination of natality statistics reveals apparent fertility differences between groups of human beings differentiated from each other on the most diverse bases, geographic, genetic (racial), social, economic, religious, educational, and so on. Also there quite evidently exist fertility differentials relative to time. The falling birth-rate—an almost world-wide phenomenon—has been and is now a major concern of statesmen as well as other students of population.

The magnitude and wide distribution of this decline in the birth-rate may be illustrated by the data of Table 1. This table gives the percentage decrease in the birth-rates per thousand of population during the present century, from 1900 through 1933 inclusive, in fifteen countries, from the levels existing in 1900.

The figures of Table 1 sufficiently indicate the reality of the prevailing downward trend of birth-rates in the western world. As the only purpose at the moment is to present concrete evidence regarding a phenomenon that in a general way every one is aware of, it is unnecessary to enter upon any discussion at this point of the factors involved in the birth-rate declines shown in the table.

Since the early writings of Karl Pearson on differential fertility, and particularly since the publication of Heron's (06) classic study just after the turn of the century (repeated by Mitra (37) thirty years later with essentially the same results) widespread interest and effort has centred upon

TABLE I

The fall of birth-rates since 1900

Country	Birth-rates 1900	Birth-rates 1933	Percentage decline in a third of a century
Austria	37·3	14·3	62
Germany	35·6	14·7	59
England and Wales	28·7	14·4	50
Norway	30·1	15·0	50
Sweden	27·0	13·7	49
Hungary	39·3	21·6	45
Switzerland	28·6	16·4	43
Belgium	28·9	16·5	43
Denmark	29·7	17·3	42
Scotland	29·6	17·6	41
Australia	27·3	16·8	38
Netherlands	31·6	20·8	34
Italy	33·0	23·7	28
France	21·4	16·3	24
Ireland[3]	22·7	19·2	15

group differential fertility in respect of social and economic status, and of intelligence and educational ratings. A great number of studies in these fields have appeared. References to the more important of these will be found in the bibliography at the end of this book. In general there has been a steady improvement in the critical and penetrating character of the statistical methodology brought to bear upon the matter, and in the soundness and pertinence of the original data subjected to analysis.

While it is true that, aside from a few exceptional pieces of earlier work, technically adequate statistical attacks upon the problem of differential fertility may fairly be said to date from about the beginning of the present century, the problem itself is as old as biology, if not, indeed, as old as mankind as a separate species. This appears to be true of many of the essential aspects of the problem, demographic and biological. The very antiquity of some, at least, of the phenomena that have led to interest in the discussion of the problem should perhaps have, in and of itself, a rather important significance in influencing and determining our present-day attitudes regarding it. Theognis and Plato deplored the undue multiplication of the unworthy and undesirable, and the failure of the best people to contribute more largely to future populations. But Aristotle perceived that the matter is not so simple as it might be; he was not unaware that genius often fails to breed genius, and in fact went so far as to say (*Rhet.* ii. 15) that the sons of Socrates, indubitably a great man, were dull and fatuous. And, according to Xenophon (*Memorabilia*), one of these sons, Lamprocles, treated his mother very badly. In the 'Airs, Waters, and Places' of the Hippocratic *corpus* instances of clear-cut group differential fertility are noted and intelligently discussed.

The general outcome of studies of differential fertility has been essentially identical in most instances, and objectively amounts to showing that groups or classes in less fortunate and favourable social and economic circumstances tend to exhibit higher fertility rates than do groups or classes more fortunately and favourably situated. But various persons have noted that objectively similar phenomena not infrequently occur in the reproduction of other organisms than man, both plant and animal. Herbert Spencer stated (98, vol. ii, p. 409), as a general biological law, that:

'Individuation and genesis are necessarily antagonistic. Grouping under the word individuation all processes by which individual life is completed and maintained; and enlarging the meaning of the word genesis so as to include all processes aiding the formation and perfecting of new individuals; we see that the two are fundamentally opposed. Assuming other things to remain the same—assuming that environing conditions as to climate, food, enemies, &c., continue constant; then, inevitably, every higher degree of individual evolution is followed by a lower degree of race multiplication, and *vice versâ*. Progress in bulk, complexity, or activity, involves retrogress in fertility; and progress in fertility involves retrogress in bulk, complexity, or activity.'

Spencer encountered some manifest difficulties in the application of this 'law' to human populations as they exist, and involved himself in plain contradictions. A part of the reason why he acquitted himself with something less than his customary dialectic *aplomb* in his discussion of human population problems appears to have been that he evidently had a strong emotional desire to smite Doubleday, as was the fashion. Doubleday, a far less cautious and learned man than Spencer, really knew more than he about human populations, I am disposed to think. Doubleday's (53) book, now largely forgotten and almost never read, contains, with all its errors of judgement, some acute observations and reasoning. What brought it and its author into some disrepute was a combination of two things: the first was that some of the facts and conclusions of his treatise offended the sentimental susceptibilities and moral judgements of the early-Victorian middle and upper classes. Self-righteous respectability did not like being told things that are now commonplaces in the discussion of population problems. In the second place, Doubleday was not a judicious man, and pushed his arguments much too far in one direction—that relating to food taken alone as an environmental factor—and overstated his case in all directions, until he was out at the extreme end of a limb, much beyond where his evidence could sustain him, and therefore a highly vulnerable target for attack. It was a real fact, then as now, that the expressed fertility of the poor was greater than that of the well-to-do and rich.[4] But present-day students are disposed to attribute its causation somewhat less naïvely than did Doubleday, who stated his case in this way:

'The GREAT GENERAL LAW then, which, as it seems, really regulates the increase or decrease both of vegetable and of animal life, is this, that whenever a *species* or *genus* is *endangered*, a corresponding effort is invariably made by nature for its preservation and continuance, by an increase of fecundity or fertility; and that this especially takes place whenever such danger arises from a diminution of proper nourishment or food, so that consequently the state of depletion, or the deplethoric state is favourable to fertility; and that on the other hand, the plethoric state, or state of repletion, is unfavourable to fertility, in the ratio of intensity of each state, and this probably throughout nature universally, in the vegetable as well as in the animal world; further, that as applied to mankind this law produces the following consequences, and acts thus:

'There is in all societies a constant increase going on amongst that portion of it which is the worst supplied with food; in short, amongst the poorest.

'Amongst those in the state of affluence, and well supplied with food and luxuries, a constant decrease goes on. Amongst those who form the mean or medium between these two opposite states—that is to say, amongst those who are tolerably well supplied with good food, and not overworked, nor yet idle—population is stationary. Hence it follows that it is upon the *numerical proportion* which these three states bear to each other in any society that increase or decrease upon the whole depends.

'In a nation where the affluence is sufficient to balance, by the decrease which it causes amongst the rich, the increase arising from the poor, population will be stationary. In a nation highly and generally affluent and luxurious, population will decrease and decay. In poor and ill-fed communities, population will increase in the ratio of the poverty, and the consequent deterioration and diminution of the food of a large portion of the numbers of such communities. This is the real and great law of human population.'

The recent work of Sydenstricker and Perrott (34) is interesting in this connexion, and would have greatly cheered Doubleday could he have known of it, showing as it does a very high expressed fertility of groups at the lowest economic levels, and, indeed, on the dole, during the depression. Bertillon (99) showed that towards the end of the last century the degree of economic group differential fertility in four great cities was probably as large as it is now. His essential results are shown in Table 2 (p. 21).

It is interesting to note that Bertillon's data show the same trend in fertility from city to city in each of the six economic groups. It is, in other words, a general and not an isolated matter of group biology with which we are dealing. Furthermore, this phenomenon of class differential fertility is not by any means confined to Western civilizations of the pattern of ours. Wattal (34) quotes data from the last (1931) census of India showing in the clearest manner that precisely the same sort of occupational class

TABLE 2

Births per 1,000 women[5] *15–50 years of age*

(From Bertillon)

Economic status	Paris (1889–93)	Berlin (1886–94)	Vienna (1890–4)	London (1891)
Very poor	108	157	200	147
Poor	95	129	164	140
Comfortable circumstances	72	114	155	107
Very comfortable circumstances	65	96	153	107
Rich	53	63	107	87
Very rich	34	47	71	63
All classes together	79	102	153	109

differential fertility occurs in the population of that country as with us. There can be here quoted only a condensed table (p. 96), but it sufficiently illustrates the point.

TABLE 3

India (1931)

Occupation of husband	*Average children per family*
Production of raw material	4·4
Preparation and supply of material substances	4·2
Public administration and liberal arts	4·0
Law, medicine and instruction	3·7

These examples are brought forward not to defend or uphold any theoretical views, expressed or implied, but merely to emphasize that the phenomena of differential fertility are not something new that lately arose because of economic or other developments of recent human social organization, nor are they peculiar to our special kind of civilization. And not only are the phenomena themselves of ancient lineage, but they have been apprehended and discussed by really quite respectable intellects long prior to these present times. All of which considerations suggest that a certain modesty and cautious reserve will be the part of wisdom in discussing the extremely complex and difficult problems of fertility, or their neat and simple solution, or recommendations about planned population policies. The landing-field for the more aeronautical explorers of population problems is still but dimly illumined, and full of pit-falls and boggy spots.

8. *The General Biology of Fertility Differentials*

If any significant appraisal of differential fertility is to be achieved it will be necessary first to try to analyse the broad general factors that are causally involved in the production of the phenomenon itself.

In a broad sense, group differences in expressed fertility may be presumed to be due to either:

1. Fundamental and consequently substantially permanent biological differences between the groups in natural, innate, reproductive capacity, or
2. Alterations by environmental forces of the natural, innate, reproductive capacities of the several groups; using 'environmental forces' in the broadest sense to include not only physical factors surrounding group living, but the interplay of biological, social, economic, and psychological elements affecting human life, or
3. Some combination of 1 and 2.

It is evident that the largest and most important human groups that could be expected to exhibit differential fertility solely because of innate biological differences (as in 1) are racial groups. There may be real racial differences in fertility resting on a solely genetic basis, uninfluenced by artificial interferences with natural reproductive activity, and not determined by direct environmental actions. But it is difficult to prove that this is so, even with relatively pure primitive and savage races. For almost invariably[6] when it is found that a particular primitive racial group exhibits a low fertility, further inquiry develops evidence that the expressed fertility has altered in quite recent times in evident consequence of environmental forces or changed habits. As an example, consider the Ba-Ila people of

Northern Rhodesia, who were found by Smith and Dale (20) to have a relatively low expressed fertility. In explanation, the authors say (i. 16):

'One reason, perhaps the chief, is the unproductiveness caused by the astonishing promiscuity of their sexual relations and the extreme earliness of age at which these relations commence. It is no exaggeration to state that from the age of seven or eight a girl, married or otherwise, counts her lovers, who are constantly changing, not singly but by the score. The writers at the time of the first census of the people were amazed to find kraal after kraal inhabited solely by adults, and to receive time and again the same reply, that there were no children, that, much as they wished for them, conception was a very difficult matter.'

In short, environmental (in the sense of non-genetic) factors were apparently the chief elements in producing the low birth-rate. But even now this situation is changing again, according to the acute and shrewd testimony of Mrs. Millin (34), who finds the population now increasing, and accounts for it in this way (pp. 264–5):

'Now they all, the black people, live peacefully in their kraals, and even if they only kill an enemy whom the witch-doctor has smelled out, or drown forbidden things like twins, or cut up someone for the purpose of concocting a magic medicine, the white people come along and make a fuss; and quite often a perfectly well-meaning person, highly respected and with occult power, is hanged.

'And so, if one can't drink, or fight or occupy oneself with religion, what is there left in life to do but propagate sons to plough the lands, and daughters to fill the kraals?'

Surely, quite regardless of the exact degree to which the observers just quoted have soundly appraised causes, this whole picture effectually nullifies any attempt to conclude that the expressed differential fertility trends of groups like the Ba-Ila rest upon any innate, genetic base. The classic example of the point is perhaps found in the various studies that have been made upon depopulation in the Pacific, and particularly Melanesia, by Rivers[7] (22), Buxton (26, 29), Pitt-Rivers (27), Roberts (27), and Baker (28, 29). While these authors differ somewhat among themselves in their distribution of emphasis upon the various causal factors thought to have been concerned, there is general agreement that the significant influences were environmental in the broad sense rather than genetic. Again, Wattal (loc. cit., supra) shows in the clearest manner that in India the descending average fertility as between Animists, Muslims, Hindus, and Parsees does not represent racial, genetic differences in innate fertility, but rather depends upon the rule that 'fertility is in inverse ratio to standard of living and intellectual development', and that the implementation of this rule to expressed fertility is through such things as relative frequency of child marriage, average age of adult marriage, prevention of conception, and other purely non-genetic factors.

Krause (35), in a careful study made at the Hamburger Rassenbiologisches Institut on families in north-western Germany and especially the northern part of the province of Hanover, was unable to find any significant correlation between fertility and the anthropometric characteristics that differentiate and distinguish races.

All the evidence that has been accumulated by the work of the last quarter of a century on the subject agrees with cumulative force in showing that among civilized populations of the western world the main factors leading to group or class differential fertility are environmental (non-genetic) in nature,[8] and that any group differences in innate biological (genetic) fertility, if they exist at all in such populations, play a small role in producing group differences in expressed fertility. With critically collected *ad hoc* material, it has been shown (Pearl, 36) that in substantial samples of urban-dwelling American women, each married once only, living in wedlock, and free of all forms of gynaecological disease, who had never made any attempt to practise contraception in any form during their reproductive lives, there does not appear to be any significant difference in innate fertility between whites and Negroes. Fig. 2 shows the age-specific median pregnancy rates per 100 computed ovulations.[9] The data from which Fig. 2 is plotted are given in Table 4.

It is evident that none of the differences can be regarded as statistically significant, having regard to the errors of sampling involved. The same result has been found to be true in various sub-samples that have been drawn from the

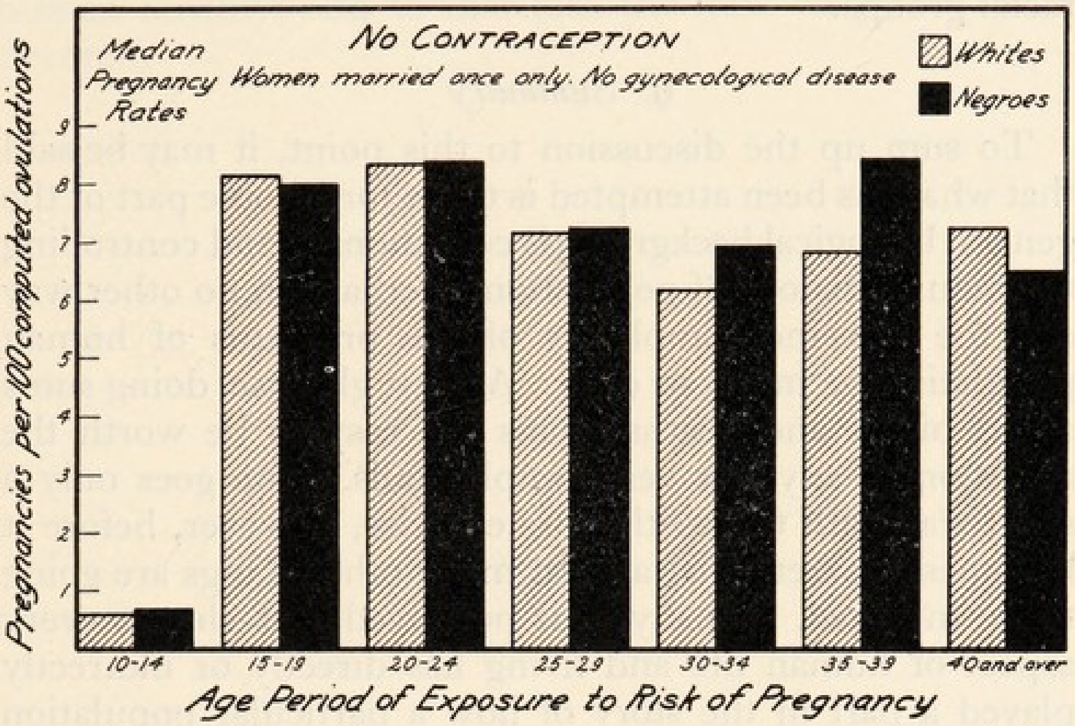


FIG. 2. Age-specific median pregnancy rates per 100 computed ovulations for women not practising contraception.

TABLE 4

Median pregnancy rates per 100 computed ovulations in women married once only, and without any gynaecological disease, and not practising contraception

Age period at risk	Not attempting contraception					Diff. / P.E. Diff.
	Whites		Negroes			
	N	Median rate	N	Median rate	Difference	
10–14	203	0·60±0·71	147	0·69±1·23	+0·09±1·42	0·06
15–19	5,080	8·14±0·26	1,688	7·97±0·45	−0·17±0·52	0·33
20–24	6,605	8·34±0·20	1,608	8·37±0·38	+0·03±0·43	0·07
25–29	4,132	7·16±0·21	883	7·25±0·35	+0·09±0·41	0·22
30–34	2,092	6·19±0·25	378	6·89±0·55	+0·70±0·60	1·17
35–39	909	6·84±0·41	122	8·44±0·97	+1·60±1·05	1·52
40 and over	226	7·27±1·01	27	6·50±2·14	−0·77±2·36	0·33

material (Pearl, 34, 37). These results plainly imply that the differences between whites and Negroes in the United States in officially recorded birth-rates are to be attributed primarily to differential environmental influences, and particularly to differences in the prevalence and effectiveness of the contraceptive efforts actually made in the two racial groups.

9. *Summary*

To sum up the discussion to this point, it may be said that what has been attempted is to set forth some part of the general biological backgrounds conditioning and controlling the natural history of population. Perhaps in no other way can the extreme complexity of the problems of human population be made so clear. At first glimpse, doing sums about births and deaths seems too easy to be worth the attention of any but very simple souls. One goes only a short way with this arithmetic exercise, however, before it becomes apparent that a great many other things are going to be involved. Finally, it is perceived that almost every aspect of human life and living has directly or indirectly played a part in the story of how a particular population came to be the kind of population it is, in quantity and quality. Instincts, emotions, and occasionally, perhaps, a little intelligence, have been involved, as well as more purely physical variables. More population is made only by already existing units of population. Therefore, let any person over 50 sit down quietly before the fire some evening and seriously think back over life to the end of arriving at a just picture of why it was that he or she really had the number of children (from 0 to *n*) that actually eventuated. Then let that same person, however briefly and necessarily imperfectly, try to think how the reasons and circumstances that have determined reproductivity have been different and varied within even the small circle of close personal friends. In this way some glimmer of a notion will perhaps be reached as to how the naturalist looks at the general problem of population and why he thinks it an extraordinarily difficult and complex one, and is more than commonly impressed with the terrible force of Bertrand Russell's dictum 'that ascertainable truth is piece-meal, partial, uncertain, and difficult'.

In this chapter the discourse has been mainly of general biological principles. It will be necessary now to penetrate more deeply into the specific and particular biology of human fertility, and to that task the next chapter will be devoted.

II

THE BIOLOGY OF FERTILITY

1. *Definitions*

AMONG all those producing children in the United States in 1934 there were 44 women past their 47th birthday, and therefore practically at the end of their fecund life, who brought forth in that year their *first* and only live births. In the same year there were two women of an extremely different order of proven breeding capacity. Each one of them, apparently quite in her stride, produced her *twenty-seventh* child.

What are the more important direct biological factors concerned in the causation of such great diversities in expressed fertility? How comes it about that some people are apparently so much more fertile than others? It is to this problem of the underlying biological elements back of the observed variation in fertility that this chapter will be devoted. But first it will be well to have a clear definition of what we are going to talk about.

The word 'fertility' has long been used as a technical term by biologists and medical men, but often without precise definition of the sense in which it was being used, or of the limitations of its meaning in a particular case. This is unfortunate, because 'fertility' has a number of common usages, of quite different biological connotations, as any dictionary makes clear. It is often used even in technical writing, for example, as identical and therefore interchangeable with 'fecundity'. But, biologically, fertility and fecundity denote two different things. To be sure, in certain types of biological reproduction they come so close together as to be, for practical purposes, interchangeable concepts, but even there the fundamental distinction remains, philosophically speaking.

Because of this confusion in terminology and in the thinking behind the verbalism, an attempt was made to define precisely 'fertility' and 'fecundity' at an early stage of the writer's work in this field (Pearl and Surface, 09, pp. 80–1). The pertinent passage is as follows:

'In all viviparous, as compared with oviparous, animals, the study of these subjects (fecundity and fertility) is greatly complicated by the fact that the magnitude of the apparent or recorded productiveness is influenced by several separate and independently varying sets of factors. The unit of such statistics is the individual offspring at birth. But the production of an individual offspring by a viviparous animal implies (1) the removal of an ovum from the ovary (ovulation), (2) the *fertilization* of this ovum, and (3) its successful *development* in utero. A considerable portion of partial or complete sterility in mammals is the result of a failure of the ovum to be fertilized, this failure in no wise depending in many cases on any fault of the ovum itself. The true innate fecundity of the female organism is clearly measured by capacity for ovulation. This is primary, and the other factors concerned in the production of an individual organism are secondary, in so far as the measurement of fecundity is concerned.

'In view of these considerations, it seems desirable to make use of a more precise terminology than that commonly employed in discussing these matters. We would suggest that the term 'fecundity' be used only to designate the innate potential reproductive capacity of the individual organism, as denoted by its ability to form and separate from the body mature germ cells. Fecundity in the female will depend upon the production of ova, and in the male upon the production of spermatozoa. In mammals it will obviously be very difficult, if not impossible, to get reliable data regarding pure fecundity. On the other hand, we would suggest that the term 'fertility' be used to designate the total actual reproductive capacity of *pairs* of organisms, male and female, as expressed by their ability when mated together to produce (i.e. bring to birth) individual offspring. Fertility, according to this view, depends upon and includes fecundity, but also a number of other factors in addition. Clearly it is fertility rather than fecundity which is measured in statistics of birth of mammals.'

If the above reasoning is sound, fertility, and not fecundity, is the variable measured in man by properly collected and standardized natality statistics. It is impossible practically to measure fecundity in man with any precision or generality.

2. *Classification*

Individual differences or variation in expressed or overt fertility—and, by consequence of summation and integration, group variation in fertility also—depend upon and are conditioned by individual (and again group) *differences* in at least the following matters:

1. Sexual desire (libido).
2. Innate reproductive capacity, genetically grounded, in part, at least, and the alteration of its expression with advancing age.
3. The span of reproductive life, which in the female is definitely limited at its beginning and end by menarche and menopause respectively.
4. Litter size—the number of young customarily brought forth at a birth.
5. The frequency of coitus.
6. The frequency of occurrence of pregnancy or conception in relation to the extent or degree of physiological possibility presented for becoming pregnant.
7. The prevalence (frequency and persistence) of contraceptive efforts, and their physiological effectiveness as actually practised.
8. Reproductive wastage—the loss of reproductive effort consequent upon the termination of pregnancies in abortions, miscarriages, and still-births, or in any other way than by live birth near enough to term so that the presumption is in favour of the viability of the child.

Naturally these eight variables are not the only ones concerned in producing variation in fertility, but they do include the most important of the direct biological factors involved. A book might be written about each one of them, and many books have been written about some of them. Because of the limitations of space, and because they are matters of contributory rather than primary interest to our present concern, only fairly brief discussions of these factors can be undertaken here. But in these discussions emphasis will be put, in so far as the present state of knowledge permits, upon the quantitative aspects. Such treatment of the case is plainly indicated, because fertility itself is a quantitative matter.

3. *Libido*

The general relation of *sexual desire* or *libido* to reproductivity and fertility was stated with much force and elegance about four hundred years ago by a great man, Ambroise Paré (1628), born in 1509 at Laval, in the ancient province of Maine, in western France, who, before he came to the end of a long life in 1590, had laid the foundations of modern surgery. What he says about libido is tinged with teleology, no doubt, but it is a fact that sexual congress is both pleasant and desired, and few will doubt that this fact has influenced the quantitative expression of fertility down through the ages. In quaint but very precise French, the good Ambroise opens the first chapter of his treatise on the generation of man with these words:

> 'L'vsage des parties generatiues est accompagné d'vn tresgrãd plaisir, & aux animaux qui sont en la fleur de leur aage, certaine rage & cupidité furieuse procede dudit vsage: ce que nature a ordonné, afin que l'espece demeure à iamais incorruptible & eternelle, par la multiplication de ses indiuidus: & partant Nature a voulu que les animaux fussent aiguillonnez d'vne ardeur & enuie extreme de se coupler ensemble, & qu'à ce desir fust conioincte vne grãde & chatoüilleuse volupté, afin d'autãt qu'ils n'ont point de raison, ils fussent neãtmoins par l'aiguillon du plaisir, incitez à se mettre en deuoir pour cõseruer & maintenir leur gẽre et espece.'

While it is obviously extremely difficult to express quantitatively individual differences in intensity of sexual desire (except as they may be reflected in some degree by frequency of coitus presently to be discussed), it is a plain fact of observation that such differences exist and to a marked degree. They range in women from so-called 'frigidity' at one extreme to nymphomania at the other. Probably an equal range of variation exists among men, but it has been less observed and discussed. In any case, while it is impossible to present a statistical table demonstrating precisely the degree of individual variation in libido, it is clear that this is the fundamental biological variable underlying variation in frequency of coitus, which will be discussed in some detail in a later section and there shown to influence fertility in a direct way.

It has been alleged that under present-day conditions variations in libido take on an added importance because of the increasing employment of the 'safe period' philosophy in contraceptive efforts. Cormack (26) says that the greatest objection to the use of the particular 'safe period' formula that has his approval 'is the fact that has now also been established that all women have a cycle of sexual desire which is strongest during the week following menstruation, that wanes as the month proceeds, and probably increases again slightly, towards the advent of the next menstruation. It is plain, therefore, that intercourse during the absence of sexual desire on the part of the women may be distasteful, and lead to marital unpleasantness.' The statement that 'all women' have such a cyclic alteration of libido is manifestly absurd. Nothing of the sort has been 'established'. Different individuals differ in the rhythm of their desire. Some have no diminution at any time in the cycle. Another thing that makes Cormack's 'objection' seem a little dubious is that his ideas about the timing of ovulation, and consequently of the 'safe period', were formed in advance of the modern critical studies of Knaus (29–33, &c.), Ogino (30, 32), Hartman (36), Wharton (36), Wharton and Henriksen (36), Weinstock (34), and others, as to the timing of ovulation in the menstrual cycle.

An important contribution to our knowledge of the cyclic changes in libido in women has been made by Tinklepaugh (33). He had access to the subjective reports and graphs of some 20 women of whom 16 were college-trained, who recorded their impressions of the varying degrees of sex desire through the menstrual cycle. Fig. 3, taken from his paper, gives in graphic form some of the principal results.

Tinklepaugh's tentative conclusions from his study are that:

'The monthly curve of "sex desire" in woman as reported by other investigators is bimodal, one crest of the curve occurring at the reproductively inappropriate time following ovulation and just before menstruation, the other falling just after menstruation, during the fertile period of the cycle. Observation of chimpanzees in which just prior to menstruation there occurred periods characterized by affectionate demonstrations of non-sexual nature, led to the belief that the premenstrual period of "desire" in woman might be similar.

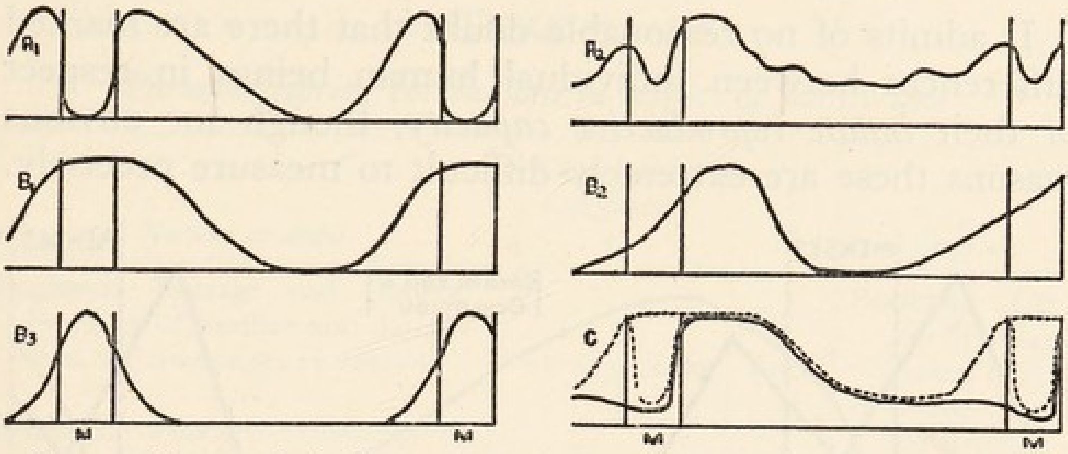


FIG. 3. Types of rhythms of sex desire reported by 20 women on the basis of retrospection. A_1, A_2 (7 cases), bimodal curves. B_1 (4 cases), B_2 (2 cases), B_3 (3 cases) unimodal curves. *C* type of rhythm reported by four subjects on the basis of daily records of sex desire and affectionateness kept from 4 to 12 months. The dotted lines represent degrees of affectionateness. In all types the period of least desire falls during the third week of the cycle. Thirteen subjects reported various degrees of pain or distress preceding or accompanying menstruation. [From Tinklepaugh, 33.]

Records of women and husbands kept through several cycles corroborated this view.

'The premenstrual period in woman is characterized by hyperaffectivity not primarily sexual in nature but easily assuming a sexual form and leading to non-fruitful coitus. The postmenstrual period is one of true sex desire. It extends from the middle or end of the menstrual flow well over to the time of ovulation near the mid-interval, though coitus occurs most often during the early days of the period. This period corresponds with estrus in other mammals, and leads to fruitful coitus.'

Dickinson (27) attempted to correlate the data from the literature on the time relations of conception resulting from a timed single coitus, with the libido curve of 200 women reported by Katharine B. Davis (29). The general result is shown in Fig. 4, taken from Tinklepaugh (33).

While, as has already been said, it is impossible to express differences in libido with quantitative precision, it is probable that Fig. 4 does represent a fair approximation to the general average situation. It cannot of course be regarded as applying to particular individual subjects.

4. *Innate Reproductive Capacity*

It admits of no reasonable doubt that there are marked differences between individual human beings in respect of their *innate reproductive capacity*, though for obvious reasons these are extremely difficult to measure precisely.

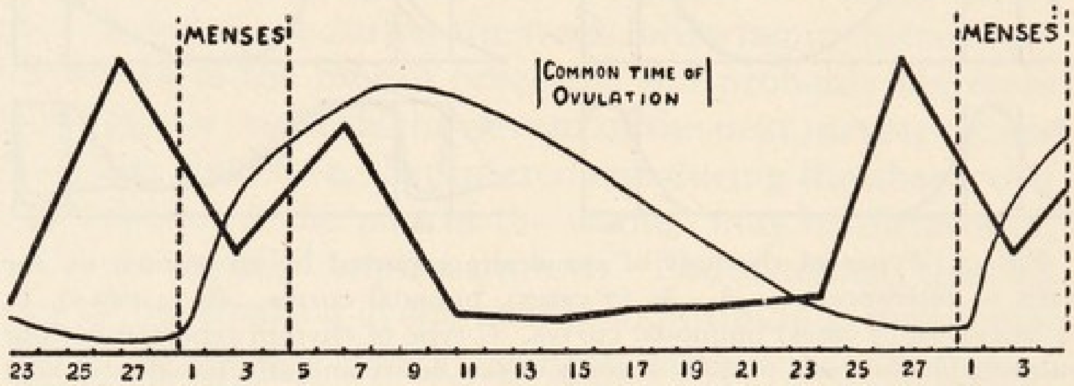


FIG. 4. Rhythm of sex desire (heavy line) and frequency of conception from timed single coitus (light line). [From Tinklepaugh, based on Dickinson's data.]

In man too many other disturbing factors influencing the overt expression of fertility come into the picture, and, as has already been pointed out, fecundity cannot be directly measured in man. But in various lower organisms, where fecundity can be measured, it has been shown that there are great individual differences and that these are inherited. Thus, to take a single example, Pearl and Surface (09) showed that in a homogeneous strain of the domestic fowl the number of eggs laid in a year ranged in different individual birds from 1 to 248 inclusive. It was further shown (Pearl and Surface, 10; Pearl, 12) by experiments in crossing a breed of relatively high innate fecundity (Barred Plymouth Rock) with one of relatively low fecundity (Cornish Indian Game) that fecundity was inherited in a manner accordant with a simple Mendelian hypothesis.

A number of direct *ad hoc* attempts have been made to measure biometrically the degree of inheritance of human fertility, by the technique of correlating size of completed families in parental and filial generations. Table 5 brings together the results of some of the better executed of such studies. The table is arranged in order of descending values of the coefficient *r*.

TABLE 5

Parent–offspring correlations in respect of family size

Nature of data	*Correlation Coefficient r*	*N*	*Source*
England. Peerage and Gentry. Families of mother and daughters. All marriages 15 years+ .	$+0{\cdot}213 \pm 0{\cdot}02$	1,000	Pearson, Lee, and Bramley-Moore (99)
England. Peerage. Families of mothers and daughters . .	$+0{\cdot}210 \pm 0{\cdot}02$	1,000	Pearson, Lee, and Bramley-Moore (99)
Families of University of Oregon students. Mother's family size and her produce. All families .	$+0{\cdot}124 \pm 0{\cdot}02$	638	Huestis and Maxwell (32)
England. Landed Gentry. Fathers and sons. All marriages 15 years+	$+0{\cdot}116 \pm 0{\cdot}02$	1,000	Pearson, Lee, and Bramley-Moore (99)
England. Peerage. Paternal grandmother and granddaughter. All marriages 15 years+ .	$+0{\cdot}112 \pm 0{\cdot}02$	1,000	Pearson, Lee, and Bramley-Moore (99)
Families of University of Oregon students. Mother's family size and her produce. City families	$+0{\cdot}111 \pm 0{\cdot}03$	520	Huestis and Maxwell (32)
England. Landed Gentry. Families of mothers and daughters. Daughter marriages 15 years+	$+0{\cdot}105 \pm 0{\cdot}02$	1,000	Pearson, Lee, and Bramley-Moore (99)
Families of University of Oregon students. Mother's family size and her produce. Country families	$+0{\cdot}104 \pm 0{\cdot}06$	118	Huestis and Maxwell (32)
England. Peerage. Fathers and sons. Sons' marriages 15 years+	$+0{\cdot}066 \pm 0{\cdot}02$	1,000	Pearson, Lee, and Bramley-Moore (99)
England. Peerage and Baronetage; Landed Gentry; and various. Families of father and son .	$+0{\cdot}051 \pm 0{\cdot}01$	6,070	Pearson, Lee, and Bramley-Moore (99)
England. Peerage and Baronetage; Landed Gentry; and various. Families of mother and daughter	$+0{\cdot}042 \pm 0{\cdot}01$	4,418	Pearson, Lee, and Bramley-Moore (99)
Germany (17th and 18th centuries). Father's family size and his produce . . .	$-0{\cdot}037$	. .	Fetscher (33)

It is evident that none of the correlations of Table 5 is of impressive magnitude. In spite of the probable errors, a cautious person will find it impossible to accept this evidence for the inheritance of human fertility at prima facie valuation. The difficulty in the case is the one already suggested. There are too many auxiliary factors such as contraception influencing the overt expression of human fertility to give the simple correlational approach on the basis of recorded family size much critical value. The problem is more complex and subtle.

The medical literature abounds in casuistic records of individual families alleged to demonstrate the inheritance of human fertility. Naturally these have little, if any, critical scientific value in establishing the point. But in order to give an idea of the general character of such evidence one case of this sort is presented, more particularly because it gives a picture of the extreme variations in fertility that do actually occur. A. V. von Marchthurn (97) reported the reproductive history of a woman suffering with epilepsy, wife of a poor linen-weaver in a suburb of Vienna, married at age 20, who by age 40 had had 32 children in 11 confinements, all but 4 born alive. Twelve were still living in 1897, and none had epilepsy. The woman was again pregnant in 1897. Her husband was one of a pair of twins, and she herself one of a set of quadruplets. Her mother was reputed to have borne 38 children.

The problem of the normal change in fertility with advancing age is fundamental in all critical studies of fertility. It has long been known that group fertility declines statistically, as age advances towards the menopause. Matthews Duncan (66) was the first to give this phenomenon adequate statistical expression, though of course it had been, in general, apparent as a fact of human experience for ages past. Forty years ago Körösi (96) made a thorough investigation of the subject, that stands as a classic in the field. Table 6 gives an abridgement of his essential results.

There are two aspects of this problem of the change of fertility with age, that have been somewhat generally confused. One is statistical, the other biological. Normal women, partners in matings where no contraceptive effort of any sort is made, vary greatly in the pattern of their reproductive lives. Some are continuously and overtly fertile from marriage to near the menopause (with variation in their *rate* of fertility expression—or in other words, exhibiting differences in the intervals between their successive

TABLE 6

Probability (*chances in 100*) *of annual births in Budapest by quinquennial age groups of father and mother* (*after Körösi*)

Age of father	Age of mother 20–4	25–9	30–4	35–9	40–4	45–9
20–4	35·0	27·3	22·8	..	..	..
25–9	40·7	33·9	25·8	22·1	16·0	..
30–4	33·2	30·8	22·7	18·4	7·4	1·8
35–9	31·1	26·0	22·3	17·5	8·7	0·8
40–4	25·0	21·4	17·3	15·7	8·0	1·3
45–9	19·7	18·9	14·1	10·8	5·6	1·1
50–4	..	..	12·5	10·2	3·7	0·4
55–9	..	..	11·2	7·6	3·0	0·3

pregnancies). Many other equally normal women, again in the absence of contraceptive efforts, become sterile (in the sense of childlessness) after having produced 1, or 2, or 3, or *n* children. This cessation of child-bearing does not necessarily or perhaps even usually imply that menstruation or ovulation has stopped, or that sexual desire or frequency of coitus has altered. It may occur any number of years prior to the menopause. Why so many women behave reproductively in this way is quite unknown, in general terms. The only generalization that can be made about the matter, in the present state of knowledge, is the somewhat innocuous one that women do in fact exhibit different reproductive patterns relative to age. Various speculations have been made, with appropriate solemnity, that we have here an expression of the effects of 'modern civilization'; of the tensions and stresses of the 'machine age'; of the accelerated *tempo* of urbanized industrial life. Realistically there is little, if any, critical evidence to support such views. They are, in ultimate essence, forms of the ancient concept of cultural primitivism, 'the belief of men living in a relatively highly evolved and complex cultural condition that a life far simpler and less sophisticated in some or all respects is a more desirable life' (Lovejoy and Boas, 35).

In addition to the fact that women exhibit different reproductive patterns relative to age, there is also to be reckoned with the fact that women representing each of these different reproductive patterns are liable to die before they have completed the full expression of their own patterns, whichever they may happen to be.

Now in the purely statistical treatments of the matter such as those of Duncan and Körösi, which may be taken as examples of others of the same general sort, all women of all sorts of reproductive patterns are thrown together in the same numerical hopper. Results of the sort shown in Table 6 are then ground out. These are valid and useful, but only in a somewhat restricted sense and field, the demographic. They show the integrated net effect on the expressed fertility of the group, of the working out of the different reproductive patterns represented, the intercurrent mortality of potential mothers, and other less important variables that are involved. Useful as this sort of knowledge is, in the nature of the case it tends to obscure, rather than illumine, the effects of whatever specific biological forces may be operating in the individual woman to alter with age her innate fertility. The direct transference of the statistical group results to the individual is in this case, as in so many others, quite uncritical and illegitimate. Yet it has often been done.

Tables of the sort referred to have been constructed in various forms to meet special needs. As a recent example Table 7 is quoted from Münzner and Löer (34). It is based upon the births, and the age distribution of the living female population in Prussia in 1931, and the Prussian life tables of 1924–6.

Recent workers have laboured to refine more precisely the statistical group aspect of the problem. Thus Livi (35, 36) eliminated some of the errors inherent in grosser treatments by taking account only of women and confinements (or conceptions) at the close of definite periods after the conclusion of marriage. He reaches the curve shown in Fig. 5, plotted by the present writer from his data. His 'coefficient of fecundity' is obtained by dividing the number of conceptions by the number of women-years of exposure to risk of conception, both taken after two years of married life. For plotting, his coefficients as published have been multiplied by 1,000.

TABLE 7

The probable number of children (K) a woman of age (x) who had borne a child in 1931 will still have (Münzner and Löer)

Age (x)	K	Age (x)	K	Age (x)	K	Age (x)	K
15	1·72	23	1·48	31	0·67	39	0·16
16	1·72	24	1·39	32	0·58	40	0·12
17	1·72	25	1·29	33	0·50	41	0·08
18	1·72	26	1·18	34	0·43	42	0·06
19	1·70	27	1·07	35	0·36	43	0·04
20	1·67	28	0·96	36	0·30	44	0·02
21	1·62	29	0·87	37	0·25	45	0·01
22	1·56	30	0·76	38	0·20	..	..

The generally smooth sweep of the group fertility curve of Fig. 5 from early reproductive life up to near the menopause is evident. It shows the fertility rising to a peak at the central age of 22·5 years, and then rapidly falling off to practically the end of the reproductive life span.

In addition to the kind of knowledge furnished by such statistical data as Livi's the biologist wants the answer to another and different question, that may be put in this way. Suppose a woman (or a group of women) remains overtly fertile up to near the menopause; in what manner and to what degree will the rate of expression of fertility be altered with advancing age? This is not an easy question to answer, because the necessary data are generally not to hand. Official statistics do not furnish them. They must be collected *ad hoc*. This we have done. The numbers are not large, but the material may fairly be regarded as in some degree making up for its meagreness by its individual precision, homogeneity, and pertinence. Out of our material of 30,949 individual reproductive histories it was possible to extract only 63 women, each fulfilling the following conditions: (1) white; (2) multipara (having been pregnant more than once); (3) aged 40 or over at the time of observation;

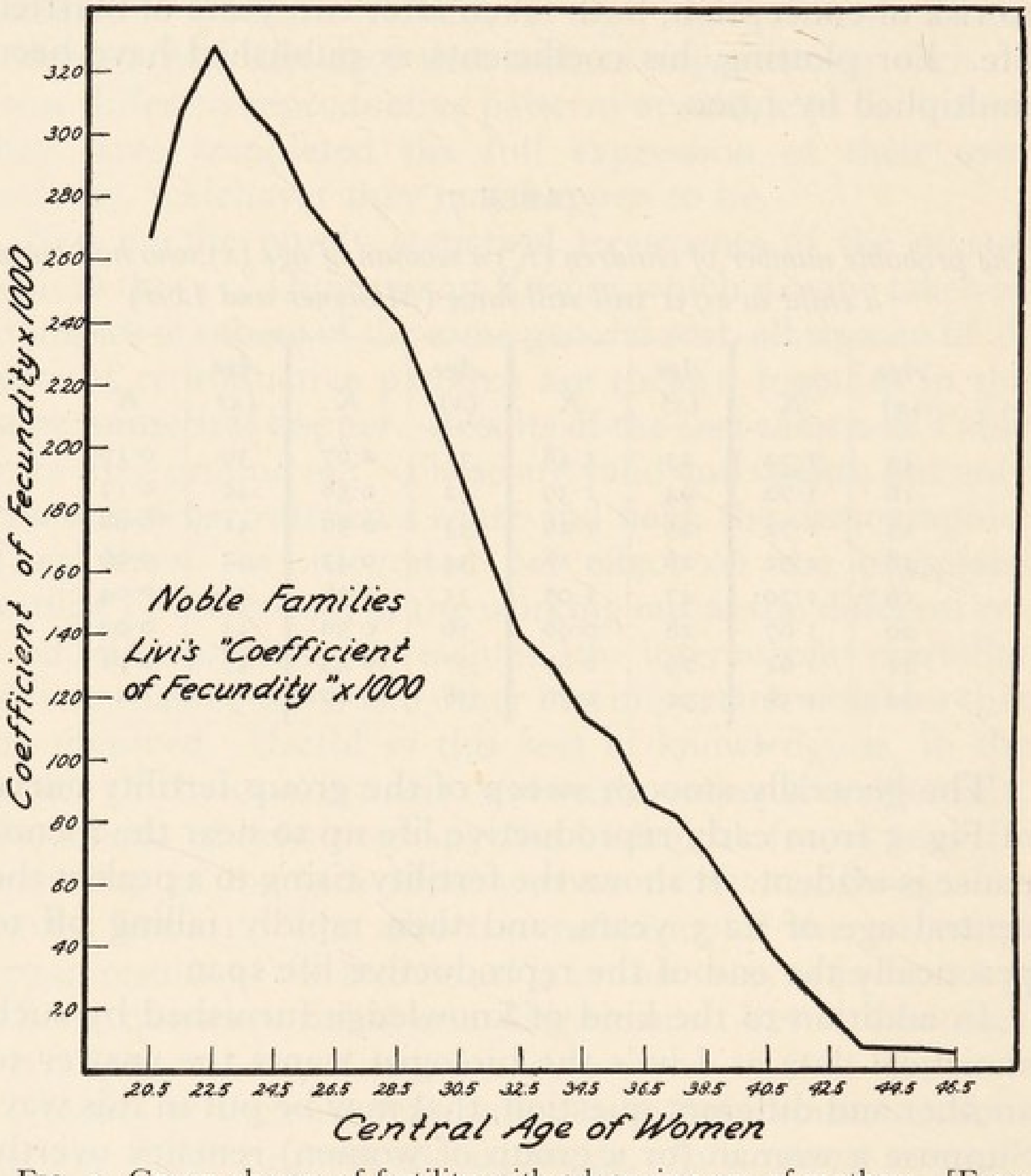


FIG. 5. Group change of fertility with advancing age of mothers. [From Livi's (35) data for mediatized and noble families of Germany, Austria, Hungary, Russia, and Poland.]

(4) married once only; (5) living continuously in wedlock from marriage to observation; (6) overtly fertile in the age period 40 and over; (7) free of any recognized gynecologic disease; (8) married in the age period 15–19 years; (9) continuously exposed thereafter to risk of conception to time of

observation; (10) never having made any effort at contraception throughout married life. These ten restrictions in the interest of homogeneity and pertinence make a formidable array, and indicate clearly enough why it is difficult to get large numbers.

A group of women similar in every respect except that they were in the age group 35–39 years at the time of observation, numbered 169. A similar group aged 30–34 years at the time of observation, included 242 women. Finally a like group aged 25–29 years at observation numbered 482.

For these four groups of women the median pregnancy and live-birth rates, age-specific for quinquennial age classes from 15 to 19 on, computed in the standard manner in use in the writer's laboratory, are set forth in Table I of Appendix I. The rates for the final quinquennial age classes in which the women were when observed are omitted in each case, because the method by which the material was collected (each history terminating with the woman's last delivery) makes the rates for the upper terminal age period unreliable and misleading, since the opportunity to become pregnant in the terminal-age period is arbitrarily curtate. It will be understood that each of the 956 women included in Table I is a separate individual. No woman appears in more than one group. What has been done is to follow through separately the fertility performance of four homogeneous cohorts of women, all married in the age period 15–19 years, from the time of marriage through the last complete quinquennial age period prior to observation. The mean and median ages at marriage and at observation of the women in these four cohorts are shown in Appendix Table I. Also that table gives the unweighted average fertility rates (pregnancy and live birth) for all the cohorts represented in each quinquennial age period.

Fig. 6 shows clearly that the changes in expressed fertility with advancing age are in certain respects quite different, when the reproductive lives of individual women are followed through virtually the whole reproductive span, from those that emerge out of the statistics of large heterogeneous groups as depicted, for example, in Fig. 5. The means measuring the true biological change in the individual's fertility show, to be sure, qualitatively the same kind of rise in fertility early in the reproductive span as we pass from the 15–19 age period to the peak in the 20–24 age

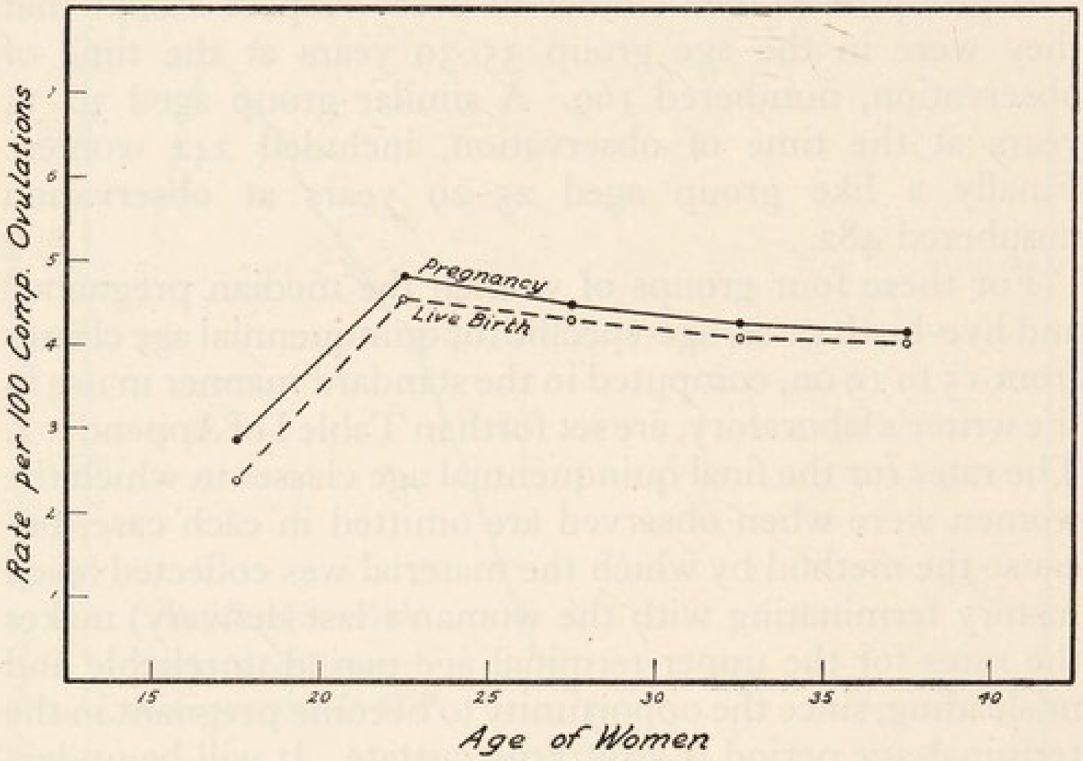


FIG. 6. Changes in the unweighted averages of median pregnancy and live-birth rates with advancing age in four homogeneous cohorts of women in whose married life no contraceptive efforts were made.

period. But thereafter the true biological decline of fertility with advancing age is much more gradual as shown by the homogeneous lots of individuals than is the statistical group decline shown by such figures as those of Körösi, Livi, and Münzner and Löer that have been cited. While not entirely negligible it is still so small as to be of less moment than has usually been supposed to be the case.

The changes can be put in percentage terms in this way:

The *rise* in the period from 15–19 to 20–24 is about 68 per cent. of the 15–19 value for pregnancy rates, and is about 90 per cent. for live-birth rates.

The *decline* in the period from 20–24 to 25–29 is 6·8 per cent. of the 20–24 value for pregnancy rates, and is 5·1 per cent. for live-birth rates.

The *decline* in the period from 20–24 to 30–34 is 11·4 per cent. of the 20–24 value for pregnancy rates, and is 9·9 per cent. for live-birth rates.

The *decline* in the period from 20–24 to 35–39 is 13·5 per cent. of the 20–24 value for pregnancy rates, and is 11·2 per cent. for live-birth rates.

The low median fertility in the age period 15–19, seen in both Figs. 5 and 6, may be regarded as the statistical expression of the biological fact, now well established, that in the human species there is a considerable time-lag after puberty before the complete expression of fertility becomes fully established, quite apart from postponement of marriage. This phenomenon of low expressed fertility in relation to exposure to risk during adolescence has been discussed by a number of workers, notably Malinowski (29) on the basis of his observations of the Trobriand Islanders, where there is a great deal of premarital sexual intercourse but relatively few conceptions, though no precautions are taken to prevent them. The same sort of thing was observed by Margaret Mead (28) among adolescent Samoans. Others who have discussed the matter from other points of view include Hartman (31), Vignes (29), and Mikulicz-Radecki and Kausch (35). The latter authors show, on the basis of data collected in the Woman's Clinic of the University of Berlin, that in 74 cases where the first sexual intercourse came between the ages of 13 and 17 years inclusive (all having passed the menarche) only 23 conceived between the same ages, although approximately 78 per cent. of them had made no attempt at contraception.

Table I of Appendix I presents another interesting point worthy of some discussion. There were in the material, as the table shows, 482 women married in the age period 15–19 who survived into the age period 25–29 and were overtly fertile in the latter period. But there were only 63 women who, married in the age period 15–19, survived into the age period 40 and over and were overtly fertile in the latter period. Now let us suppose that the 40 and over cohort also started with sufficient women in it so that when, for them, the age period 25–29 was reached there were still in it 482 women overtly fertile. The only thing likely to cast doubt on the reasonableness of such a supposition would be the possible effect of the secular trend towards later age at marriage in the calendar time period involved. In fact, in that period such a trend was negligible so far as the present argument is concerned. Let us assume then for the moment that the 40 and over cohort did in fact have 482 members when those in it were 25–29 years old. There would seem then to be two major factors to account for the result that when the cohort reached the 40 and over age period there were only 63 women left in it. One of these factors would be the mortality of the women between age 27·5 and 42·5 years (in round figures). The other factor would be the dropping out of women because they produced no more children—that is, became sterile along the road. Now the mortality factor, on the basis of Foudray's (23) aggregate white urban female table (pp. 18–19) would account for the loss of only 10·2 per cent., or 49 women roughly. This would leave 89·8 per cent., or 333 women from whom 270, or 56 per cent. of the 482 starters, dropped out supposedly because they stopped having children (became sterile in that sense) somewhere along the 15-year period between the ages of 27·5 and 42·5 years, even though continuously exposed to the chance of pregnancy during these 15 years, in so far as the coitional efforts of the same identical spouses may be regarded as establishing such a chance.

Is this 56 per cent. figure to be regarded as a reasonable result, considering the data upon which it is based, and the assumptions made in the preceding paragraph in reaching it? A categorical answer is impossible, for the data necessary to check it critically do not exist. But what may perhaps fairly be regarded as a rough sort of check may be got at in the following way. In Livi's table from which Fig. 5 is plotted the fertility figure for age 27–28 is 0·250. Now suppose that figure to be reduced between central ages 27·5 and 42·5 years by the combined operation of the three factors (*a*) mortality, in the same proportion that the numbers of surviving women in general are reduced, (*b*) individual biological decline of innate fertility with advancing age, and (*c*) the dropping out of women because they produced no more children, in the same proportion that the number of women has been assumed to be thus reduced in the argument that has preceded. Using the same numerical factors that we have above—except for an extrapolation of (*b*) corrected to allow for reduced exposure in the terminal 40 and over age period—what value would be expected to appear in Livi's table against the age rubric 42–43? The answer works out to 0·0155. The actual value in Livi's table is 0·0178. Everything considered, this is not a bad agreement. It suggests, at least, that our 56 per cent. may not be far wrong for the proportion of previously fertile women who became sterile (in the sense of bearing no more children) after central age 27·5 years.

One further point about Table I of Appendix I merits attention. Careful scrutiny of the vertical columns of that table will indicate two sorts of trends in the values. Neither of these trends can be regarded as statistically significant, having regard to the probable errors of the present samples. Both trends are regular. The first concerns the age column 15–19. In that the median rates (pregnancy and live-birth) tend regularly to increase as we pass down the table from older to younger cohorts, by small amounts to be sure, but still evident. On the other hand, the rates in all the other age columns tend regularly to decrease as we pass down the columns from the oldest to the youngest cohort considered. What these slight trends signify, if anything, or if they have some real meaning how they are to be rationally explained, I have not been able to fathom. Ages at marriage or observation bring no help to the dilemma, as can be seen from the bottom of Appendix I, Table I. The obvious first suggestion from the face of the figures is that women who are going to continue through to the age period 40 and over tend to be a little less fertile at the start in the age period 15–19 than those who are going to cease child-bearing somewhere along the road. But if this idea be accepted how shall the opposite trends of the other age columns be explained? I am unable to solve the riddle. Perhaps it is only an accident of sampling.

The material upon which Appendix I, Table I, is based can, because of its great homogeneity, be usefully employed to appraise the innate individual variability that exists among human beings in respect of fertility. To this end the central (B) portion of Table I has been prepared. It gives the standard deviations of the rates for which the medians are given in part A of the table. These figures show that there is a very considerable amount of variation in fertility, even when many of the extraneous circumstances that usually influence its expression are relatively constant, as is the case in the present samples of women. This variation is greatest in the terminal age periods here discussed (15–19 and 35–39). The variation in the 15–19 age period is highest of all, as would reasonably be expected from the occurrence of low adolescent fertility already discussed. The lowest average standard deviation in pregnancy and live-birth rates is found in the age period 25–29 years. Thereafter the variability rises in association with the falling off in the fertility rate with age.

5. *Menarche, Menopause, and Reproductive Span*

The *span of reproductive life* is sharply delimited in the human female by the beginning of menstruation (menarche) and its cessation (menopause). Only from a little after the first of these events to a little before the second is a woman physiologically capable of reproduction. In the male the delimitation of the reproductive span is less precise. Puberty, with the capacity for seminal emission, is a less definitely marked point in the boy's life than in the girl's. And at the other end of life the *potentia coeundi* and the *capacitas fecunditatis* of the male fade away unequally, but steadily, albeit slowly, like other sorts of senile decay. Various authors have urged that there is a real male climacteric, corresponding to the menopause in the female. The alleged evidence for this is extremely trifling when critically viewed. What really happens, as Blum (36) points out, is that commonly in the age period 50–54 years men consult physicians for psychoneurotic disturbances, difficulties about the heart, the circulation, the respiratory system, and the prostate. At the same time a gradual diminution in the *libido sexualis* begins to be noticed. All are aspects of gradual senescent changes.

The discussion may start with *age at menarche*. There is a large literature on this subject. But when one examines it critically certain defects at once appear. In the first place many authors neglect to put their observations in the form of frequency distributions, from which alone can any adequate appraisal be made of the normal degree of variation in the phenomenon. Furthermore, on critically checking cases where distributions are given, it is frequently found that the calculations of centring constants, such as means and medians, are erroneous. For these reasons and others, in order to establish a solid biometric base relative to this important landmark for studies of human fertility it has seemed advisable to collect from the literature as many as possible of the original frequency distributions for variation in age at menarche that appear to have been based upon reasonably accurate observations, and then compute *de novo* from these distributions the basic biometric constants, according to a uniform procedure.[10] The resulting figures will then be comparable with one another.

Table II of Appendix I gives the standard basic constants for age at menarche for 169 different distributions. The table is not exhaustive. We are constantly adding items to it as we extend our coverage of the literature in our fertility studies. But as it stands it covers a wide range of geographic, climatic, social, economic, and secular diversity. Twenty-seven of the listed items are inclusive ones; that is, they include some or all of the same women that appear in other distributions in the table. Leaving these 27 items out, the remaining 142 include recorded ages at menarche of 163,401 different individual women.

The items of Table II are arranged in ascending order of mean age at menarche. The mean values range from $13{\cdot}17 \pm 0{\cdot}02$ years (Native East Indians) to $16{\cdot}98 \pm 0{\cdot}09$ (Spanish, Province of Asturias). The table as a whole, which may fairly be regarded as the most comprehensive ever put together on a uniform basis of computation and in which there is no entry not supported by detailed frequency distribution observations, gives something less than complete support to the various generalizations that have been put forth regarding the influence of various factors upon the time (age) of inauguration of the menstrual flow. The commonest of these is the one that relates average age at menarche to climate, and by consequence to latitude, asserting that menarche arrives earlier the hotter the climate, and later the colder. Mills and his associates (30–37) have devoted much attention to this matter in recent years, and have brought perhaps the most cogent evidence to its support yet adduced. The idea is, of course, a very old and prevalent one. Tilt (1850) discoursed upon it, and collected data existing at that time to support it. So also did Raciborski (1868). Fraenkel (24) presents some data in favour of it, and in general accepts it. Škerlj (32) devotes a special, if not completely convincing, contribution to the relation between age at menarche and latitude. An objective and critical examination of Table II of Appendix I with this point in mind shows that while in a general and rather inexact way the rule appears to be true, still there are many apparent exceptions to it. Certainly the climatic influence is neither unique nor precise in establishing the age at menarche in either individual or group. In this connexion it is of interest to note that the group with the highest mean age at menarche in Table II, and also the group with next to the lowest mean are both groups of Spanish women. Other factors play definite roles and perhaps in many cases more important ones. Innate biological constitution must be thought of here, and also race. Indeed about as plausible a case could be made for race as for climate, as a differential determinant of age at menarche. Hofstätter (30) is of the opinion that race is of primary importance. General social conditions of life have been alleged to influence age at menarche. It is impossible to review the literature on this point here, but it is of some interest to note that so long ago as 1610 Hippolytus Guarinonius observed and recorded that the farmers' daughters in the region of Innsbruck experienced menarche later than girls living in towns, and earlier than the daughters of the nobility.

To bring still further into order the complex mass of data assembled in Appendix I, Table II, and reduce it to more readily comprehensible bounds, the following Table 8 has been prepared. This gives the frequency distributions for (*a*) the group *means* of Table II, and (*b*) the group *standard deviations* of Table II, and (*c*) the derived *inter-group* biometric constants for those two variables, on the basis of the 142 non-overlapping items of Table II.

TABLE 8

Inter-group variation in age at menarche

Mean ages at menarche from Table II (years)	*Frequency*
13·00–13·49	3
13·50–13·99	11
14·00–14·49	25
14·50–14·99	24
15·00–15·49	27
15·50–15·99	20
16·00–16·49	20
16·50–16·99	12
Total	142

Inter-group

Mean of means = 15·17 ± 0·05 years
Median of means = 15·15 ± 0·06 years
Standard deviation of means = 0·90 ± 0·04 years

Standard deviation in age at menarche from Table II (years)	*Frequency*
0·50–0·74	1
0·75–0·99	..
1·00–1·24	10
1·25–1·49	19
1·50–1·74	27
1·75–1·99	35
2·00–2·24	26
2·25–2·49	14
2·50–2·74	8
2·75–2·99	2
Total	142

Inter-group

Mean of S.D.s = 1·85 ± 0·02 years
Median of S.D.s = 1·85 ± 0·03 years
Standard deviation of S.D.s = 0·41 ± 0·02 years

With reasonable assurance it may be concluded from Table 8 that, as a statistical generalization, the average age of menarche as judged by a world-wide sample of considerable size, is not far from 15 years. As a round figure we may take 15·2 years, or 15 years 2·4 months, the inter-group mean and median of the individual group means agreeing so far. Owing to the difficulty injected by the pernicious habit authors have displayed of stating ages in single integers,[10] the mean of 15·2 years is to be regarded as a *maximum*. But if from Table II (Appendix I) another distribution of the means is made, wherein 0·5 year is dropped from each mean not starred in that table (i.e. each mean where ages were stated only in integral figures in the original), the inter-group constants (mean and median)

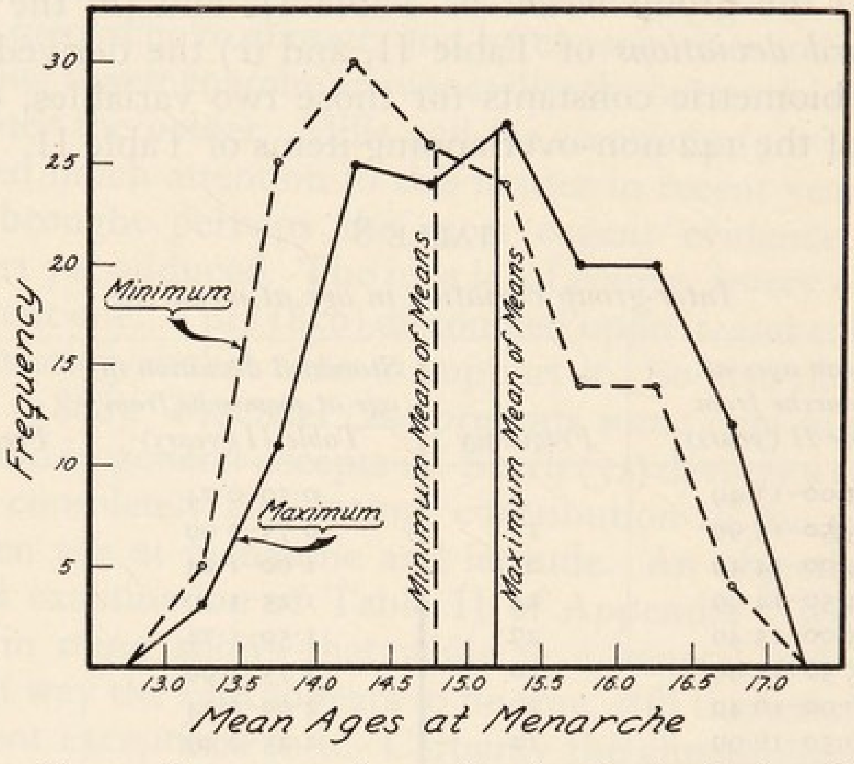


FIG. 7. Frequency polygons showing the distribution of group mean ages at menarche. Data from Table II (Appendix I). Solid line denotes maximum hypothesis.

derived from such a distribution will give *minimum* values. This has been done, and the resulting inter-group mean of means is 14·80 years, and the inter-group median of means is 14·71 years. So then we are led to the reasonably satisfying conclusion that a fair general value for the average age at menarche lies somewhere between 14·8 and 15·2 years. If we split the difference and call it 15 years as a round figure we shall plainly not be far wrong.

The two distributions (maximum and minimum) for inter-group variation in mean age at menarche are shown graphically in Fig. 7.

The age at menarche is evidently not very variable. The inter-group mean of the standard deviations of Appendix I,

Table II, is only 1·85 years with a standard deviation of less than six months. The range of individual diversity in age at inception of the menses is very considerable—from under six years to over 27 years certainly.

The determination of mean *age at menopause* is a much more difficult matter than for menarche, because the phenomenon itself is less sharply and precisely delimited. For months or even years before the actual cessation of menstruation in most women the normal regularity of the flow becomes disturbed. The involutionary changes as the end of the reproductive life span is approached are gradual, and their overt manifestations in high degree irregular. Consequently the biometrician finds a much more meagre store of reliable material to hand for the determination of this important constant than for menarche.

Table III of Appendix I assembles the data from the literature so far reduced biometrically. Just as with the case of age at menarche the constants of Table III have all been computed in the writer's laboratory by standard and uniform procedures. Only those cases are tabled where actual frequency distributions are given in the original source. The total number of individual women included in Table III (omitting duplications from inclusive series) is 5,047, in 20 groups. The data are arranged in Table III in ascending order of mean age at menopause. The lowest mean, $43·96 \pm 0·35$ years, is found in a group of French women, and the highest, 49·40 years, in a group of Norwegian women.

The biometric constants for inter-group variation in mean age at menopause and standard deviation in age at menopause are given in Table 9, based on the 20 non-overlapping series. The frequency distribution of the group means is shown graphically in Fig. 8.

Fig. 8 suggests that the inter-group distribution of mean ages at menopause may be bimodal, but the relative meagreness of the available data precludes the possibility of asserting this as a firm conclusion. The inter-group biometric constants do, however, support the general biological observation that age at menopause is a more variable phenomenon than age at menarche. The inter-group mean of standard deviations is $4{\cdot}68 \pm 0{\cdot}14$ years for menopause, as against $1{\cdot}85 \pm 0{\cdot}02$ years for menarche.

TABLE 9

Inter-group variation in age at menopause

Inter-group constant	*Means in Table III (years)*	*Standard Deviations in Table III (years)*
Mean	$46{\cdot}38 \pm 0{\cdot}23$	$4{\cdot}68 \pm 0{\cdot}14$
Median	$46{\cdot}25 \pm 0{\cdot}29$	$4{\cdot}43 \pm 0{\cdot}18$
Standard deviation	$1{\cdot}52 \pm 0{\cdot}16$	$0{\cdot}93 \pm 0{\cdot}10$

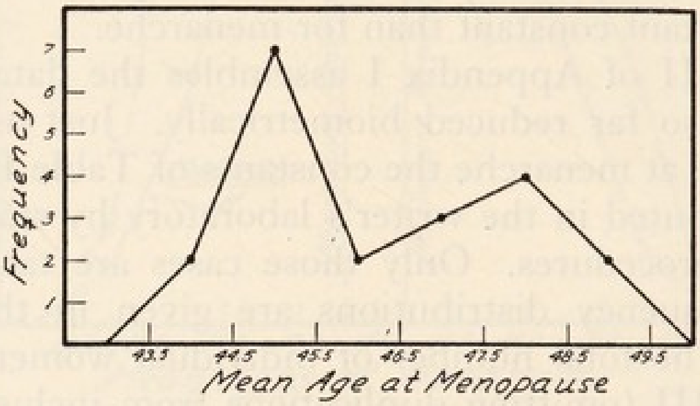


FIG. 8. Frequency polygons showing the distribution of group mean ages at menopause.

It appears, in general and so far as the presently available data indicate, that the average age at menopause is between 46 and 47 years. We shall take 46·4 years as the definitive value for this constant for the present.

It is evident that an approximation to the average *duration of reproductive life* in the human female may be arrived at in two different ways. On the one hand we may take the difference between the inter-group means (or medians) for ages at menarche and menopause as the desired figure; or we may assemble from the literature and biometrically reduce series of observations that have been got by taking the differences between age at menarche and age at menopause in individual women and assembling them in frequency distributions.

On the first plan, the data of Tables 8 and 9 give the following results:

Mean reproductive span $= 46 \cdot 38 - 15 \cdot 17 = 31 \cdot 21 \pm 0 \cdot 24$ years.
Median reproductive span $= 46 \cdot 25 - 15 \cdot 15 = 31 \cdot 10 \pm 0 \cdot 30$ years.

On the second plan are presented the data in Table IV of Appendix I, which assembles all the series so far found where the differences between ages at menarche and menopause for individual women have been put into frequency distributions. As before the biometric constants of Table IV have been computed in this laboratory by a standard and uniform procedure. The table includes records of 1,460 individual women. The means of Table IV range from $28 \cdot 13 \pm 0 \cdot 19$ years, for Kisch's old series of private patients at Marienbad, to $33 \cdot 05 \pm 0 \cdot 22$ years for a series of urban Czechoslovakian women. The former value is undoubtedly too low, because it includes a considerable number of reproductive spans abnormally shortened by pathological conditions. But taking the unweighted average of the means in Appendix I, Table IV, as they stand we get as the inter-group mean 31·25 years, and as the average of the medians 31·88 years. Thus it is evident that, by whatever procedure we approach it, there is good agreement in fixing the average duration of the reproductive span of life in women at between 31 and 32 years—and for practical purposes 31·2 years may be taken as a definitive figure. The unweighted mean of the standard deviations of Table IV is 5·40 years, representing the inter-group average scatter of women in respect of the duration of their reproductive span.

While theoretically reproduction may go on at any time during the reproductive span of a woman's life, and for an even longer period in a man's, practically the distribution of expressed fertility is by no means even in respect of time. The great bulk of the reproducing is done by both women and men between the ages of 20 and 45. But there is much variation in different localities and different groups in respect of reproductivity in marginal ages. To indicate the extent of this variation Table V of Appendix I has been prepared. It shows for the United States, and each state separately, the percentages of all children born alive in 1934 to parents of known ages produced by: (*a*) mothers under 15 (age class 10–14 years); (*b*) mothers under 20; (*c*) fathers under 20; (*d*) mothers 45 and over; (*e*) fathers 50 and over; (*f*) fathers 55 and over; (*g*) mothers under 20, and 45 and over, taken together; (*h*) fathers under 20, and 45 and over, taken together.

Consider first these last two inclusive marginal age groups. It appears that in the United States as a whole in 1934 mothers under 20, and 45 and over, together produced 12·8 per cent. of all the live births. But correspondingly marginally aged fathers produced only 7·8 per cent. of all the live births. At first sight this seems a curiously unexpected difference, because of the fact that many men are biologically capable of engendering offspring many years after 45. Furthermore, on the evidence, a lot of them have a keen taste for young spouses. But the fact is that statistically these caprine urges are evidently more than offset by the economic necessity that usually compels the male to postpone marriage until into the twenties at least.[11] This point is borne out by the 'under 20' percentages considered separately. They are for mothers 12·5 and for fathers 1·5 for the United States as a whole. For the combined marginal age reproductivity (under 20, and 45 and over, together) the range of variation among the several states is very great, being for mothers from 22·2 per cent. in Florida to 6·8 per cent. in Connecticut, and for fathers from 18·6 per cent. in Kansas to 5·2 per cent. in New York.

Study of Appendix I, Table V, leads to the following tentative generalization: the proportion of the total reproductivity due to persons in the marginal age groups tends to be *higher* in the culturally and educationally more backward states, particularly those of the south and south-west, which are also predominantly rural and agricultural in their population setting, and in which *per capita* wealth is on the whole lowest, and the proportion of Negroes in the population is highest. On the other hand, the proportion of total reproductivity due to marginally aged persons tends to be *lower* in the culturally and educationally more advanced states, particularly those of the North Atlantic seaboard and the heavily urbanized and industrialized nearer Middle West, relatively wealthy, and having few Negroes in their populations.

We have also made a table corresponding to Appendix I, Table V, for the Birth Registration Area as it existed in 1919, when it contained 21 states and the District of Columbia. This table is not reproduced here from considerations of space. But it brings out some interesting points. In the first place, the whole B.R.A. of 1919 had percentages of live births, to mothers and fathers respectively, of under 20, and 45 years of age and over, of 8·2 and 8·4, as against the 1934 figures of 12·8 and 7·8. This comparison, however, does not mean much because few southern states were included in the 1919 area. What is much more significant and important is the situation revealed by the comparisons set forth in Table 10. In that table the percentages of live births in 1919 and 1934, to mothers and fathers respectively, of marginal reproductive ages (under 20, and 45 and over, taken together) are set side by side, and the direction and amount of the changes in these percentages in the 15 years indicated for the 21 states and the District of Columbia. The table is arranged in descending order of percentages of live births to marginally aged mothers of 1919.

From Table 10 it is to be noted in the first place that there were from 1·7 to 5·5 per cent. *more* births to marginally aged mothers in 1934 than there were in 1919, in the same states. This trend in reproductivity was exhibited in every single one of the 21 geographic and political areas included in the table. What this change really means is *not* that there occurred any sudden uprush of the reproductive urge in young girls under 20, or in women near the menopause. It means rather that *fewer* women aged 20–44 years, in proportion to those aged under 20, and over 45, were reproducing in 1934 than in 1919. Between 1919 and 1934 the birth-rate in the U.S.B.R.A. dropped from 22·3 to 17·1. But the women aged 20–44 years inclusive were proportionally *more* responsible for this drop than were the women under 20 and over 45.

In the second place it is to be noted that the percentage of live births to fathers under 20, and 45 and over, was *lower* in 1934 than in 1919, in every single geographic area included in the table, by amounts ranging from 0·3 to 3·5

TABLE 10

Percentage of live births produced by parents of known ages in 1919 and in 1934 by (a) *mothers, and* (b) *fathers who were in the marginal age periods of under 20 and 45 and over, together with the differences between these percentages*

State	Mothers		Fathers		Differences	
	1919	1934	1919	1934	Mothers	Fathers
South Carolina	13·5	19·0	13·0	9·5	+5·5	−3·5
Kentucky	13·0	16·0	12·2	10·3	+3·0	−1·9
District of Columbia	12·1	15·4	7·6	5·6	+3·4	−2·0
Virginia	12·0	16·5	13·0	10·2	+4·5	−2·8
Maryland	11·5	16·0	9·3	8·2	+4·5	−1·1
North Carolina	11·4	15·7	13·0	10·4	+4·3	−2·6
Indiana	10·1	13·5	8·6	7·5	+3·4	−1·1
Oregon	9·4	11·9	8·8	7·7	+2·5	−1·1
Kansas	9·0	11·1	9·3	7·8	+2·1	−1·5
Washington	8·9	11·9	9·2	7·2	+3·0	−2·0
Vermont	8·6	10·3	8·8	8·5	+1·7	−0·3
Pennsylvania	8·5	11·4	7·3	7·0	+2·9	−0·3
Ohio	8·4	11·2	6·9	6·5	+2·8	−0·4
California	8·4	11·2	8·6	6·6	+2·8	−2·0
Michigan	7·7	11·2	7·5	6·2	+3·5	−1·3
Utah	7·2	10·8	8·8	7·3	+3·6	−1·5
New Hampshire	7·0	9·5	8·4	7·3	+2·5	−1·1
Wisconsin	5·7	8·6	8·6	6·6	+2·9	−2·0
New York	5·4	7·2	6·0	5·2	+1·8	−0·8
Minnesota	5·2	7·8	9·8	8·0	+2·6	−1·8
Connecticut	4·9	6·8	6·4	5·9	+1·9	−0·5
Massachusetts	4·9	6·9	6·3	5·7	+2·0	−0·6

per cent. Since there is no striking change in the prevalence of illegitimacy in the period covered, the suggestion that comes at once to mind is that men tended during the period under review to become progressively more cautious about assuming the responsibilities of parenthood after 45 years of age, their wives doubtless co-operating in this attitude.

Table V (Appendix I) shows that the percentages of births to fathers under 20 are so small that attention must be directed primarily to the 45 and over group.

A third point to be noted from Table 10 is that whereas in 1934 in every single demographic unit in the table the percentage of births to marginally aged fathers was *lower* than that to marginally aged mothers, in 1919 the percentage to marginally aged fathers was *higher* than that to mothers in 13 out of the 22 demographic units considered. This is another evidence of the marked change in reproductive pattern that had occurred in the fifteen years under review.

At this point the discussion of the biological limitations imposed on reproductivity by advancing age must be ended. In this section there have been established statistical norms for the limits of reproductive life in man, and it has been shown that there is considerable variation among individuals and groups in respect of the age location of these limits. This variation can plainly act as one of the biological factors influencing differential fertility.

In closing this section the extent of the variation that can occasionally occur in the limits of the human reproductive span may be illustrated and emphasized by two examples that appear to be well authenticated, and that certainly are not devoid of human interest. Recently two Russian obstetricians, Chaschinsky and Jerschow (33), described in the *Zentralblatt für Gynäkologie* (an eminently respectable and 'sound' medical journal), with great clinical and anthropometric detail, the full-term pregnancy and delivery of a $6\frac{1}{2}$-year-old girl from the Kharkow district in the Ukraine. This girl developed secondary sexual characters at the end of her fourth year and shortly afterwards began to menstruate. Her still-born child at term weighed 3,000 grams (a quite normal weight) and was 50 cm. in length.[12]

At the other end of reproductive life may be cited the case reported by a French gynaecologist, Depasse (91). The grey-haired patient came to him because of a supposed abdominal tumor that two other physicians had diagnosed, one as a fibroid, the other as a cyst. Upon careful examination *ballottement* and the foetal heart were discovered. The patient was 59 years of age. She had passed the menopause nine years before, and had a married daughter 40 years old. On December 21, 1889, the patient was delivered of a healthy child, which she nursed herself, and weaned on her sixtieth birthday.[13]

6. *Litter size*

The number of young produced at a birth, or *litter size*, in the human species is more frequently one than any other number. To such an extent is this so that customarily little thought is given to the matter, and it is subconsciously assumed that any deviations from this figure are of no consequence in the appraisal of group fertility. But litters of 2, 3, 4, and occasionally higher numbers do occur, in point of fact, and in sufficient numbers to make the total number of children produced by a group of women sensibly different from the total number of full-term pregnancies experienced by the same group. Furthermore it is entirely within the bounds of possibility that the mean litter size for the human species, or for particular groups, races, or varieties of it, may show a secular change. Animal breeders have been able to observe, and have a hand in bringing about, just such secular changes in the mean litter size of races or strains in other species. An example is afforded by the experiments of the late Alexander Graham Bell (12) in breeding sheep at Beinn Breagh, Nova Scotia. In any case the desirability of studying critically the question of litter size in connexion with any thorough investigation of fertility seems apparent. Such studies have been made and enough of the results will be presented here to establish two points; first that there is a considerable amount of both individual and group variation in human litter size, and second that the effect of this is great enough to modify sensibly group fertility.

The distribution of individual variation in human litter size takes an extremely skew J-shaped form, to use the convenient if somewhat inexact biometric terminology. This is shown in Table 11.

TABLE 11

Frequency distributions, absolute and percentage, of litter size in live and still-births together, in the United States Birth Registration Area in 1930–32 inclusive

Litter size	*Total number of pregnancies*	*Percentage frequency*
1	6,481,183	98·8244
2	76,302	1·1634
3	782	0·0119
4	15	0·0002
Totals (pregnancies) Total births = 6,636,193	6,558,282 Births per pregnancy = mean litter size = 1·01188±0·00003	99·9999

There are significant racial differences in mean litter size. This may be illustrated by the fact that in the United States Birth Registration Area, for the three years 1930–32 inclusive, the mean litter size for whites was 1·01146±0·00003 individuals per litter, while for the coloured the mean was 1·01474±0·00009. The difference was 0·00328±0·000094, and was thus about 35 times its probable error, leaving no doubt that the mean litter size was significantly higher in the coloured than in the white population.

There are great differences between the several states of the United States in respect of mean litter size. This is shown in Table VI of Appendix I. The table starts with Arkansas, having a mean litter size of 1·01735±0·00026 and a mean birth-rate of 21·4 per thousand. It ends with Nevada, displaying a mean litter size of 1·00765±0·00094 and an average birth-rate of 13·8. Next to the bottom of the list is New York, with a mean litter size of 1·00803±0·00008 insignificantly different from that of Nevada, but based upon a much larger population. Between New York and Arkansas there is a difference in mean litter size of 0·00932±0·00027, more than 34 times its probable error.

More significant than the absolute values of the mean litter sizes of Table VI is the general parallelism of the trends of litter size and birth-rate as we go down the table. In general there is a plain tendency for mean litter size to be relatively high in states where the birth-rate is high, and relatively low where the birth-rate is low. This indicates clearly that the litter size plays a definite role in bringing about observed diversities in group fertility. The facts

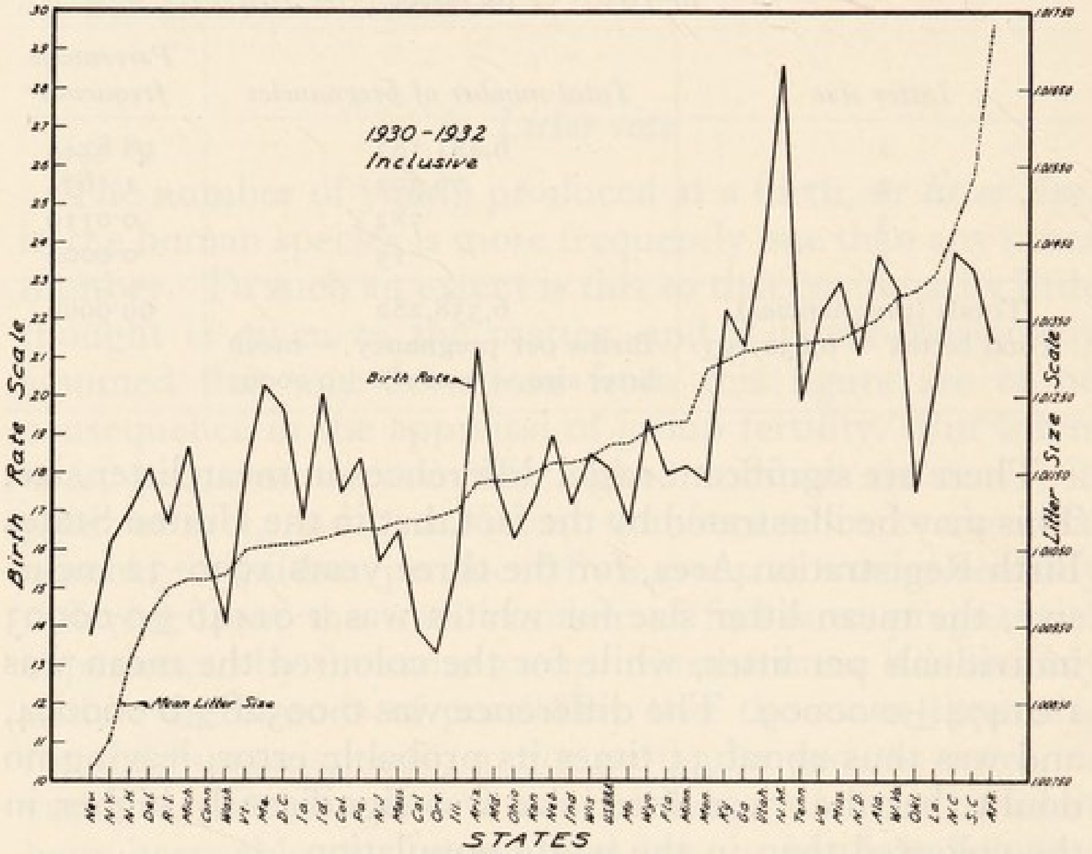


FIG. 9. Mean litter size (dotted line), and mean birth rate (solid line) plotted from the data of Table VI (Appendix I). The states are arranged in ascending order of mean litter size from left to right in the diagram.

suggest that in general groups that exhibit high fertility because the women in them become pregnant and have babies relatively often are also the groups in which the women bear twins and triplets relatively frequently. Hellin (95) and Grassl (08) have developed extensively the thesis that a tendency to multiple births is associated with, and an integral part of, the expression of generally high innate fertility.

The general parallelism between mean litter size and birth-rate is shown graphically in Fig. 9, plotted from the data of Appendix I, Table VI.

Table VI and Fig. 9 bring out again in another form the general fact that has already been noted that high group fertility in the United States tends to be found preponderantly in the less wealthy, less urbanized, less industrialized, and generally less socially and economically advanced states. Of the 20 states in Table VI exhibiting mean litter sizes

TABLE 12

Average percentages of twin and triplet births in different countries

(From Greulich)

Average twin percentage	*Country**	*Country**	*Average triplet percentage*
1·59	Denmark	Denmark	0·0185
1·46	Sweden	Norway	0·0158
1·44	Norway	Poland	0·0158
1·34	Netherlands	Italy	0·0143
1·34	Poland	Sweden	0·0137
1·25	Germany	Canada	0·0135
1·23	Bulgaria	Netherlands	0·0131
1·23	Canada	Germany	0·0129
1·19	Hungary	United States	0·0121
1·16	Italy	Hungary	0·0113
1·15	United States	France	0·0109
1·13	France	Belgium	0·0107
1·13	New Zealand	Bulgaria	0·0100
1·13	Uruguay	Australia	0·0091
1·11	Belgium	Uruguay	0·0083
1·07	Australia	New Zealand	0·0076
0·82	Argentina	Brazil	0·0069
0·76	Greece	Colombia	0·0062
0·68	Brazil	Argentina	0·0060
0·40	Colombia	Greece	0·0040

* The names of the countries studied arranged in the order of the magnitude of their respective average twin and triplet percentages.

above the general U.S.B.R.A. average, 15 are located south of the Mason and Dixon line. In addition to the relative economic and social backwardness of these states they also contain relatively larger Negro populations, characterized as has already been shown by a significantly higher litter size than the whites.

Different countries also show wide diversities in mean litter size. This is illustrated by Table 12 rearranged from Greulich (30), which gives percentages of twin and triplet births in 20 different countries, in approximately comparable time periods.

It is apparent from the percentages of Table 12 that if mean litter sizes were actually calculated from the original data they would show a corresponding extent of variation.

Not only is there variation between groups, but there is also considerable secular variation in mean litter size in the same population. Thus, for example, Böhmert (26) tabulated multiple births in Bremen for each year from 1826 to 1925. The extremes of incidence were 0·79 multiple births per 100 total births (in 1827) to 2·06 (in 1834).

There is a curious rule about the relative frequency of different-sized human litters that was first discovered and clearly enunciated[14] by Zeleny (21) in the following words: 'If $1/n$ is the proportion of twin births to all births in a large population during any period, then the proportion of triplet births during the same period is very near to $1/n^2$.' By extension of the rule the expected number of quadruplets would be $1/n^3$, and so on for higher litter sizes. In illustration of the rule he cites 13,360,557 births in Prussia in the period 1826–49, where $1/n$ (for twins) was observed to be $1/89{\cdot}1$ and $1/n^2$ (for triplets) was observed to be $1/(88{\cdot}9)^2$. In 1,339,975 births in the U.S.B.R.A. in 1917 the observed number of twins was $1/93{\cdot}1$ and the number of triplets was $1/(93{\cdot}0)^2$.

The data of Table 11 *supra* do not work out quite so well. On the basis of *pregnancies* the number of twins is $1/85{\cdot}95$, whence the expected number of triplets would be $1/7387{\cdot}4 = 1/(85{\cdot}95)^2$. But the actually recorded number of triplets was $1/8386{\cdot}6$, which is about $1/(91{\cdot}58)^2$, a considerable discrepancy in defect. The actually recorded number of quadruplets was $1/437218{\cdot}8$, while the expected number was $1/634947{\cdot}2 = 1/(85{\cdot}95)^3$. The number of quadruplets actually recorded corresponded to about $1/(75{\cdot}9)^3$, indicating a production in excess of expectation of similar order to the defect in the triplet production. If the computations are made on the basis of *births* instead of pregnancies the case is not essentially altered though the absolute numbers are changed.

Greulich (30) on the basis of 120,061,398 cases of labour in 21 different countries got a better agreement, the twin, triplet, and quadruplet ratios being respectively $1/85{\cdot}2$; $1/(87{\cdot}3)^2$; and $1/(87{\cdot}5)^3$. Jenkins (27) thinks it 'likely that the frequency of triplet pregnancies at any age of mothers is equal to the square of the frequencies of twin pregnancies at that age, and that any deviation from this rule in plural births is due to a differential mortality of twins and triplets in utero'. An impartial examination of the data, however, does not warrant quantitatively quite so enthusiastic an espousal of the Zeleny rule as Greulich and Jenkins seem to adopt. Thus, for example, Veit's (55) old Prussian statistics (1826–49) confirm the rule beautifully for triplets ($1/89{\cdot}09$ twins, $1/(88{\cdot}94)^2$ triplets) but depart widely for quadruplets ($1/(71{\cdot}9)^3$ observed against $1/(89{\cdot}1)^3$ expected), the error being an excess production of quadruplets over expectation. Nippold's (89) figures for 42,292 births in Freiburg show an observed occurrence of triplets of $1/(118{\cdot}8)^2$, whereas the expectation from the rule (and the actual twins produced) was $1/(84{\cdot}6)^2$. Freudenberg's (26) figures for German births (1901–13) with an observed production of twins of $1/78{\cdot}24$, showed an actual production of triplets of $1/(88{\cdot}85)^2$, of quadruplets of $1/(90{\cdot}59)^3$, and of quintuplets of roughly $1/(71{\cdot}4)^4$. Only by extreme courtesy could this be called good agreement between observation and theory. Guzzoni degli Ancarani (89), in connexion with a sextuple pregnancy that he studied, tabulated a great mass of material from the literature on the relative frequency of different human litter sizes. The degree of agreement with the Zeleny rule varies greatly in the different series of statistics. In a later paper the same author (00) presents figures on 83,368,012 births in Europe, which upon analysis show the frequency of twins to be $1/87{\cdot}83$, of triplets to be $1/(84{\cdot}28)^2$, of quadruplets to be $1/(91{\cdot}18)^3$, and of quintuplets to be $1/(80{\cdot}06)^4$, again not a quite perfect agreement with theory. Very lately Guttmacher (37), on the statistically meagre series of deliveries at the Johns Hopkins Hospital (41,134 deliveries in total), found only moderately good agreement with expectation from the Zeleny rule. On the other hand, Diddle and Burford (35), on the basis of a miscellaneous tabulation over a fifth of a billion births (219,899,446), found quadruplets to have occurred among them at the rate of $1/(86{\cdot}8)^3$, which is rather good, since $1/86{\cdot}8$ is a fairly close approximation to the average frequency of twinning. A conservative general conclusion would appear to be that while the observed frequency of human litter sizes in a general way, and with frequent significant exceptions, appears to approach the expectations set by the Zeleny rule, that rule cannot be regarded as a completely established general biological law on the basis of present evidence.

Various other aspects of the biology of human litter size have been investigated. The weight of the evidence adduced by Dix (04), Weinberg (09*a*), Patellani (20), Floyd (22), Peiper (23), Apert (26), P. T. Wilson (30), Curtius and von Verschuer (32), H. C. Meyer (32), Jankowich-Simon (36), Dahlberg (30), von Verschuer (33 and 33*a*), and others indicates that a tendency to plural births is inherited, and probably through both male and female lines. Further evidence of a genetic factor in the matter is afforded by the extreme racial differences that exist in respect of human litter size. Mondière (80), for example, records for Annamese women the extraordinarily low twin frequency of 1/10,211. Mongolian peoples appear generally to exhibit relatively low plural birth frequencies. Komai and Fukuoka (36) emphasize the truth of this fact among the Japanese.

On the environmental side Davenport (30) notes an increase in mean litter size with increasing latitude, the averages being lowest in the tropics and highest in the most northern countries, climate being presumably the determining factor. Oku's (33) correlation studies confirm this idea, in the sense that between twin-birth rate and average temperature he gets a net (partial) correlation of $-0{\cdot}61 \pm 0{\cdot}06$, with population, birth-rate, population density, urbanization, rate of attendance in girls' schools, average income, marriage rate, average age of female at marriage, and rate of natural increase in population, all held constant. An early speculator on the subject, Reimann (1822) had the idea that the prevailing weather might have something to do with the production of twins. The effect of the World War on the frequencies of multiple births has been studied by a number of workers, including David (22) for births in Budapest, Mayer (22), Cristalli (23) for births in Naples, Prinzing (25–26), Siemens (26), and Frommolt (36). In general there is agreement that the proportion of multiple to all births in the belligerent countries tended to rise during the War, and to continue at a higher level than usual for a few years after. Siemens doubts there was any real change, but the figures he presents suggest it. Geissler (88, 89) and Lommatzsch (95, 97, 98) present data indicating a differentiation in mean litter size between city and village (rural) populations in Saxony. Putting together the data for individual years given in their papers cited (87, 88, 94–6) into a single frequency distribution, I have computed the following mean litter sizes, on the basis of 315,134 urban and 423,982 rural births in total:

Mean litter size for urban population =	1·012474
Mean litter size for rural population =	1·012109
Difference	0·000365 ± 0·000018

This is a certainly significant difference statistically, indicating a definite tendency towards larger mean litter size under the urban than in the rural environmental conditions at the time and place of record.

Bertillon (98, 00) pointed out that the proportion of multiple births tends to increase with advancing age of mother until the late thirties and then declines somewhat as the menopause is approached. This result has been confirmed by many subsequent students, notably Coghlan (03), Freudenberg (26), Jenkins (27), Orel (27), Rossi (26), and Patellani (21).

In this section it has been shown that human litter size is an important variable to be considered in the analysis of fertility. It varies racially, geographically, and in time, through rather wide limits, and is definitely correlated with group fertility in general.

7. *Frequency of Coitus*

Coitus, the act of sexual connexion, serves the purpose in normal reproduction of placing the spermatozoa in the vagina, close to the *os uteri*, through which they rapidly pass to the cavity of the uterus and the Fallopian tubes, where, if one chances to meet a fresh unfertilized ovum, fertilization normally takes place. While artificial insemination is possible, coitus is and will long remain a practically obligate part of the process of normal human reproduction, and one that differentially affects fertility. Human artificial insemination is being used at the present time, in so far as it is employed at all, largely for one or the other of two reasons—the relief of sterility where the difficulty is thought to be such as can probably be overcome by this technique, and eugenic or quasi-eugenic experimentation (cf. Seymour and Koerner, 36).

The *frequency of coitus* varies greatly with different individuals, as will presently be demonstrated statistically, ranging between the extremes of sexual asceticism and athleticism.[15] It is the objective expression of a psychological variable, sexual desire (libido), of great significance in reproduction and fertility. There are a number of biological reasons why frequency of coitus is so important in influencing variation in realized or expressed fertility. Perhaps the most significant of these is the relatively short duration of life of the germ cells in the female genital tract, with the consequent necessity for fairly close timing if fertilization is to occur. Leaving all other factors out of account, the probability of the coincident presence of fresh germ cells from both sexes in the tract will tend to increase with frequency of coitus. As Moench (30) says: 'In view of the short life of the ovum and spermatozoa, it is easy to realize that a careful examination of the sexual habits of any given couple is of prime importance in investigating any case of impaired or absent fertility.'

It was formerly thought that ova and spermatozoa kept alive in a state of sound activity for long periods of time after they had been shed from the gonads into the female genital tract. Recent advances in knowledge have greatly altered this view. The following Table 13 summarizes present opinion on the subject. More references might be cited, but these will suffice to indicate the state of the case.

TABLE 13

Duration of potentiality of fertilization of human germ cells in the uterus and tubes

Authority	*Spermatozoa (hours)*	*Ovum (hours)*
Albrecht (36)	48–72	'Only several'
Anderson (33)	48–72	24
Belonoshkin (34)	24–48	. .
Bryce, Teacher, and Kerr (08)	. .	48
Cary (36)	'Normally migrating in deep cervical mucosa' 36–80	. .
Engle (33)	48	48
Fürbringer (28–29)	2–48	. .
Hoehne and Behne (14)	4–20	. .
Knaus (32)	36	. .
Kurzrok (28)	. .	'Short'
Miller, Schulz, and Anderson (33)	48–72	24
Moench (37)	48 'at most'	'Scarcely 24'
Ohlin (35)	10–15 (under tubal conditions)	. .
Boas and Voet (34)	'Impregnation time = combined period of potentiality of sperm and ovum for fertilization = 12–48, nearer 24.'	

Commenting on the life duration of unmated germ cells Hartman (32) says (pp. 667–8): 'The theory that ova may lie in wait for spermatozoa for any length of time is therefore improbable. What a fertile organism the human species would be if this were the case! The marvel is not how fertile but how sterile is humanity. Sterility, not contraception, is the biggest problem of the gynecologist.'

There have been but few biometric studies on frequency of coitus, because of lack of adequate data. The first of these (Pearl, 25) showed the average frequencies per month to change with age as follows on p. 68.

Age	*Average frequency*
20–29	$12{\cdot}57 \pm 0{\cdot}65$
30–39	$12{\cdot}78 \pm 0{\cdot}50$
40–49	$10{\cdot}95 \pm 0{\cdot}38$
50–59	$8{\cdot}23 \pm 0{\cdot}34$
60–69	$5{\cdot}30 \pm 0{\cdot}30$

The average frequencies of coitus per month were also found to be different according to social-economic status, in the manner indicated below, taking all ages together from 20 to 69 inclusive.

Group	*Average absolute frequency*	*Relative*
Farmers	12·6	100
Merchants and bankers . .	10·8	86
Professional men . . .	8·8	70

The relation of these results to the well-known facts of social-economic class differential fertility already discussed earlier is obvious.

Recent contributions to the question of coital frequency have been made by Rondelli (34), Harvey (32), and Bernard (35). Rondelli emphasizes the correlation of libido with fertility and of fertility with frequency of intercourse. Harvey analysed and discussed the data on coital frequency of Dickinson and Beam (31), Davis (29), Hamilton (29), and Pearl (25). Bernard made a most interesting correlational study of some 73 married couples on relief in St. Louis. Modal points in frequency of coitus seemed to be indicated at once in 2, 3, and 7 days approximately. Definite positive correlations were found between health of husbands and (*a*) marital dissatisfaction of husbands, and (*b*) recency (constructively frequency) of coitus; between health of wives and marital satisfaction of husbands; number of days since last coitus and poor health of husband; practice of contraception and neuroticism in men. It is unfortunate that Miss Bernard's sample was so small. An investigation along the same lines with a larger material would be very valuable.

Lately, in the writer's laboratory, the data of Gurewitsch and Grosser (29) collected in Kharkow have been analysed biometrically. Their material is not presented in the most effective way for biometric study, but in view of the great dearth of any quantitative data on the subject it was thought desirable to make as much as possible out of it. Gurewitsch

TABLE 14

Biometric constants for frequency of coitus per month, computed in the writer's laboratory from various data

Group	*N*	*Mean (times per mo.)*	*Median (times per mo.)*	*Standard deviation (times per mo.)*	*Coefficient of Variation (per cent.)*
Married couples. (U.S.A. Pearl. ♂ age 30–39)	247	12·78 ± 0·50	9·90 ± 0·63	11·61 ± 0·35	91 ± 5
Married couples. (U.S.A. Pearl. ♂ age 20–29)	213	12·57 ± 0·65	9·01 ± 0·81	14·06 ± 0·46	112 ± 7
Married couples. (U.S.A. Davis)	919	12·38 ± 0·21	7·34 ± 0·26	9·28 ± 0·15	74 ± 2
Married couples. (U.S.A. Pearl. ♂ age 40–49)	252	10·95 ± 0·38	8·77 ± 0·48	8·96 ± 0·27	82 ± 4
Married couples. (U.S.A. Dickinson and Beam)	526	9·76 ± 0·31	5·89 ± 0·39	10·56 ± 0·22	108 ± 4
Married couples. (U.S.A. Pearl. ♂ age 50–59)	247	8·23 ± 0·34	6·25 ± 0·43	8·00 ± 0·24	97 ± 5
Married women. (Russian. Gurewitsch and Grosser)	124	8·10 ± 0·51	7·80 ± 0·64	8·48 ± 0·36	105 ± 8
Married men. (Russian. Gurewitsch and Grosser)	531	6·87 ± 0·24	7·60 ± 0·30	8·28 ± 0·17	121 ± 5
Married couples. (U.S.A. Pearl. ♂ age 60–69)	191	5·30 ± 0·30	3·61 ± 0·38	6·19 ± 0·21	117 ± 8
Unmarried men. (Russian. Gurewitsch and Grosser)	488	1·50 ± 0·11	0·55 ± 0·14	3·76 ± 0·08	251 ± 20
Weighted mean values of constants for 9 married series	..	10·09	7·28	9·48	97

and Grosser collected this material in 1926 by the questionnaire technique. The sample included 1,162 males and 332 females attending technical, agricultural, and other higher schools in Kharkow. They ranged in age from 16 to over 35 years. The biometric constants for frequency of coitus per month (necessarily omitting the cases recorded as 'irregularly') are set forth in Table 14. Also included in Table 14 are (*a*) our biometric reductions of the data in Dickinson and Beam (31) (Table VIII, p. 58), rearranged with Dr. Dickinson's express approval (*in litt.*) in order to put them in a more amenable form for computation; (*b*) our computations from unpublished manuscript data furnished the writer by Dr. Katharine Bement Davis, regarding 919 of her series of 1,000 women who gave definite numerical information on their questionnaire as to coitus frequency 'In early years of marriage', and finally (*c*) the data already published by Pearl (25). The items in the table are arranged in descending order of mean coitus frequencies per month.

The Russian results of Table 14, while giving lower average frequencies of coitus than the writer's American material cited, seem fairly consistent *inter se*. The means (and medians) of the two sets of results taken together accord well with the proverbial advice to inquiring newly weds of 'two or three times a week' as a normal and regular habit to be formed. The constants derived from the series of Dickinson and Beam, which may probably be regarded as intrinsically rather highly reliable, also fall in general line with the others. The Davis data are in quite close accord with Pearl's 20–29 and 30–39 age groups. On the whole it may be concluded that Table 14 gives a fairly reliable general biometric picture of the frequency of coitus in groups of the sorts sampled.

Critical students of sexology and fertility have long been aware that in the general philosophy of ardent birth-control propagandists there is a somewhat unrealistic element, when their thinking touches upon the question of the relation between frequency of coitus and expressed fertility. This lack of complete realism can perhaps be best illustrated from the methodological philosophy by which they attempt to appraise quantitatively the effectiveness of different contraceptive techniques. The procedure followed is in principle like this. A certain number of women are instructed in the use of a particular contraceptive technique. They are then followed for a certain period of time, usually of the order of a year, or two or three. If none becomes pregnant during this follow-up period, except as a result of deliberate planning for conception implemented by complete cessation of contraceptive effort until the pregnancy is manifested, it is then stated that the contraceptive method under examination is 100 per cent. effective in preventing conception. Obviously this reasoning is based upon the assumption—

about which, however, nothing is usually said—that in the absence of contraceptive effort the n women under consideration would have experienced in the period of follow-up observation at least $n-x$ pregnancies, where x is conceived of as a number so small as to be for all practical purposes negligible. Or, to put the assumption the other way about, the methodology proceeds as though every 10 copulations of any women not already pregnant, of any age between menarche and menopause, any time, anywhere, in the absence of contraceptive effort would result certainly in something of the order of 7 to 9 pregnancies, if not actually 10.

Now it is plain to any student of sex behaviour and fertility that this assumption, in whatever form made, is not well in accord with the facts of life. If one copulation meant statistically one pregnancy, or anything like it, the world would have been already even more sadly overstocked with humanity a long time ago than some think it now is. Certainly now, and probably since man emerged in evolution as a distinct species, there has been a great deal more sexual coition than reproduction, regardless of birth control. Few women and few mated pairs of human beings have exhibited a coitus-fertility rate approaching 100 per cent. over any considerable period of time.

Some years ago the writer determined, at whatever cost in effort, to attempt to reach a reasonably approximate value for that most basic of all statistical constants in the study of human fertility, namely, the number of copulations that had actually occurred, on the average, in the lives of couples known and proved to be fertile (that is, not physiologically sterile) for each pregnancy experienced and each live birth produced, in the complete absence of contraceptive effort of any sort throughout their reproductive lives to the time of observation and record. To state the problem is to make it evident that it is a difficult one. The chief difficulty is to get a sufficient body of reliable data covering the point, in which the study of each individual case has been so thorough, so complete, and so long continued as to produce confidence that the record in its broad essential features is substantially correct. So much is all that can be humanly expected. Few people keep exact diary records of their copulative behaviour, and still fewer of those who do release them for scientific purposes.[16] But most people do have rather well-defined and settled habits in matters of sex behaviour, and know what those habits are. A reasonably approximate quantitative appraisal of these habits is the best we can hope to achieve, but in the otherwise complete absence of statistical information even so much will be of value.

We have collected over the past twelve years a small sample of cases—199 in all—about which we know, of positive first-hand knowledge, the essential accuracy of which can be guaranteed: (*a*) that the couples were not sterile; (*b*) that they had never made any sort of contraceptive effort during their wedded lives, with which we are alone concerned; (*c*) that their sexual habits at ages were reasonably constant except as interfered with by serious illnesses or protracted absences of one partner from the conjugal bed, for both of which disturbing factors we have records and can therefore make corrections; (*d*) that their pregnancies and births experienced are correctly recorded; (*e*) that the information as to sexual habits came primarily in all cases from the wife, but was independently checked in many cases by separate interviews with the husband. Besides these basic items, a great deal more about the majority of the cases is known and recorded—social, economic, health, and other matters. It is hoped that it may be possible eventually to publish a detailed study of these cases from a variety of points of view. Here considerations of space and immediate purpose preclude the presentation of anything more than a few results that have accrued from the material.

Of the 199 cases 123 were patients and controls free of recognizable pathology in our constitutional studies (Pearl, Sutton, *et al.*, 29), and the remaining 76 came from other sources. The accessory information about social, health, and other matters is less complete for these 76 cases, though they are on the same footing as to the basic items listed above. It is fully recognized and to be emphasized that the sample is small. The phenomena (sex behaviour and fertility) dealt with are intrinsically rather highly variable. Consequently any generalization from the present data to other groups or to people in general would be in the highest degree hazardous and unwarranted. But in the present state of knowledge even this meagre sample is plainly better than no sample at all. And in all fairness it can be said that the range, particularity, and accuracy of the data make some compensations for their numerical meagreness.

The couples involved were all resident in Baltimore. The women involved ranged in age at observation from the age group 15–19 years to and including the age group 75–79, the largest age class being 35–39 and the median age at observation being 36·8 years. The best brief indication of the social-economic status of these couples, as a group, is afforded by the figures presented in Table 15, which gives the percentage distribution of the material by husband's occupation, in broad classes,[17] as defined by Pearl (33).

TABLE 15

Occupation of husbands, in broad classes

Occupational class	*Percentage frequency*	
	Present sample	*All occupied males in New York City. Census of 1930 (Pearl, 33, p. 496)*
I. Owners, managers, officials, and professional men	12·6	18·7
II. Skilled and semi-professional workers	59·9	53·7
III. Labourers—unskilled and semi-skilled	27·5	27·6

While class I is somewhat under-represented in the present sample as compared with New York City, and class II correspondingly over-represented, in general one may fairly conclude that occupationally the sample is probably reasonably representative of American urban conditions.

In Table VII of Appendix I are given the total and net potentially effective average numbers of copulations per pregnancy and per live birth experienced, by age of mother in ten-year classes. The distinction between 'total' and 'net potentially effective' coitus frequencies is based upon the fact that any sexual activity that may be indulged in while the wife is in the pregnant state[18] cannot be regarded as having anything whatever to do with fertility, because as a physiological fact a woman cannot become pregnant while she already is pregnant, save for the excessively rare and quite abnormal possible occurrence of superfoetation, which has never yet been absolutely and completely proven to occur in woman. Net potentially effective sexual coition can only be that occurring at other times than during pregnancy.[19]

One apparent discrepancy will be noted in Appendix I, Table VII. The total number of pregnancies, and of live births set down in the bottom line of the table, is more than the sum of the pregnancies and live births respectively that have been assigned above to age periods in the mothers' lives. This comes about because the data were lacking for a few of the women to assign the pregnancies and live births to particular age periods, although they were known for the whole duration of marital experience.

In Fig. 10 are shown graphically the average numbers of copulations (gross total and potentially effective number) associated respectively with one pregnancy and one live birth, by ages of wives. The diagram is based upon the data of Appendix I, Table VII.

The data of Appendix I, Table VII, and Fig. 10 demonstrate numerically the fact that in the ordinary sexual and reproductive activities of human beings there is a wide quantitative difference between the two. Taking all ages together in this sample of 199 couples there were, on the average, 351 copulations in gross total associated with each pregnancy and 416 with each live birth. If only potentially effective copulations be considered there were of these, on the average, 254 for each pregnancy and 301 for each live birth. In other words, 253 out of each 254 copulations, on the average, that conceivably might have been effective were actually without reproductive result even though no attempt at contraception was made. These figures, for the first time, give an approximate estimate of the magnitude of the average group risk of pregnancy in human beings associated with sexual intercourse between fertile individuals doing nothing to diminish the risk, but motivated in their sex behaviour solely by libido, habit, and desire for children.

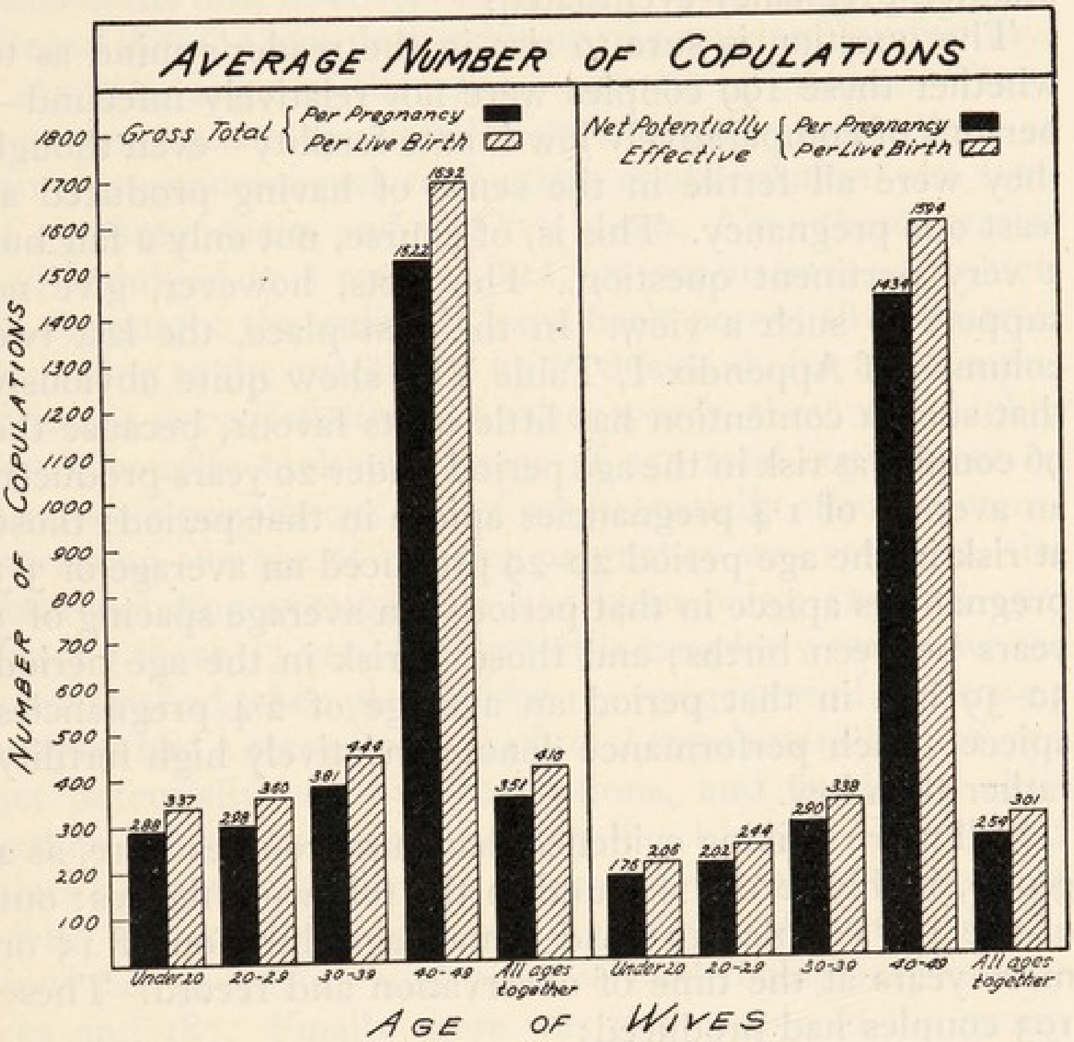


FIG. 10. Average number of copulations associated with a single pregnancy (solid bars) and with a single live birth (cross-hatched bars). The figures at the tops of the bars are the average numbers.

The average number of copulations per pregnancy and live birth shown by these 199 overtly fertile couples will probably astonish many persons who have never looked carefully into the quantitative aspects of human sex behaviour and reproduction. Especially is this likely to be the case so far as concerns net potentially effective copulatory activity. Birth-control propaganda is in no small degree responsible for this attitude. Detailed study of the case records of women in our collection of 30,949 reproductive histories is interesting in this connexion. Couples who intermitted the regular practice of contraception in order to produce a wanted pregnancy experienced intervals ranging from a few months to two or three or more years before the planned pregnancy eventuated.

The question is sure to rise in the reader's mind as to whether these 199 couples were not relatively infecund—persons of comparatively low innate fertility—even though they were all fertile in the sense of having produced at least one pregnancy. This is, of course, not only a fair but a very pertinent question. The facts, however, give no support to such a view. In the first place, the last two columns of Appendix I, Table VII, show quite obviously that such a contention has little in its favour, because the 96 couples at risk in the age period under 20 years produced an average of 1·4 pregnancies apiece in that period; those at risk in the age period 20–29 produced an average of 3·3 pregnancies apiece in that period—an average spacing of 3 years between births; and those at risk in the age period 30–39 had in that period an average of 2·4 pregnancies apiece. Such performance denotes relatively high fertility rather than low.

Still more striking evidence that these couples were, as a group, highly fertile is found in the following figures: out of the 199 couples 103 had a marriage duration of 15 or more years at the time of observation and record. These 103 couples had produced:

	Mean number	*Median number*	*Range*
Pregnancies	$7{\cdot}20 \pm 0{\cdot}26$	$6{\cdot}75 \pm 0{\cdot}32$	1–18
Live births	$7{\cdot}07 \pm 0{\cdot}23$	$5{\cdot}95 \pm 0{\cdot}29$	0–15

There were in the 199 couples 69 who had at the time of observation a marriage duration of 20 or more years. The corresponding constants for them were:

	Mean number	*Median number*	*Range*
Pregnancies	$7{\cdot}16 \pm 0{\cdot}32$	$6{\cdot}31 \pm 0{\cdot}41$	1–18
Live births	$6{\cdot}96 \pm 0{\cdot}29$	$5{\cdot}75 \pm 0{\cdot}36$	0–15

These were surely highly fertile couples. The whole material, including all marriage durations, produced, as shown in Table VII, an average of 5·8 pregnancies and 4·9 live births during the aggregate period of observation. Since nearly half the couples had been married fewer than 15 years at the time of observation it is evident that it cannot be alleged that the sample is made up of persons of low fertility.

Another angle of the matter may be of interest. There were among the 199 couples 37 who had produced 10 or more pregnancies each to the time of observation, or a total of 432 pregnancies and 355 live births. Now these couples had indulged in a total of 111,773 copulations, of which 67,667 might theoretically have been potentially effective, according to the criteria set up in this study for the computation of net copulation. In other words, these very highly fertile couples took an average of 259 total copulations to produce a pregnancy; and of net potentially effective copulations an average of 157 per pregnancy was required, the corresponding averages per live birth being 315 and 191. Among these 37 very highly fertile couples were 21 whose marriage had taken place in the 15–19 age period. These 21 couples had a record of 63,248 total copulations and 38,752 net potentially effective copulations, and produced altogether 253 pregnancies and 207 live births. This record gives 250 total copulations per pregnancy and 306 per live birth, the corresponding net potentially effective copulations per pregnancy and per live birth being respectively 153 and 187. Finally there was one couple in the group married in the age period 15–19 and reproducing in each of the four periods 15–19 to 40–49 inclusive. They indulged in a total of 6,468 copulations (on a rough average something under one every two days) of which 4,277 were in the net potentially effective category. They produced 14 pregnancies and 14 live births, resulting in ratios of 462 total copulations per pregnancy and per live birth. The corresponding net figure is 306.

Altogether it is evident that even very highly fertile people have much coital activity statistically associated with their reproductive performances.

The point may be raised that the theoretical basis upon which the concept of net potentially effective coitus has been here set up is too broad, in view of modern knowledge about ovulation. Biologically this is undoubtedly true. More and more evidence is accumulating to show that the human female is incapable of conceiving except during a restricted part of each menstrual cycle. The most liberal estimates of the extent of the fertile period made by the leading present-day students of the 'safe period' put it at a third or less of the whole menstrual cycle. Suppose we accept this as a round figure, and deduct two-thirds of the average number of copulations in the 'net' columns of Table VII, to make a closer approximation to a true net potentially effective coitus figure. We shall still be left with averages of from 55 statistically very net indeed and more truly potentially effective copulations per pregnancy in the age period under 20, rising to 478 per pregnancy in the age period 40–49 years.

The results of this study of the frequency of coitus in relation to reproduction furnish emphatic quantitative confirmation of the statement of Hartman quoted above. The relative sterility of the human organism is truly the marvel rather than fertility. A distinguished investigator working on artificial insemination in an attempt to relieve sterility said to the writer not long ago that he and his associates in the work had come to regard conception as somewhat partaking of the nature of a miracle, so numerous were the physiological barriers thrown in its way in the human female —such as ovulation only monthly, short life duration of shed germ cells, mucous blocking of the *os uteri*, &c. This is, of course, a humorously exaggerated viewpoint, and was meant to be so taken, but still, it has in it an element of solid truth. Furthermore, under certain conditions the normally high fertility of lower mammals may be held in abeyance for long periods of time without the intervention of the birth controller. Years ago we attempted in the laboratory to get ordinary wild house mice that we had caught in traps to breed in cages at the laboratory. The animals were healthy and seemed happy. Their sexual activity was in every respect apparently normal. Coitus was regular. But it was nearly two years before pregnancy and reproduction occurred. With the next generation (young of wild mice bred in captivity) there was no difficulty. They reproduced as nonchalantly as tame white mice. Other workers have had similar experiences. But the biology of this temporary sterility in the presence of apparently normal sexual activity is still nearly a complete mystery.

The increase in the number of copulations per pregnancy (or birth) with advancing age of the wife brought out by the data of Appendix I, Table VII, and Fig. 10 is striking. In the age period 40–49 there were more than eight times as many net potentially effective copulations per pregnancy experienced than there were in the under 20 period. This is presumably an expression, in part at least, of the diminution of innate capacity for fertility with advancing age in both males and females.

The difference between the number of copulations statistically associated with a single pregnancy and with a single live birth are the consequences of the phenomenon of reproductive wastage, to be discussed later in detail.

In this section it has been shown, in sum, that the frequency of coitus varies greatly from couple to couple. It in part represents the overt expression of diversities in the intensity of libido. It is a factor of major importance in bringing about individual and group differences in expressed fertility. For the first time there is presented a statistical approximation to a really basic constant of fertility, namely, the average number of copulations statistically associated with the production of a pregnancy (or live birth) in normal human reproduction unaffected by artificial interference (birth-control).

8. *Pregnancy Rates*

The next item on the list of factors importantly concerned in the biology of fertility is the *pregnancy or conception rate* in relation to the extent of time during which it is biologically possible for a woman to become pregnant. The significance of this in any attempt to study fertility quantitatively is so evident as to need little discussion. It becomes especially important when one attempts to evaluate the significance of birth control as a factor in causing the decline in the birth-rate now occurring among so many populations.

It is a commonplace of the physiology of reproduction that normally after a mammalian ovum has been fertilized and implanted in the uterine wall a further impregnation cannot occur until after the uterus has been emptied of the product of the existing pregnancy. In short, a woman is not, and cannot be, exposed to the chance of becoming pregnant while she is already pregnant. It therefore follows that any statistical measure of the time-rate of occurrence of pregnancy, if it is to attempt even the beginning of an approach to critical precision, should at the outstart make some sort of allowance for this plain physiological fact. Statistics of human reproduction come to the analyst, if sufficient trouble is taken in their collection, in the following form: a woman has been cohabiting during a specified length of time (generally from the date of her marriage to the date of record); in this interval of time she has experienced n pregnancies; of the pregnancies n_1 may have resulted in full-term living births, n_2 in still-births, n_3 in abortions or miscarriages ($n = n_1 + n_2 + n_3$). The duration of each of these several pregnancies may be determined and recorded to a close degree of exactness, if sufficient pains are taken, in a large proportion of cases. If through failure of memory or lack of co-operation on the part of the patients the requisite data cannot be furnished, reasonable corrective terms based upon general statistical experience as to the distributions of pre-term endings of pregnancy may be applied.

In reaching a reasonably adequate statistical expression of the true pregnancy rate per unit of time at biological risk another significant biological factor involved in the matter needs to be taken into account. This is the woman's ovulation rate. What we really want as a measure of pregnancy rate is the answer, for each individual woman and constructively for the group, to the following question: What proportion of all the ovulations experienced during the period of observation resulted in the fertilization of an ovum or ova and pregnancy? On the basis of present knowledge of the physiology of reproduction it is possible to construct a measure of the pregnancy rate which will answer the question to a degree of approximation sufficiently close to the actuality for all practical statistical purposes.

In proceeding to set up such a rate it was necessary to consider certain underlying physiological matters.

(*a*) It is well established that normally the human female ovulates once and once only in each menstrual cycle (Hartman, 29). As a statistical fact this undoubtedly represents the normal state of affairs for most women throughout a large part of the period between menarche and menopause. In developing the form of statistical pregnancy rate used in the writer's recent work on fertility, and in this book, one ovulation per menstrual cycle is taken as an absolute rule. This, however, is recognized to be a statistical convention rather than an absolute fact of nature. The justification for taking it as a rule is that it is true in the vast majority of cases, and it therefore is the best single statistical generalization on the matter that can be adopted. It has, however, been shown by Corner (23) and Hartman (32) that in monkeys menstruation without ovulation may occasionally occur. It is possible, and in the writer's opinion probable, that this sometimes occurs in the human female, especially near the limits of the reproductive span (menarche and menopause). Mikulicz-Radecki and Kautsch (35) are of the opinion that the low adolescent fertility already discussed in an earlier section is chiefly to be explained on the basis that the ovulatory cycle normally starts some years later than the menstrual cycle. This plainly, however, cannot be universally true, because every year there occur births to mothers in the 10–14 age group.

(*b*) Accepting (*a*) as a statistical generalization for the reasons given, it follows that the number of ovulations in a year will normally be determined by the average length of the menstrual cycle. This is usually stated to be 28 days, and there is a great deal of accumulated evidence that, statistically speaking, this is extremely close to the average figure. For example, Kelly (08) found 942 out of 1,000 women reporting a 28-day interval. Heyn (20) reported the same interval for 63·5 per cent. of 1,684 women. Sanes (16) found 75 per cent. menstruating regularly and 72 per cent. of these at 28-day intervals. Allen (33), King (33), Moench (37), and others have emphasized the irregularity and variability of the interval, but upon calculating the biometric constants for King's own data for 354 menstrual intervals, derived from two groups of women ranging from 17 to 35 years, we find the following results:

Mean interval	$= 28{\cdot}41 \pm 0{\cdot}17$ days.
Median interval	$= 27{\cdot}94 \pm 0{\cdot}21$ days.
Standard deviation	$= 4{\cdot}83 \pm 0{\cdot}12$ days.
Coefficient of variation	$= 17{\cdot}0 \pm 0{\cdot}4$ per cent.

Plainly with a probable error of mean and median of the order of four to five hours on the basis of a sample of only 354 intervals, no serious error will be made by taking 28 days as the average length of the menstrual cycle *for statistical purposes*. This gives 13·04 ovulations per woman per year. Considering the approximate nature of the calculations, in that all individual variation in respect of the menstrual interval is going to be neglected, no harm will be done by dropping the decimals and taking 13 as the normal average number of ovulations per year.

Again it is evident that this is a statistical approximation rather than a rigid biological law. It is adopted for reasons of practical statistical convenience, and because statistically it appears to be the best single generalization that could be used. It neglects the errors introduced by the fact that some women are irregular in respect of their menstrual (and presumably ovulatory) cycles, and that some women have typically a 21-day cycle instead of a 28-day. It is, however, believed that when everything is taken into account the residual error in group pregnancy rates due to these methodological imperfections in the rate as set up are not serious or systematically biased. The chief reason for this belief is that statistically the menstrual interval does work out to be, on the average, close to 28 days in samples of material from widely divergent sources and races. Lack of space prevents the presentation of the detailed evidence on the point that we have in our biometric files.

(*c*) A woman normally does not ovulate during the time she is pregnant, nor during the puerperium (the period between parturition and the complete involution of the uterus).

On the basis of the above considerations there has been devised the statistical expression for pregnancy rate that is used in this book.[20] It is not perfect, but it gives valid relative values when uniformly applied to observed reproductive records.

It is to be understood that the pregnancy rate described above is only one of many possible ways by which a numerical expression or measure of the fertility of human mated couples can be reached. The crude live-birth rate is another; the number of births per 100 (or per 1,000) person-years of married life is still another. Each of these, and various others that might be cited, expresses in quantitative terms, or 'measures' a more or less different aspect of a biologically complicated matter. Each has its particular field of usefulness. In consequence all of them are made use of, in one way or another, in this book. These different methods of quantitatively appraising fertility are in no sense either contradictory, or mutually exclusive. Instead they are complementary and supplementary to each other. Each leads, with differing degrees of precision, to the same broad statistical results and conclusions when applied to the same observations, but by a slightly different route. The reader who will take the trouble to think through for himself carefully just what each of the indices of fertility used in this book really measures will not be confused by their numerical differences when applied to the same observations. The 'pregnancy rate' devised by the writer measures one aspect of fertility with a higher degree of statistical specificity relative to the biological processes of human reproduction than any other hitherto used. It relates the number of pregnancies actually experienced to the number of ova that theoretically might have been fertilized and led to the impregnation of the woman, or, alternatively to the duration of the time period in which it was physiologically possible for her to become pregnant if she indulged in copulation. It does this with precise accuracy, except for the limitations implicit in the biological postulates which underlie the method, as already explained earlier in this section.

9. *Contraceptive Efforts*

Inasmuch as a considerable part of this book is to be devoted to the results of an attempt to appraise quantitatively the effect of contraceptive efforts on fertility and the movement of population any lengthy discussion of contraception as a factor in fertility is unnecessary at this point.

It is generally agreed by all persons competent to have an opinion on the subject that the practice of contraception (birth-control) is a factor at least potentially capable of influencing the birth-rate. There is no such widespread agreement as to how significant a factor it actually has been, and is now, in causing the decline of birth-rates. Some persons think it is the only factor worthy of serious consideration. Others are of the opinion that it has played almost no significant role, up to the present time, in the movements of the birth-rates of large population aggregates considered as wholes. Still others hold an intermediate position somewhere between these extremes.

There are several immediately apparent reasons for this diversity of opinion. In the first place, until recently no one has really known anything definite about how extensively contraceptive measures of any sort are actually used by the general population of any country taken as a whole, or by any statistically substantial part of it. Secondly, for emotional or propagandist reasons, exaggerated inferences, in one direction or the other, are drawn from meagre experience, statistically considered. The leaders of the birth-control movement, for example, argue that information on contraceptive techniques should be widely disseminated, because relatively few know anything about them. On the other hand, those opposed to birth-control argue that already information on the subject is so widespread, and the techniques are put into practice so generally, as even to endanger the continued existence of some of the groups standing highest in the scale of civilization. Both sides to this controversy are in possession of the same objective evidence. One side knows nothing that the other does not know relating to what may be euphemistically called the 'facts' in the case.

In the third place, there existed until recently almost nothing in the way of critical, objective, unbiased evaluation of the effectiveness of any or all contraceptive techniques as actually practised in the population. If a few special studies such as those of Davis (29), Brown, Greenwood, and Wood (20), and Dickinson and Beam (31) are excepted, nearly all the so-called direct evidence as to the effectiveness of contraceptive practices had, until lately, come from persons or organizations interested in birth-control propaganda (as examples see Cooper, 28, and Stopes, 30). But it is a sound human instinct to look somewhat askance at too obviously *ex parte* testimony and to attach but little weight to any protestation of honesty or nobility of purpose that may accompany it. The major difficulty in the matter under discussion appears to have been the considerable confusion of thought about the difference between the potentiality and the actuality of effectiveness of contraceptives. It is dubious logic to reason from the fact that a highly intelligent woman, thoroughly trained in biology in a university, and obsessed with an overwhelming fear of unwanted pregnancy, is able to use a particular contraceptive device with unfailing success, to the conclusion that this contraceptive device is, or will be, equally effective as actually used by all women who resort to it in the general population. Nor can it be safely inferred from the same premiss that birth-control is a major factor in causing the decline in the birth-rate.

What has long been greatly needed is a substantial body of accurate, unbiased, detailed information, collected by trained obstetricians, about the reproductive histories of a large and representative sample of women, including an account of the nature and extent of any contraceptive efforts made in connexion with their sexual activity. Furthermore, such information should, for obvious reasons, not come from birth-control clinics; it has been repeatedly shown that women attendant upon such clinics as patients are not a representative sample of women in general, and this alone is a sufficient reason for turning to other sources for data.

The purpose of such a collection of data would be to make possible more reliable answers than have hitherto been available to two basic questions, namely:

1. *To what extent statistically is any sort of contraceptive technique, device, or habit actually practised in a defined sample of the general population at a specified time, as near as possible to the present?*

2. *What is the quantitative effectiveness of contraceptive efforts by the various presently known techniques, considered both separately and all together, in reducing the relative incidence of pregnancy, as these techniques are actually used in a defined sample of the general population, below that observed in an otherwise statistically similar sample of women making no contraceptive efforts whatever?*

As will appear in later chapters, the writer's laboratory, with the generous assistance of the Milbank Memorial Fund, has been engaged since 1931 in the collection and biometric analysis of just such a body of information. The more important of the results achieved to date are discussed in later chapters of this book.

10. *Reproductive Wastage*

Any particular pregnancy may be terminated in any one of the following ways:

(*a*) By the birth of a living child. This event may occur at the full term of pregnancy which is the normal, most usual, and most desired termination; or the living child may be born one or even two months before the full term of pregnancy. This latter event is designated generally as prematurity. With the aid of modern knowledge and appropriate apparatus many such premature children are now kept alive to grow up into entirely normal individuals.

(*b*) By a still-birth, which in strict logic and definition means an infant born dead at or near term.

(*c*) By a miscarriage or abortion. These terms are applied to the passage from the mother of a foetus insufficiently developed to have any chance of extra-uterine life. As a matter of fact, the aborted foetus, in a great many cases, is dead before it is cast out of the womb. Abortions and miscarriages may be separated into three general classes; namely, first, those where the abortive termination of the pregnancy is due to natural causes, in the sense that no one intentionally interfered with the process of gestation. Of all such causes probably the existence of syphilis in the mother is one of the most common. But other pathological conditions may produce the same result, as may also such things as traumatic injuries, and a variety of less well-understood causes. The second category of abortions includes those where the course of gestation is deliberately and intentionally interrupted by one or another of a great variety of techniques[21] put into operation by the woman herself or by some one else whom she employs for the purpose. These are generally designated as criminal abortions because most civilized countries regard the procedure as murder, which in strict biological logic and fact it is. The third category of abortions include those deliberately induced by reputable physicians in order to safeguard the mother's life or future health. These are generally called therapeutic abortions, and would be placed in strict legal logic in the category of justifiable homicide, as when a person kills another in defence of his own life.

As a collective and inclusive designation for all terminations of pregnancy except those included in category (*a*) (live births) the writer (32) suggested the term *reproductive wastage*, to mean the total loss to fertility in reproductive processes begun but never brought to successful termination. In the aggregate this wastage is considerable. Unfortunately it is impossible to appraise the amount of it accurately from the official statistics of general populations, for a number of reasons. In the first place, natural abortions occurring very early in the period of uterogestation are frequently not immediately recognized as such. Next, the numerous induced abortions are nowhere systematically recorded, because in most civilized countries their induction is a criminal offence in itself. Next, the portion of the period of gestation during which a natural abortion is required by law to be registered as a still-birth varies widely in different countries and in different states in the United States, but mostly it is only after four months of development has occurred, while the number of abortions occurring during the first three months of pregnancy is actually large, both absolutely and relatively. Finally, it is well known that the registration of still-births occurring before the seventh or eighth month of gestation is extremely imperfect. But even with all these difficulties, in the U.S. Birth Registration Area in 1932 (the whole U.S.A. except Texas) there were 3·8 still-births registered for each 100 live births. The proportion of still-births (as defined by law and the registration authorities) varies with the age of the mother, being lowest in the prime of her reproductive life, and higher earlier and later, as is shown graphically in Fig. 11.

The frequency of natural abortions increases significantly with the number of pregnancies a woman has experienced. The writer (33) showed from the reproductive histories of 1,152 women that among those who had undergone 1 to 9 pregnancies, 12·6 out of every 100 pregnancies had ended in miscarriage or abortion, while among those who had experienced 10 to 22 pregnancies, 22·9 out of every 100 had ended this way. The difference is $10{\cdot}3 \pm 0{\cdot}73$. This result, that relative abortion frequency tends to rise with manifested fertility, is confirmed by the experience of Taussig (31, 36), so far as concerns the general trend. In another study (Pearl, 32) of reproductive wastage it was shown that in a group of 571 highly fertile white women the average rate was $17{\cdot}83 \pm 0{\cdot}58$ per 100 pregnancies, and in a comparable group of 145 highly fertile Negro women the average was $13{\cdot}12 \pm 0{\cdot}82$ per 100 pregnancies. The author was of the opinion that, on the whole, the most noteworthy point brought out by these values was the markedly lower mean reproductive wastage rate in the Negro women as compared with the whites. The mean reproductive wastage rate was

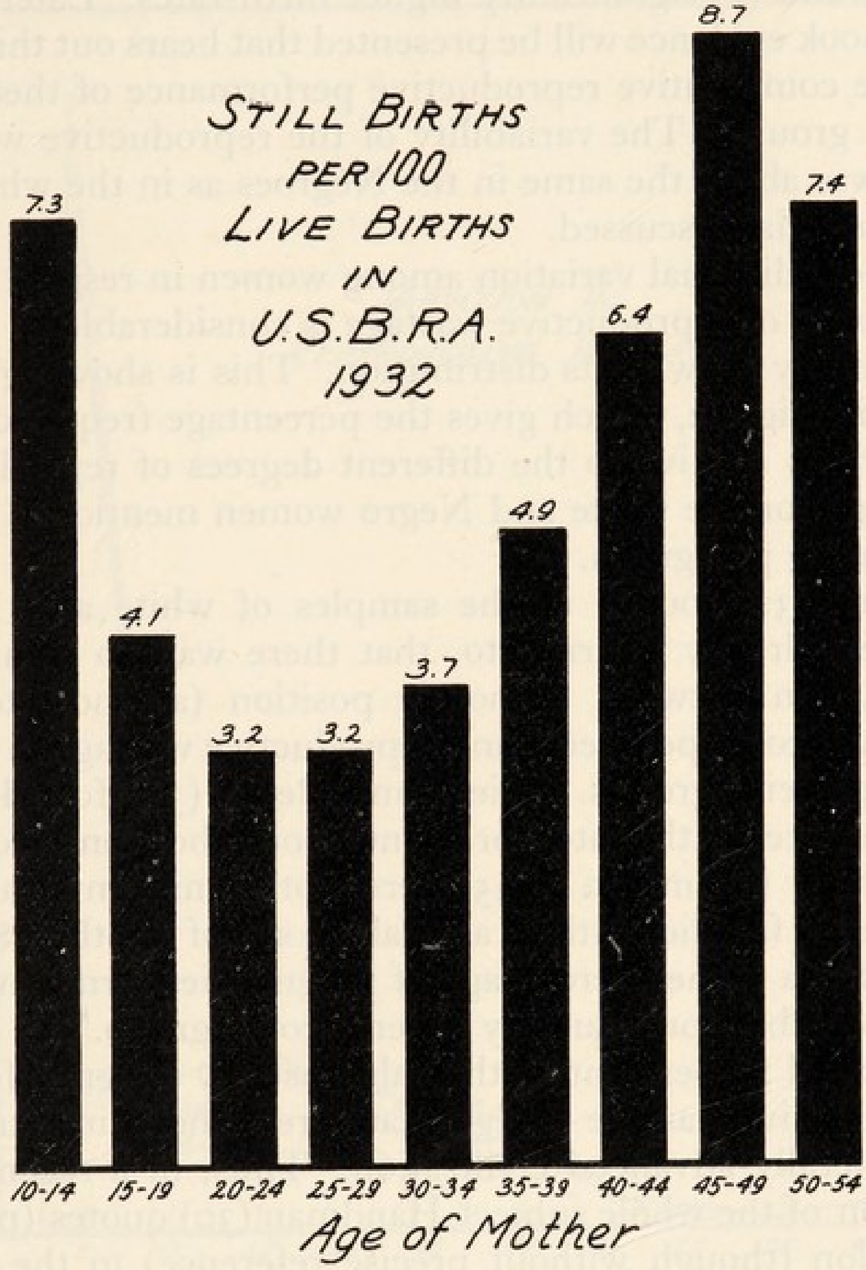


FIG. 11. Number of still-births for each 100 live births in the U.S.B.R.A. in 1932. (Data from Table V (p. 19) of *Birth, Stillbirth, and Infant Mortality Statistics . . . 1932*. Washington: Bureau of the Census, 1934.)

4·71 ± 1·01 points lower in the Negroes than the whites, a difference of roughly 26 per cent. of the white value. Plainly in so far as this material may be taken as indicative the Negroes were actually operating reproductively as biologically more efficient machines than the whites; they had, on the average (*a*) significantly higher pregnancy rates, because less ready and efficient contraceptors, (*b*) significantly lower reproductive wastage rates, and by necessary consequence of (*a*) and (*b*) significantly higher birth-rates. Later on in this book evidence will be presented that bears out this view of the comparative reproductive performance of these two racial groups. The variability of the reproductive wastage rate was about the same in the Negroes as in the whites in the material discussed.

The individual variation among women in respect of the incidence of reproductive wastage is considerable in range, and highly skew in its distribution. This is shown graphically in Fig. 12, which gives the percentage frequency distributions relative to the different degrees of reproductive wastage for the white and Negro women mentioned in the preceding paragraph.

Pearl (32) found, in the samples of white and Negro women already referred to, that there was no significant correlation between economic position (as indicated by family income per week) and reproductive wastage in either of the racial groups. Wiehl and Berry (37) found that: 'Differences in the rates for spontaneous abortion according to family income in 1935 were not significant, but the women in families with an annual income of less than $1,000 reported a higher percentage of pregnancies terminated by induced abortion than any other income group.'

Around 20 per cent. is the value usually assigned for the reproductive wastage in legitimate pregnancies in countries of generally advanced civilization. Thus, in a recent discussion of the whole subject Handman (30) quotes (p. 373) Bertillon (though without precise reference) to the effect that the proportion was 19·3 per cent. in France. Prinzing (31), in a chapter devoted to the subject, gives figures from various sources ranging from around 10 per cent. to more than 20 per cent. Dickinson and Beam (31) found in a group of 703 white women of higher social and economic status a reproductive wastage rate of 29·6 per 100 pregnancies. On the other hand, from Table X (p. 10) and Table III (p. 18) of Davis's (29) report on her questionnaire study of 1,000 married women it is possible to gather the following data: 991 women in this series reported having had 1,726 children in total (Table X), while 985 women reported having

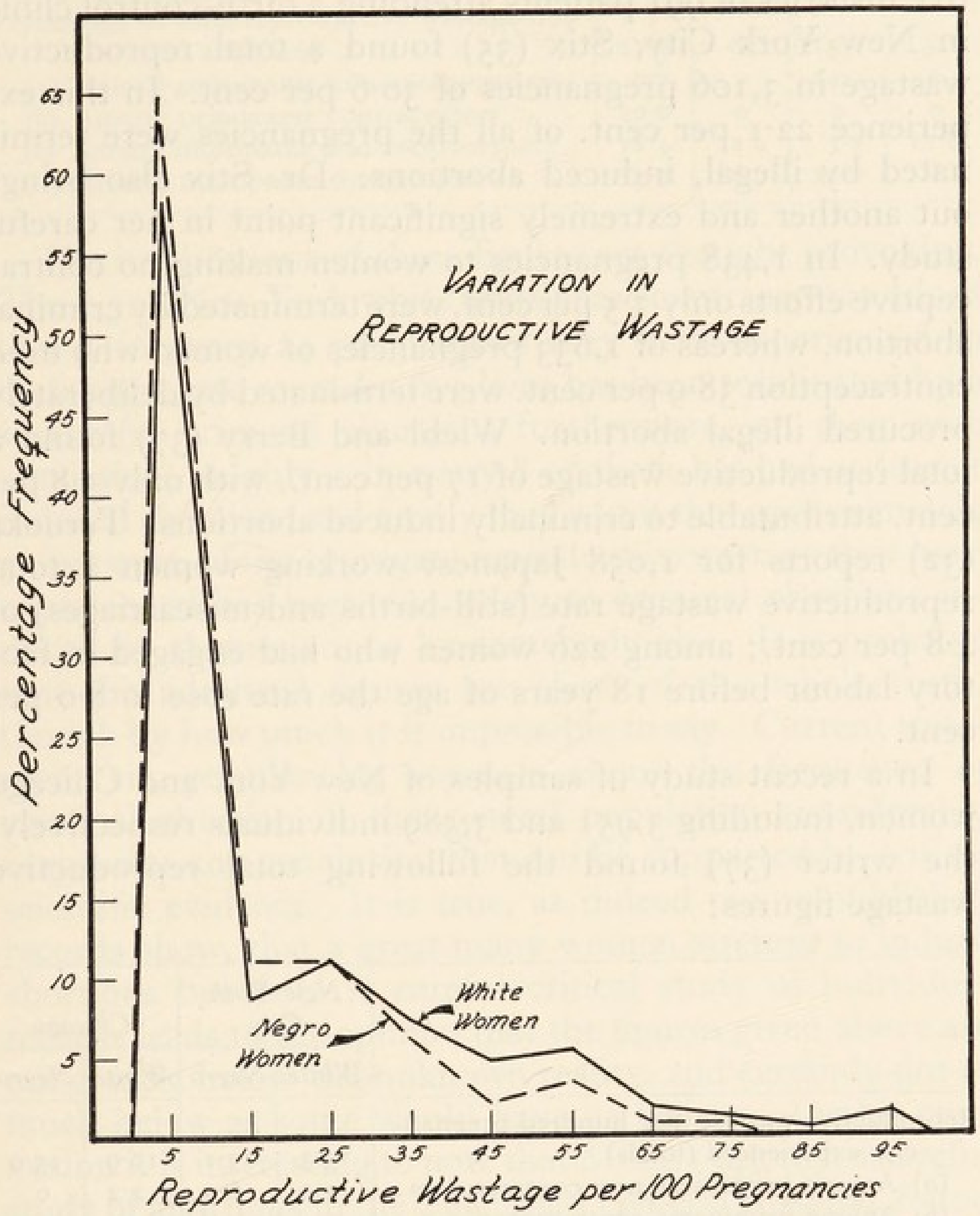


FIG. 12. Percentage frequency polygons showing the extent and character of individual variation in reproductive wastage in white (solid line) and Negro women (dash line). (Data from Pearl (32), Tables 6 and 7, pp. 549 and 550.)

had 2,258 pregnancies. Disregarding the discrepancy of six women not reporting pregnancies who did report births, these figures give a reproductive wastage in the Davis sample of roughly 22 per cent. This figure is still somewhat higher than that for Pearl's series but nearer to it than to the Dickinson and Beam result. In a study of the reproductive histories of 991 patients attending a birth-control clinic in New York City, Stix (35) found a total reproductive wastage in 3,106 pregnancies of 30·6 per cent. In this experience 22·1 per cent. of all the pregnancies were terminated by illegal, induced abortions. Dr. Stix also brings out another and extremely significant point in her careful study. In 1,438 pregnancies to women making no contraceptive efforts only 3·5 per cent. were terminated by criminal abortion, whereas of 1,633 pregnancies of women who used contraception 38·9 per cent. were terminated by deliberately procured illegal abortion. Wiehl and Berry (37) found a total reproductive wastage of 17 per cent., with only 3·8 per cent. attributable to criminally induced abortions. Teruoka (32) reports for 1,058 Japanese working women a total reproductive wastage rate (still-births and miscarriages) of 4·8 per cent.; among 226 women who had engaged in factory labour before 18 years of age the rate rose to 8·0 per cent.

In a recent study of samples of New York and Chicago women, including 3,951 and 3,589 individuals respectively, the writer (37) found the following total reproductive wastage figures:

	New York City		*Chicago*	
	White	*Negro*	*White*	*Negro*
Reproductive wastage per hundred pregnancies experienced (totals)	13·3	13·1	10·9	15·9
(*a*) Among primiparae non-contraceptors .	3·5	6·0	2·2	0
(*b*) Among primiparae contraceptors .	2·1	4·8	0·9	0
(*c*) Among multiparae non-contraceptors	16·0	14·4	13·2	18·8
(*d*) Among multiparae contraceptors .	14·2	13·5	13·4	16·4

The question of criminally induced abortion is becoming a serious one in all critical discussions of present reproductive trends. In the New York and Chicago samples the findings on this point were as follows:

	New York City		*Chicago*	
	White	*Negro*	*White*	*Negro*
Percentage of total reproductive wastage due to induced abortions	21·0	6·6	15·1	5·8
(*a*) Among primiparae non-contraceptors .	7·7	0	14·3	0
(*b*) Among primiparae contraceptors .	20·0	0	0	0
(*c*) Among multiparae non-contraceptors .	11·4	2·4	5·2	11·8
(*d*) Among multiparae contraceptors .	29·7	16·7	20·0	0

The implications of these figures are thought provoking. The 1,328 New York white multiparae contraceptors admit that 1 in every 24 pregnancies they have experienced in their aggregate reproductive lives has been terminated by a successful criminal abortion; furthermore, on their own admission, roughly 1 in every 8 of them has had at least 1 induced abortion; and finally they admit that approximately 30 per cent. of the aggregate reproductive wastage they have experienced has been due solely to criminal abortions induced by themselves or by somebody else. It is probable that the admitted figures are short of the whole truth, though by how much it is impossible to say. Current statements in popular lay journals about the frequency of criminal abortion in the general population considerably exaggerate any conclusion that can be supported by critical scientific evidence. It is true, as indeed our unpublished records show, that a great many women attempt to induce abortions but fail. A careful critical study of individual records leads to the opinion that the figures given above are not greatly below the unknown reality, and certainly not as much below as some would have us believe. In this connexion it is interesting to note that Millar (34), in his careful study of abortions in the Cincinnati General Hospital, found that 31 per cent. of the total number of the cases admitted that their abortion had been criminally induced.

While the New York multiparae contraceptors have been discussed first as an example, the picture presented by the little table as a whole is not exactly a pleasant one from any point of view. It is to be remembered that the table contains only women living in wedlock who have been married only once and are free of venereal disease—in other words, generally not people of loose morals. These are records of families, living together and rearing children, on the whole representative of the most substantial sort of traditionally typical American families at each social and economic level represented in the data, from 'very poor' through 'well-to-do and rich'. The figures as to purposefully induced abortions are not estimates or wild exaggerations based on emotional opinions. On the contrary, they are records of actual happenings, which admittedly probably somewhat understate the complete facts but can therefore be accepted with greater confidence as establishing minimal values, below which the truth cannot lie.

What emerges is that in the two largest American cities samples of white child-bearing women that are known to be fairly representative of the population from which they come are exhibiting the following kind of behaviour:

1. Deliberately causing from one-sixth to more than one-fifth of their aggregate reproductive wastage.
2. By so doing voluntarily taking one of the most serious risks to their very lives as well as to their future health and well-being that a woman can take.
3. At the same time contributing substantially, through the direct and indirect taxes that they pay, to the support of an intensive and statistically highly successful public health programme of keeping babies alive and in good health.

Such a picture somehow seems to tally badly with a national pride, that not infrequently becomes emphatically vocal, in being a socially enlightened, intelligent, and progressive people.

One of the most interesting things that these figures bring out, just as did those of Stix from a totally different New York sample, is that resort to wilfully induced abortion is much more common among women who practise birth-control than it is among women who do not. The result is one to be expected on the morally lower levels of behaviouristic psychology. The abortionist is called on to rectify the inadequacies of birth-control.

So far as these samples may be taken as indicative, the suggestion is that the Chicago white women resort somewhat less to induced abortion than the New York women. Larger samples would be necessary to be quite sure about this, but the suggested trend is probably real. The induced abortion rate tends to be lower among the Negroes than among the whites, as is clearly shown by the New York figures.

Altogether, to sum up this section, there can be no doubt that reproductive wastage is a biological factor of major importance in differentially influencing fertility, as realized or expressed.

11. *Discussion*

In concluding this necessarily incomplete treatment of some of the biological factors involved in the determination of expressed differences in fertility, it seems desirable to attempt something in the way of synthesis, by indicating in skeletonized outline some of the inter-relationships between a part of the indirect variables—social, economic, and environmental generally—on the one hand, and the direct biological variables that have been under discussion, on the other hand. The chart on the following page attempts to do this.

This chart, in common with most succinct classifications of complex human phenomena and relationships, falls short of logical perfection or completeness. But perhaps it will in some degree serve two purposes; first, help to clarify and unite in a single view some of the more significant elements in an extremely complex matter; and, second, to get into the record, as the legal phrase has it, a formal statement of the fact that the writer is not unaware of the great importance of the influence of social and economic variables upon human fertility. Perhaps the chart will be permitted to take the place of tiresome reiteration of this awareness every time specifically biological aspects of fertility are discussed in the remainder of the book.

All of the entries in the chart are to be regarded as *variables*—biological or sociological, or both—in the sense

Classification of some of the more important factors influencing individual and group fertility

Indirect Factors of the First Order	*Affecting*	*Indirect Factors of the Second Order*	*Some or all of which in turn influence or condition some or all of the*	*Direct Factors*
Economic Circumstances	⟶ ⟵	Average age of marriage Education Occupation Physical health Mental health, interests, and attitudes	⟶	Sexual desire (libido) Age specific innate reproductive capacity Coitus rate Conception rate Contraceptive rate Reproductive wastage rate
Density of Population	⟶	Occupation Physical health Mental health, interests, and attitudes	⟶	Sexual desire (libido) Age specific innate reproductive capacity Coitus rate Reproductive wastage rate
Religion	⟶	Average age of marriage Education	⟶	Age specific innate reproductive capacity Coitus rate Contraceptive rate
Other Folkways (Habits, Laws, &c.)	⟶ ⟵	Average age of marriage Education Occupation Physical health Mental health, interests, and attitudes	⟶	Sexual desire (libido) Age specific innate reproductive capacity Coitus rate Contraceptive rate Reproductive wastage rate

in which that word is used in the natural sciences. These variables are mutually interrelated with, and interactive upon, one another in extremely complex ways. But the directions and sequences of these interrelations and interactions are, however, in general, probably about as indicated in the chart. Economic circumstances, for example, do, in fact, influence each of the second-order indirect variables, and each of these in turn does influence or determine the expressed or realized values of the direct variables in the last column. In the case of density of population there might perhaps be indicated a direct pathway, as well as the indirect one, to the factors of the last column. Such a direct causal chain has been demonstrated by carefully controlled experiments on the fecundity and fertility of the fruit fly

Drosophila (Pearl, 32). While it is evident that one cannot safely transfer results from flies to man, there appears now to be sufficient evidence that density of population directly affects the physiological mechanisms of human reproduction to warrant tentatively drawing the conclusion suggested.

Of the primary indirect factors included in the chart economic circumstances is clearly the most important in influencing group differential fertility. Next in order would probably be density of population on the basis of the observed differentials between urban and rural fertility.

Of the second-order indirect variables mean age at marriage would probably rate as of first importance, and health as second. The postponed marriages and the wider and more varied mental interests of the well-to-do as compared with the poor are powerful agents in contributing to their lower expressed fertility.

Among the direct factors there would seem no doubt that contraception and reproductive wastage (including as it does induced abortions) easily are the most powerful in their effects on realized or expressed fertility. In fact they are directly and causally determinative of its comparative level in many cases. And they are in large degree purposively controlled variables, in contrast to the natural biological variable represented by the normal change in fertility of the woman with advancing years.

If the classification embodied in the chart be accepted as giving a roughly approximate picture of the factors at work in producing group differential fertility, we must be further impressed by the fact that the indirect variables of both the first and the second order are not always in a fixed condition of stable equilibrium, but instead some of them are apt to exhibit more or less continual change or flux, not only now but almost always, save for short intervals of time. The same is notably true of one of the direct variables, contraception rate. The use of contraceptive measures is, without the smallest doubt, spreading and increasing in the world's population every day.

III

HUMAN AND ANIMAL REPRODUCTIVE PATTERNS

1. *The Problem*

THE pattern of reproductivity, viewed as a whole, shows a wide range of diversity among different species of animals. This diversity includes within its compass all of the various factors concerned in the physiological mechanisms of reproduction. Some animals, for example, have their reproductive activities restricted to certain seasons of the year; others, like man and some of the other higher primates, reproduce all the year round, exhibiting only relatively minor seasonal fluctuations in the rate. Some animals begin reproducing as soon as they have reached the stage in their individual development and growth where it is physiologically possible, and keep it up until they die, or until they are very close to that event; others have their reproductivity confined to a limited part of their individual life-cycle, of greater or smaller extent as the case may be.

Many such diversities might be enumerated, and their details discussed, but the purpose of the present chapter will be primarily to examine some of the more striking characteristics of the human reproductive pattern and to some extent compare them with the situation in lower forms.[22]

The discussion may begin with a consideration of the quantitative relationship between the actual reproductive performance of a large population aggregate and the potential reproductivity of which it is theoretically capable, so far as concerns any limitations set by strictly biological variables. In general the physiological mechanism of reproduction peculiar to its kind sets a limit to the time rate of the reproductive performance of any organism. How closely does actual reproductive performance approach this physiological limit in a particular species? It is known from observations in field and laboratory, as well as from breeding experience with domestic animals, that the approach is fairly close for most animals lower than man in the evolutionary scale. There are, of course, always inherent individual variations in fecundity and fertility that lead to differences between individuals in expressed reproductive capacity. Also illness and advancing age may temporarily or permanently slow down the rate of reproduction in particular individuals. Furthermore, complete physiological sterility may occur in lower animals as it does in man.[23] But, with due allowance for the effects of such factors as these, it is a fact that in the normal course of events a lower animal such as a fly or a frog, for example, keeps on reproducing up to the limit of its capacity throughout the portion of its life-span within which it is able physiologically to reproduce at all.

With man the case is somewhat different. Besides the physiological limitation of reproductive capacity in the female, which confines her child-bearing to the period between menarche and menopause, there are the two other factors of major importance that have been discussed in the preceding chapters, marriage and contraception. This chapter will be devoted to an objective examination and description of the human reproductivity pattern, its comparison with infra-human patterns, and an attempt to appraise for the general population of the United States the quantitative effect of the factors that differentiate human from animal populations in respect of reproduction.

2. *Actual and Potential Reproductivity*

Let us now examine the following question concerning the population of the United States in a particular year: What proportion of the women potentially capable physiologically of reproducing in 1930 actually reproduced in that year? It should be clearly understood at the start that the answer can at best be only approximate, for reasons presently to be discussed, but even so it will perhaps be suggestive.

In the Birth Registration Area of the United States, which in 1930 included all the states except Texas and South Dakota, there were living 30,871,292 females[24] between the ages of 15 and up to 50 years, of whom approximately 63 per cent.[24] were married, while 37 per cent. were either single, widowed, or divorced. But whether single, married, widowed, or divorced, the vast majority of them were *physiologically* potentially capable of reproduction. The average age at menarche, as has been shown in the preceding chapter, is not far from 15 years, and at menopause between 46 and 47 years. In adopting the age limits just stated (15–49, inclusive) it is definitely certain that some females physiologically capable of reproduction have been excluded, because in 1930 there actually occurred 3,026 births (living and still) to mothers under 15 years of age, and 160 births (living and still) to mothers aged 50 years and above. Let us start then with the initial general assumption (subject to later corrections) that in round numbers substantially all of these 30 odd million women between 15 and 49 years of age were physiologically potentially capable of reproducing in 1930. Theoretically, then, these 30,871,292 women might conceivably have produced in 1930 at least 30,871,292 births of some kind of product of conception, provided they had all set their minds and hearts and bodies to it (in the sort of way that flies or termite queens appear to do). For, be it noted, it is not physiologically impossible for a woman to reproduce once a year regularly over considerable stretches of years. Some do.[25]

Actually in 1930 there were officially recorded as occurring in the same area, to mothers aged 15 to 49 years inclusive, 2,173,415 live births and 83,498 still-births, making a total of all births (living and still together), including illegitimate as well as legitimate, of 2,256,913.[26] This still does not represent quite all the reproductive activity of the year for a number of reasons. In the first place there occurred a considerable number of unrecorded abortions, natural and criminal. To attempt to estimate their number would be sheer guessing, so this item may as well be left for the moment as a recognized but unquantified error. A small offset against it is found in the fact that in the total recorded births multiple births (twins, triplets, &c.) are included, each of which required only one mother. In the second place, females under 15, and of 50 years and over, in age together produced in the year 2,970 live and 216 still-births, or 3,186 births in total. But it has been deliberately decided to confine the discussion to the age limits 15 and 49, inclusive, because such a very small proportion of human females outside those limits are biologically capable of reproduction. Finally 27,573 live, and 2,752 still-births, or a total of 30,325, were produced in 1930 by women whose ages failed to get recorded on the birth certificates. The majority of these women undoubtedly fell within the ages of 15 and 49 years, inclusive, but precise information on this point is lacking.

Taking the figures as they stand, and realizing that they give only an approximation to the hidden truth, it appears that at least 2,287,196 births[27] (living and still together) of 1930 were probably produced by mothers between 15 and 49 years of age, inclusive. But these 2,287,196 births were produced by only about 7·4 per cent. of the 30,871,292 females physiologically potentially capable theoretically of reproducing in that year. Now it is undoubtedly true that some of these females were actually not physiologically capable of reproducing in that year by reason of true biological sterility for which they were alone chargeable and in which their consorts played no part, or because of acute or chronic disabling illness, or because they were so malformed or otherwise so defective as literally to make mating a biological impossibility. Suppose 15 per cent. be deducted for this cause, which includes the supposition that 40 per cent. of all women in the age group 45–49 years had already passed the menopause. The percentage of births to total women then rises to 8·7 only. Also suppose it be assumed that the unrecorded abortions were four[28] times the recorded still-births, the still-births as now recorded being supposed in some states to include all products of conception delivered dead at whatever period of uterogestation, and to include some at every period except the very earliest, and add this figure to the births. The resulting percentage of actual to potential mothers, on the basis of the number of females reduced by 15 per cent. for reasons already mentioned, becomes only 10·0.

So, then, on the basis of liberal allowances for errors it appears that probably *not more than 10 per cent. of the women physiologically potentially capable of reproducing in 1930 actually reproduced.* Put in another way, this result means that the females 15 to 49 years of age, after the liberal deduction for disabilities already noted, produced in 1930 on the average only about 0·1 of a birth apiece (living and still together, with the allowance added for unrecorded abortions). Now, as has been shown in Chapter II, the total duration of the physiologically possible reproductive life of the human female is about 31·2 years, as an average. So it follows that if each of the women 15–49 years of age were to reproduce annually for 31·2 years at the average rate exhibited by the whole group in 1930, she would produce, as an average, in her whole reproductive life $31{\cdot}2 \times 0{\cdot}1 = 3{\cdot}1$ births in total.

3. *Infra-human Animal Reproductivity*

What impresses a biologist most strongly about this figure is its marked contrast to the conditions that prevail amongst organisms lower in the evolutionary scale than man. While it is not possible, because of considerations of space, to set forth here equivalent data for lower forms in any great detail, a few examples may be given. First consider the rat, by no means the most luxuriant reproducer even among mammals. The following figures are compiled from data published by King (24), and in each case cover the whole lifetime of the mothers.

Strain	*Mean no. of offspring produced per mother*	
Piebald (black-hooded) females ($N = 51$) .	55·8	(p. 349)
Extracted Norway females ($N = 50$) . .	34·8	(p. 347)
Stock albino females ($N = 148$) . . .	33·7	(p. 340)
Extracted albino females ($N = 57$) . .	28·0	(p. 346)
Norway females ($N = 88$).	21·2	(p. 343)

Evidently the poorest sort of reproductive performance in the rat is many times better than that exhibited by human females, even though allowance is made for the fact that no physiologically sterile rats enter into the averages.

Drosophila is a more prolific breeder than any mammal. How much so is evidenced by the following figures quoted from Alpatov (32, p. 95) regarding total egg production throughout the lifetime of the fly:

Group	*Mean no. of eggs produced per female*
Wild (reared at 19° C.; imaginal life at 25°) ($N = 37$)	941·1 ± 35·9 eggs
Wild (reared at room temp.; imaginal life at 30°) ($N = 26$)	713·8 ± 40·3 eggs
Vestigial (reared at room temp.; imaginal life at 30° C.) ($N = 35$)	432·6 ± 25·8 eggs
Wild (reared at 30° C.; imaginal life at 25°) ($N = 38$)	430·3 ± 33·4 eggs
Wild, underfed (reared at 30° C.; imaginal life at 25°) ($N = 27$)	315·4 ± 19·1 eggs

In round numbers these flies performed reproductively from one to three hundred times better than American females in 1930.

For the pond-snail *Lymnaea columella* Baily (31) gives data on 9 individuals observed from birth to death. Their average duration of life was 111·1 days, and the average total number of eggs produced in their lifetimes was 390·9. Winsor and Winsor (35) reported much more extensive data on the same species bearing the same general import, but including some much higher fecundity records. For example, 4 snails under certain specified conditions as to density of population produced in their lifetimes an average of 1,840 eggs apiece; another group of 5 of different parentage but the same density conditions produced 1,681 eggs apiece, on the average; still another group of different parentage and different density conditions, including 9 individuals, produced an average of 1,249 eggs apiece in their total lifetimes.

It is evident that mankind, as a species, is not only a slow but also an indifferent producer. He facultatively alters the expression of the fundamental biological drive or urge to reproduction that is a part of his being and that he shares in common with all other living things. Practically every year's birth statistics show examples of women who in a total reproductive span of about 30 years produce 24 or more births. This is not 'indifferent' reproduction, considering the rigid limitations of the human reproductive mechanism with its long period of gestation, and considering in due biological perspective the length of man's life-span. Such cases demonstrate the maximum physiological possibilities of the human reproductive machinery. But such women are extremely few in number. The vast majority are different. Individually, and racially, there appears to be, under present social and other environmental conditions, a slow but definite progressive trend towards less and less human reproduction, probably without any great lessening of human sexual activity. It seems probable that, while only about 10 per cent. of the women theoretically potentially capable of reproduction in 1930 actually reproduced, at least 70 to 75 per cent. of them were sexually active in greater or less degree in that year. Certainly the 63 per cent. married were, and so also were a lot of the single, widowed, and divorced, realistically considered. Here lies the fundamental biological contrast between man and the lower forms. When the latter are sexually active reproduction inevitably follows, generally speaking; whereas in the human species, for a variety of reasons, including contraception, partial or complete sterility, and sundry others, a vast amount of human sexual activity has no other result than sensual satisfaction.

It may perhaps be urged that the discussion so far is quite unfair on the ground that it should have been restricted to married women. Too much weight should not be attached to this point, however, since the whole discussion is professedly and of set purpose only *biological* in its viewpoint. Marriage is a legal and religious institution, not fundamentally a biological one. By and large there is no biological reason why the unmarried women in the total group under discussion should not have been married, mating and reproducing. In other words, this restriction on their reproduction is not biological in character. Nor, for that matter, and in the same sense, is contraception. There is no law, natural or political, that compels people to practise birth-control if they do not want to.

In short, all that has been attempted so far is an objectively realistic examination of the performance of a substantial sample of human females as reproducing animals, in comparison with the performance of other animals lower in the evolutionary scale. The examination of human reproductive performance covers one year only, but, except for secular trends, any other recent year would show essentially the same result.

4. *Nativity, Race (Colour), and Age Patterns*

So far the discussion has been of the females biologically potentially capable of reproduction as a whole group. It is desirable now to examine separately into certain sub-classes, of biological and sociological interest, and their mutual interrelations. To make this possible entailed some complications and difficulties because, in the first place, Texas and South Dakota had to be deleted from the total figures in each instance, and also because the colour (race) classifications of the data used by the Census Bureau in compiling birth figures in 1930 were not completely consilient with those used in enumerating the population. The birth statistics do not separate Negroes as such, but throw them into a general category, 'Coloured'. The population figures separate Negroes as a class and have another rubric, 'Other Races', which includes Mexicans, Indians, Chinese, Japanese, Filipinos, Hindus, Koreans, Hawaiians, Malays, Siamese, and Samoans.

The discussion which follows relates to *live births* only.

First, tables were set up (see Pearl, 36, pp. 515–16) giving the absolute numbers of (*a*) live births in the Birth Registration Area in 1930 to women aged 15 to 49 years, inclusive, and (*b*) the total number of women falling within the same age limits, enumerated in the same area in the census of 1930, the totals in both cases being divided into sub-classes as to age in five-year classes and nativity–racial (colour) origin. From these tables were then computed the percentage tables shown here as Tables 16 and 17. The method of derivation of these tables will be made clear by specific examples. The upper left-hand corner cell of Table 16 contains the percentage 9·34. This means that 9·34 per cent. of all the fully recorded live births of 1930 to women aged 15–49 (there have been all told 2,173,415 such births) were to native white women aged 15–19, inclusive (there having been 203,069 births to such women). The percentage of 14·99 in the upper left-hand corner cell of Table 17 means that of the 30,871,292 women aged 15–49, inclusive, just under 15 per cent. were native whites aged 15–19, inclusive.

Some of the data of Tables 16 and 17 are shown graphically in Figs. 13 and 14.

It is seen that more than three-quarters of all the births were to native white mothers. Also more than three-quarters of all the women who potentially might have been mothers were native whites. Of the remaining births 11·5 per cent. were to coloured mothers, who were nearly all Negroes. Of the potential mothers (all women between 15 and 49 years of age, inclusive) 10·33 per cent. were Negroes and less than 1 per cent. of 'Other Races', most of whose live births, in so far as they had them, were probably recorded in the 'coloured' birth category. The sum of the percentages of potential mothers in these two race (colour) categories (10·33+0·87) is 11·20, a figure again in very close agreement with the percentage of coloured live births (11·50). The residue of births and potential mothers were in the foreign-born white class. The potential mothers in this class constituted 12·10 per cent. of all potential mothers, and the actual mothers in the class produced 12·01 per cent. of all the live births of the year.

Taken as a whole picture, the closeness of agreement in 1930 between the percentages of live births and of potential mothers by nativity–race (colour) classes is extraordinary. The numbers of actual mothers of the year in the several nativity–race (colour) classes were just about as closely as possible proportionate to the numbers of potential mothers

TABLE 16

Percentage distribution of live births in 1930, born to mothers aged 15–49 years, inclusive, in the U.S. Birth Registration Area (percentages less than 0·01 omitted)

Age of mothers	*Native white mothers*	*Foreign-born white mothers*	*White mothers of unrecorded nativity*	*Coloured mothers*	*Totals*
15–19	9·34	0·40	0·01	2·54	12·29
20–24	23·95	2·30	0·02	3·64	29·90
25–29	19·58	3·30	0·01	2·40	25·29
30–34	13·02	2·87	0·01	1·52	17·41
35–39	7·81	2·22	0·01	1·04	11·08
40–44	2·52	0·84	. .	0·32	3·68
45–49	0·22	0·08	. .	0·05	0·35
Totals	76·43	12·01	0·06	11·50	100·00

TABLE 17

Percentage distribution of females, aged 15–49 years, inclusive, in the United States (less Texas and South Dakota) in 1930

Age	*Native whites*	*Foreign-born whites*	*Negro*	*Other races*	*Totals*
15–19	14·99	0·54	1·96	0·17	17·67
20–24	13·68	1·10	1·95	0·16	16·88
25–29	11·71	1·63	1·71	0·15	15·20
30–34	10·61	1·92	1·34	0·13	14·00
35–39	10·07	2·38	1·39	0·12	13·95
40–44	8·41	2·35	1·05	0·08	11·89
45–49	7·23	2·19	0·93	0·07	10·41
Totals	76·70	12·10	10·33	0·87	100·00

It will be noted that in Tables 16 and 17 the totals of the rows and columns do not always check in the last decimal place with the sums of the entries in the cells of the body of the tables. The discrepancies arise from the fact that the percentages in the marginal rows were computed from the absolute frequencies. Both marginal and cell percentages are correct *to the stated number of decimal places*, though paradoxically the cell percentages do not always add to the marginal totals.

from whom they were drawn. *Each nativity–race (colour) class, whether native white, foreign-born white, Negro, or other was as a whole group reproducing in 1930 proportionately*

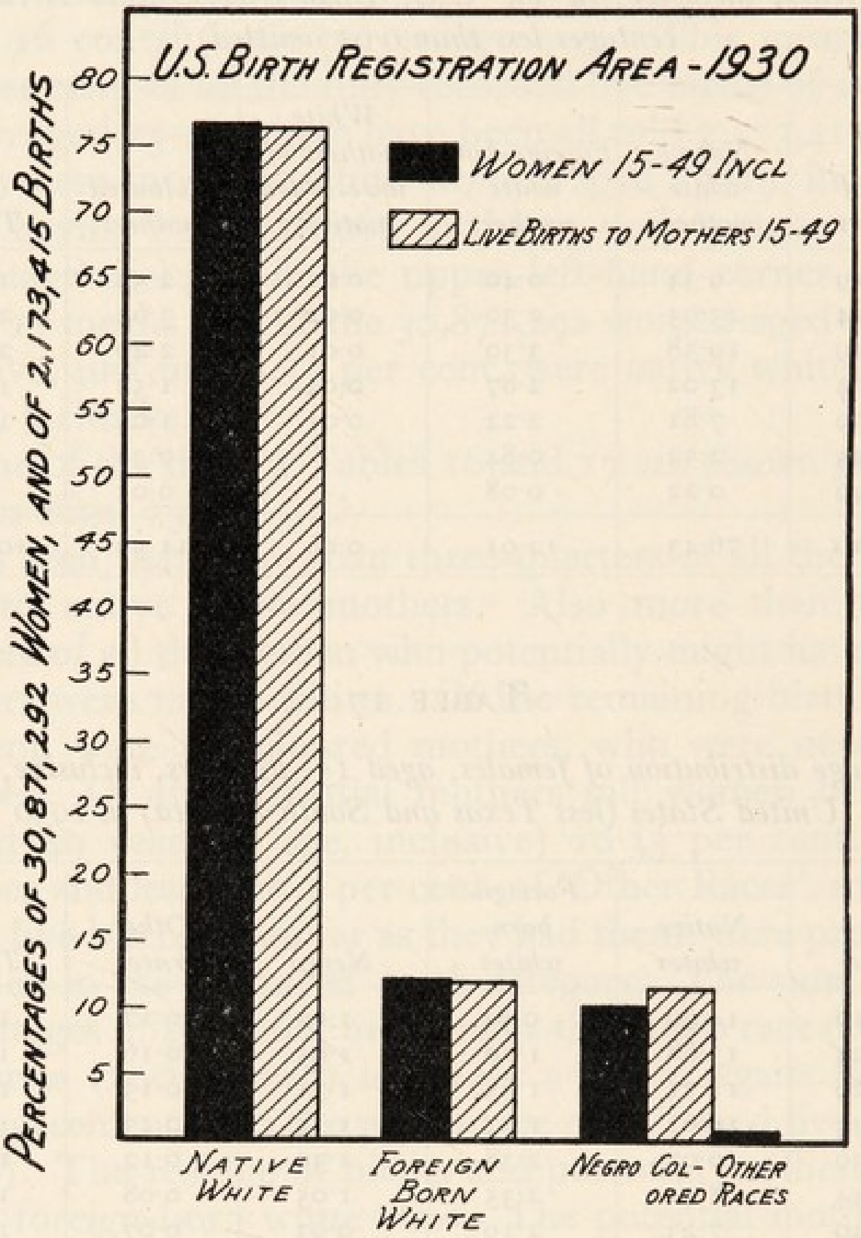


FIG. 13. The relationship between women aged 15–49 years, inclusive (solid bars), and live births to women within the same age limits (cross-hatched bars) in 1930, by nativity and race.

to its representation in the population, with a near approach to exact precision. Any idea that foreign-born women as a group in the whole United States population are at the present time out-breeding their native-born sisters—a notion of rather widespread journalistic prevalence at least —finds no vestige of support from the actual facts of 1930.

This equality in relative total breeding performance between foreign-born and native white women as groups, is, however, in part a consequence of a distorted age distribution of the former group.

Mothers falling in ages between 20 and 34 years, inclusive, produced 72·6 per cent. of all the live births in 1930, and

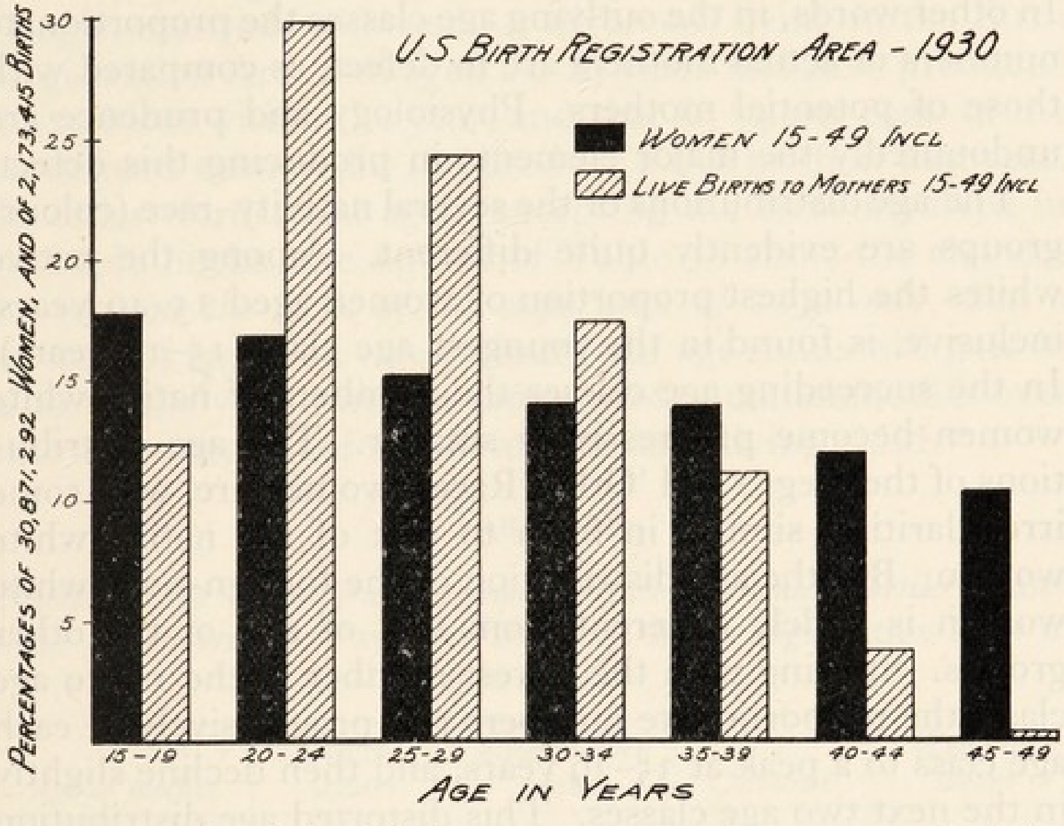


FIG. 14. The relationship between women aged 15–49 years, inclusive (solid bars), and live births to women within the same age limits (cross-hatched bars) in 1930, by age.

native white mothers within the same age limits produced over half (56·55 per cent.) of all the live births. But of all the potential mothers only 46·08 per cent. fell within the age limits 20–34, while the native white potential mothers within the same age limits constituted but 36 per cent. of all potential mothers. It is thus evident that the women between 20 and 34 years of age were contributing to the live births of the year considerably in excess of their proportionate representation in the population. This excess is greatest in the age period 20–24 years. It is in that quinquennium that American women, taken as a whole group, exhibit the highest tide of their reproductive activities. It is in these 15 years of life between 20 and 34 that the largest proportion of women permit themselves to be transposed from the category of potential to actual mothers.

In no other age class outside of the limits 20 and 34, either earlier or later, are the percentages of live births as great as the corresponding percentages of potential mothers. In other words, in the outlying age classes the proportionate numbers of actual mothers are in defect, as compared with those of potential mothers. Physiology and prudence are undoubtedly the major elements in producing this defect.

The age distributions of the several nativity–race (colour) groups are evidently quite different. Among the native whites the highest proportion of women aged 15–49 years, inclusive, is found in the youngest age class (15–19 years). In the succeeding age classes the numbers of native white women become progressively smaller. The age distributions of the Negro and 'Other Races' women are, with some irregularities, similar in form to that of the native white women. But the age distribution of the foreign-born white women is widely different from that of any of the other groups. Starting with the lowest number in the 15–19 age class, the proportionate numbers rise progressively in each age class to a peak at 35–39 years, and then decline slightly in the next two age classes. This distorted age distribution curve for the group of foreign-born white women is presumably a consequence of the operation of the restrictive features of the present immigration law.

Each of the contour surfaces defined in Tables 16 and 17 is self-contained and independent—that is, relates exclusively to its own defined universe of discourse. They have not so far been numerically interrelated to each other. What is now wanted to complete the picture is a *nativity–race (colour)–age contour surface of fertility* (or expressed reproductivity). That is provided in Table 18.

The manner of construction of Table 18 and its meaning will be made clear by the following description. Using a single cell, to make the description precise and concrete, in 1930 in the Registration Area there were 71,619 live births to foreign-born white mothers aged 25–29 years inclusive, and there were in the same area and year 502,264 foreign-born white women in total. 71,619 × 100/502,264 = 14·26 per cent., the figure entered in the corresponding cell of Table 18. This means that in 1930—neglecting the slight error consequent upon the occurrence of multiple births—14·26 per cent. of all the foreign-born white women (single, married, widowed, or divorced) living in the Birth Registration Area and aged 25–29 years inclusive produced a live birth within the year, and that 85·74 per cent. of the so-defined women did not produce a live birth in that year. In other words, and again excepting the error involved in multiple births, the figures of Table 18 show the chances in 100, *on the basis of the experience of 1930 only*, that a woman of specified race (colour) and age status will pass in a particular year from the category of potential mother over into the category of actual mother of a living child.[29]

TABLE 18

Nativity-race (colour)-age contour surface of female fertility based upon the experience of 1930 in the U.S. Birth Registration Area as then defined

Age of mother	*Native whites*	*Foreign-born whites*	*Coloured*	*Weighted means*
15–19	4·39	5·19	8·37	4·89
20–24	12·33	14·67	12·19	12·46
25–29	11·77	14·26	9·07	11·70
30–34	8·64	10·53	7·26	8·75
35–39	5·46	6·59	4·89	5·59
40–44	2·11	2·53	1·97	2·18
45–49	0·21	0·27	0·35	0·24
Weighted means	7·02	6·99	7·23	7·04

The significance of the figures of Table 18 having been made clear, the results worthy of note may be discussed. Taking the women of all ages from 15 to 49 inclusive as whole groups it appears that there is no substantial difference in weighted mean group reproductivity rate between native white, foreign-born white, and coloured groups. On the average about 7 per cent. of the potential mothers in each of these groups became actual mothers of live babies in 1930. But while the differences between the nativity–race (colour) groups as wholes in mean relative fertility are absolutely too small to be of any practical importance, some of them are statistically significant in comparison with their probable errors. This is not the case for the native and foreign-born white groups, where the difference is $7{\cdot}02 - 6{\cdot}99 = 0{\cdot}03 \pm 0{\cdot}01$, which can hardly be regarded as certainly statistically significant. Taking the figures at their face value, however, the weighted mean relative fertility of the coloured group as a whole is significantly higher than that of either the native or the foreign-born white group, the differences being respectively $7{\cdot}23 - 7{\cdot}02 = 0{\cdot}21 \pm 0{\cdot}01$ and $7{\cdot}23 - 6{\cdot}99 = 0{\cdot}24 \pm 0{\cdot}01$. Both these differences are more than 20 times their probable errors. But one feels that the point is really academic, because it still remains the fact that these differences in means are too small to be of any particular importance, and furthermore the figure for the coloured suffers from an intrinsic disability that cannot be precisely resolved, as has been noted above. The really impressive fact appears to be that these nativity–race (colour) whole group weighted mean relative fertilities turn out so nearly alike as they do.

An interesting statistical paradox is presented by the fact that while the age specific relative live-birth fertilities of the foreign-born whites are, for every single age group from 15–19 years through 45–49 years, higher when taken separately than those for native whites, the mean relative fertility of the foreign-born whites as a whole group is slightly lower than that of the native whites as a whole group. The explanation is found, of course, in the distorted age distribution of the foreign-born white potential mothers, and, in consequence, of the foreign-born white actual mothers.

A similar though less marked paradox is found in the comparison of the total group and age specific relative fertilities of coloured and both sorts of white groups. In only two age periods (15–19 years and 45–49 years) are the age specific relative fertilities of the coloured greater than those of the whites. Yet as a whole group the coloured exhibit a significantly higher weighted mean relative fertility than that of either white group. This, again, is in part a consequence of peculiarities in age distribution.

In 1930 the conversion of potential capacity for motherhood into actual motherhood reached its highest peak among the foreign-born white women aged 20–24 years. For all three nativity–race (colour) groups it is in this age period that relative fertility is highest. The much higher relative fertility of the coloured group in the youngest age period (15–19 years) is noteworthy. The excess reproductive performance of the coloured in this age period over both white groups is, of course, certainly significant statistically. The difference between coloured and foreign-born whites is $8{\cdot}37 - 5{\cdot}19 = 3{\cdot}18 \pm 0{\cdot}44$ or more than 7 times its probable error. The difference between coloured and native white groups in this period is still larger, and its probable error smaller.

We have seen that the white and the coloured women in the United States potentially capable of reproduction were reproducing in 1930 as whole groups in almost exact proportion to their representation in the population. Also their weighted mean relative fertilities, on a live-birth basis, were, for the groups as wholes, nearly equal. These facts present a pretty set of logical difficulties when they are considered relative to the practice of birth-control in the population. Consider first native white and coloured groups. The evidence from general experience and observations, as well as from specific investigations (Pearl, 36) to be discussed in some detail in a later chapter of this book, is that Negroes attempt contraception much less frequently, and are less efficient about it when they do, than whites in the American population and especially native whites. Yet, as Table 18 shows, as a group, with a not seriously different age distribution, the coloured women exhibit a weighted mean live-birth fertility that is only a little higher than that of the native whites. Furthermore, rather precise and trustworthy evidence already discussed in Chapter I indicates that in the complete absence of contraceptive effort and of diseases of reproductive organs, the net natural fertilities of whites and Negroes are substantially identical age for age. Now, actually, the coloured group in the present material, between the ages of 20 and 44 inclusive, shows lower age specific live-birth fertilities than the native whites (Table 18) in spite of the fact that birth-control is practised far less.[30] Perhaps the greater prevalence of venereal disease in the Negro population—an undoubted fact—is the explanation. But also it is just barely possible that in numerically large population groups, as these under discussion are, birth control in either whites or coloured may not be playing as important a role in determining the general levels of expressed fertilities as it is currently supposed to be. Perhaps other fundamental biological factors are equally or more important. Relative frequency of marriage will not greatly help here in endeavouring to solve the riddle, because the Negroes are not so much hampered in reproductive activities by pre- or extra-marital taboos as the native whites. The problem is, in the present status of available data, insoluble at this time. But the logical dilemma is clear. Two large groups of women, both potentially capable of reproduction, and both having substantially the same sort of age distribution, exhibit as whole groups about the same mean relative fertility, yet one practises birth-control very much more, and more effectively, than the other.

Consider next the native and foreign-born white groups relative to contraception. It has already been pointed out that one of the chief reasons why they show, as whole groups, about the same mean relative fertility is found in the distorted age distribution of the foreign-born women. So that need not be discussed further. Presumably, on currently prevalent views among population students, all or nearly all the superiority of the foreign-born in age specific fertilities over the native shown in Table 18 is to be explained by less contraceptive effort among the foreign-born women. Undoubtedly there is less, and what there is is probably less effective. Accepting this temporarily as a fact, for the sake of the argument, the differences between the two sets of age specific fertilities should then theoretically be a rough measure of the net effectiveness of the more prevalent and better contraception of the native whites. Let us examine the figures. To facilitate the examination and comparison we define:

Percentage A = [Native white age specific fertility (Table 18)] × 100/Foreign-born white age specific fertility (Table 18).

Percentage B[31] = [Age specific median pregnancy rate of white women practising contraception most intelligently] × 100/Age specific median pregnancy rate of white non-contraceptors.

Percentage C[31] = [Age specific median pregnancy rate of white women practising contraception most intelligently] × 100/Age specific median pregnancy rate of white women practising contraception least intelligently.

We then have:

<table>
<tr><th>Age class</th><th>15–19</th><th>20–24</th><th>25–29</th><th>30–34</th><th>35–39</th><th>40–44</th><th>45–49</th></tr>
<tr><td>Percentage A</td><td>84·6</td><td>84·0</td><td>82·5</td><td>82·0</td><td>82·9</td><td>83·4</td><td>77·8</td></tr>
<tr><td>Percentage B</td><td>11·3</td><td>35·7</td><td>51·7</td><td>72·9</td><td>88·7</td><td colspan="2">103·2</td></tr>
<tr><td>Percentage C</td><td>19·5</td><td>49·8</td><td>69·3</td><td>92·6</td><td>125·4</td><td colspan="2">82·4</td></tr>
</table>

It seems at once evident from these figures that the differences in age specific fertilities between the native and foreign-born whites of Table 18 (Percentage A) are not at all of the sort known to be associated with differences in amount and effectiveness of contraceptive effort in more precisely controlled and thoroughly studied samples of American women (Percentages B and C). The relative differences in fertility between the native and foreign-born white groups of the present discussion (Percentage A) are substantially constant for all age periods during reproductive life. But where the differences in expressed fertility are known to be associated primarily with differences in contraceptive practice (Percentages B and C) they are greatest at the lowest ages, and decrease steadily with advancing age. This suggests that the native–foreign-born fertility differentials of the present material may be in some really substantial part due to some other factor (genetic or environmental or a combination of both) than contraception.

This factor may conceivably be racial, though one inclines to doubt it, except possibly in a comparatively small degree quantitatively. Again we are confronted with a puzzle that cannot be solved with the information at present available. But judgement may well be reserved until the results set forth in Chapter V *infra* have been examined.

5. *The Secular Trend in Actual versus Potential Reproductivity*

How has this matter of actual reproductive performance as compared with theoretical biological potentiality been trending in the recent past? A direct comparison of the 1930 results just discussed with an earlier period is not possible, because the Birth Registration Area in 1920 was much smaller than in 1930, and in 1910 there was no Birth Registration Area at all in the United States. What we have therefore been compelled to do is to compare the situation as it existed in 1920 in the Birth Registration Area as then constituted, with the situation in the same group of states in 1930. That is to say, we have set up for 1930 an area identical with that which was in fact the Birth Registration Area in 1920. This area included the following states: Connecticut, Massachusetts, Michigan, Minnesota, New Hampshire, New York, Pennsylvania, Vermont, District of Columbia, Maryland, Indiana, Kansas, Kentucky, North Carolina, Ohio, Utah, Virginia, Washington, Wisconsin, California, Oregon, South Carolina, and Nebraska.

In these states there were in 1920 approximately 16·27 million women aged 15–49 years inclusive, and they produced in that year some 1·48 million live births, in round numbers. Ten years later, in 1930, the number of women 15–49 had increased to 19·43 millions approximately, the increase of 3·16 millions in round numbers being 19·4 per cent. These women produced in 1930 a total of 1·36 million live births. The expected increase in live births in 1930 over 1920 for these states, since the number of potential mothers had increased by 3·16 millions, turned out to be not an increase at all but a decrease. Actually in these states 125,091 *fewer* babies were born alive in 1930 than had been in 1920. So the reasonably to be expected increase of 19·4 per cent., on the assumption that the women of 1930 went about their reproducing as effectively as the corresponding cohort of women in 1920 did, was turned into a deficit of 8·4 per cent. This state of affairs was partly due to a change in the age distribution of the respective cohorts of potential mothers. In 1920 50·09 per cent. of the 15–49 year-old cohort fell within the age period 15–29, the years when reproductivity is highest. But in 1930 the percentage of women in the 15–49 cohort who fell in age between 15 and 29 had dropped to 48·74. This circumstance clearly might reasonably be held responsible for some of the observed decrease in reproductivity in 1930. But it is evident that the shift in age distribution was not great enough to account for more than a small part of the drop in expressed fertility.

The decline in manifested fertility in these states between 1920 and 1930 was relatively great, as can be indicated in another way. If the 19·43 million women of ages 15–49 years, inclusive, of 1930 had performed reproductively just exactly as well as the 1920 cohort of potential mothers actually did—no better or no worse—there would have been expected 1,772,173 live births in 1930. Actually there were 1,359,222. So then the real fertility loss was of some 412,951 potential living births that did not occur. The small shift in age distribution of the cohort of potential mothers of 1930 as compared with 1920 cannot possibly account for more than a small part of so major a deficiency as this.

There is another respect in which the 1930 reproductive performance differed strikingly from that of 1920. It will be recalled that in the preceding section it was shown that in the United States as a whole (with Texas and South Dakota alone omitted) each nativity–race (colour) group reproduced in 1930 in virtually identical proportion to the representation of potential mothers aged 15–49 years in the population. In 1920, as judged by the areas that can be compared, this was not so. The differences in this respect are portrayed graphically in Fig. 15.

From Fig. 15 it is seen that in 1930 in the defined area the several nativity–race (colour) groups were reproducing in almost exact proportion to their representation by potential mothers in the population, as was earlier shown to be the case for the country as a whole. But in 1920 the native white potential mothers were producing proportionately *fewer* live births than their representation in the population, while the foreign-born white and coloured groups were producing proportionally *more* live births than their population representation. The difference was considerable for the foreign-born whites, but small for the coloured group. There is to be seen here one broad demographic result of the operation of the present immigration law. It is clearly producing one of its intended effects, namely to raise the proportion of native-born whites in the United States population.

With this broad view of the change in manifested fertility between 1920 and 1930 the stage is set for a more detailed analysis. To that end Table 19 is presented. This table corresponds in its structure and method of computation to Table 18 discussed in the preceding section. That table gave the distribution of female fertility in 1930 by nativity, race, and age for the whole Birth Registration Area for 1930. Table 19 gives the corresponding distributions for an aggregate of 23 states in 1920 and the same states in 1930.

It is evident from Table 19 that the decline in fertility between 1920 and 1930 in this huge population aggregate was sweeping in its incidence. Every age period and all of the nativity–race (colour) groups shared in it—some more and some less, but all were involved. The secular change was smaller in the native white group than in any other. While in the aggregate 8·42 per cent. of the 15–49 year-old cohort of native white women produced live births in 1920, only 6·94 per cent. of the corresponding 1930 cohort did. This is a relative drop of 18 points, taking the 1920 performance as 100. The decline was greater in the coloured group (largely Negro). There, in the aggregate, 9·91 per cent. of the 1920 cohort produced live births in the year,

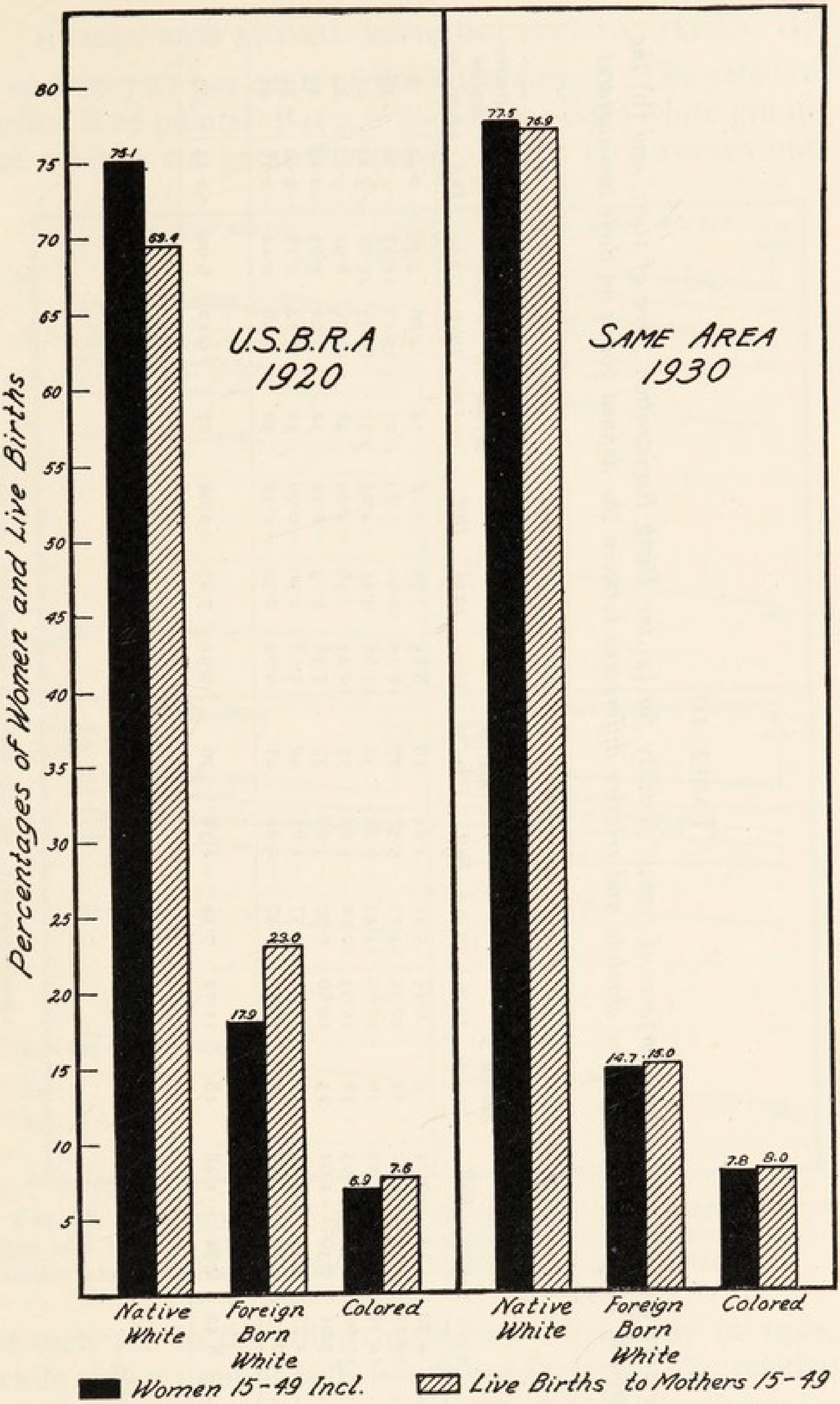


FIG. 15. The relationship between women aged 15–49 years, inclusive (solid bars), and live births to women within the same age limits (cross-hatched bars) in 1920 and 1930, for the same area in each of these years, by nativity and race.

TABLE 19

Nativity–race (colour)–age contour surfaces of female fertility for (a) *the Birth Registration Area of 1920, and* (b) *the same area in 1930; together with the absolute and relative differences between the defined points on these two surfaces*

Age of mother	Native whites				Foreign-born whites				Coloured				Weighted means			
	1920	1930	Diff.	Relative decline '20–'30	1920	1930	Diff.	Relative decline '20–'30	1920	1930	Diff.	Relative decline '20–'30	1920	1930	Diff.	Relative decline '20–'30
15–19 .	4·36	4·12	−0·24	6	6·45	5·21	−1·24	19	8·85	7·75	−1·10	12	4·86	4·46	−0·40	8
20–24 .	14·25	12·23	−2·02	14	20·35	14·77	−5·58	27	16·29	12·60	−3·69	23	15·17	12·47	−2·70	18
25–29 .	14·12	11·89	−2·23	16	20·60	14·42	−6·18	30	13·68	9·45	−4·23	31	15·25	12·01	−3·24	21
30–34 .	10·60	8·67	−1·93	18	15·93	10·70	−5·23	33	10·45	7·56	−2·89	28	11·74	8·92	−2·82	24
35–39 .	7·01	5·39	−1·62	23	10·66	6·70	−3·96	37	7·58	5·13	−2·45	32	7·92	5·63	−2·29	29
40–44 .	2·77	2·05	−0·72	26	4·22	2·57	−1·65	40	3·08	2·09	−0·99	32	3·14	2·18	−0·96	31
45–49 .	0·25	0·20	−0·05	20	0·51	0·27	−0·24	47	0·64	0·32	−0·32	50	0·38	0·22	−0·16	42
Weighted means .	8·42	6·94	−1·48	18	11·72	7·14	−4·58	39	9·91	7·27	−2·64	27	9·12	6·99	−2·13	23

as against 7·27 per cent. of the 1930 cohort. The relative decline is 27 points. But it is the foreign-born white group that exhibits the greatest change. There 11·7 women out

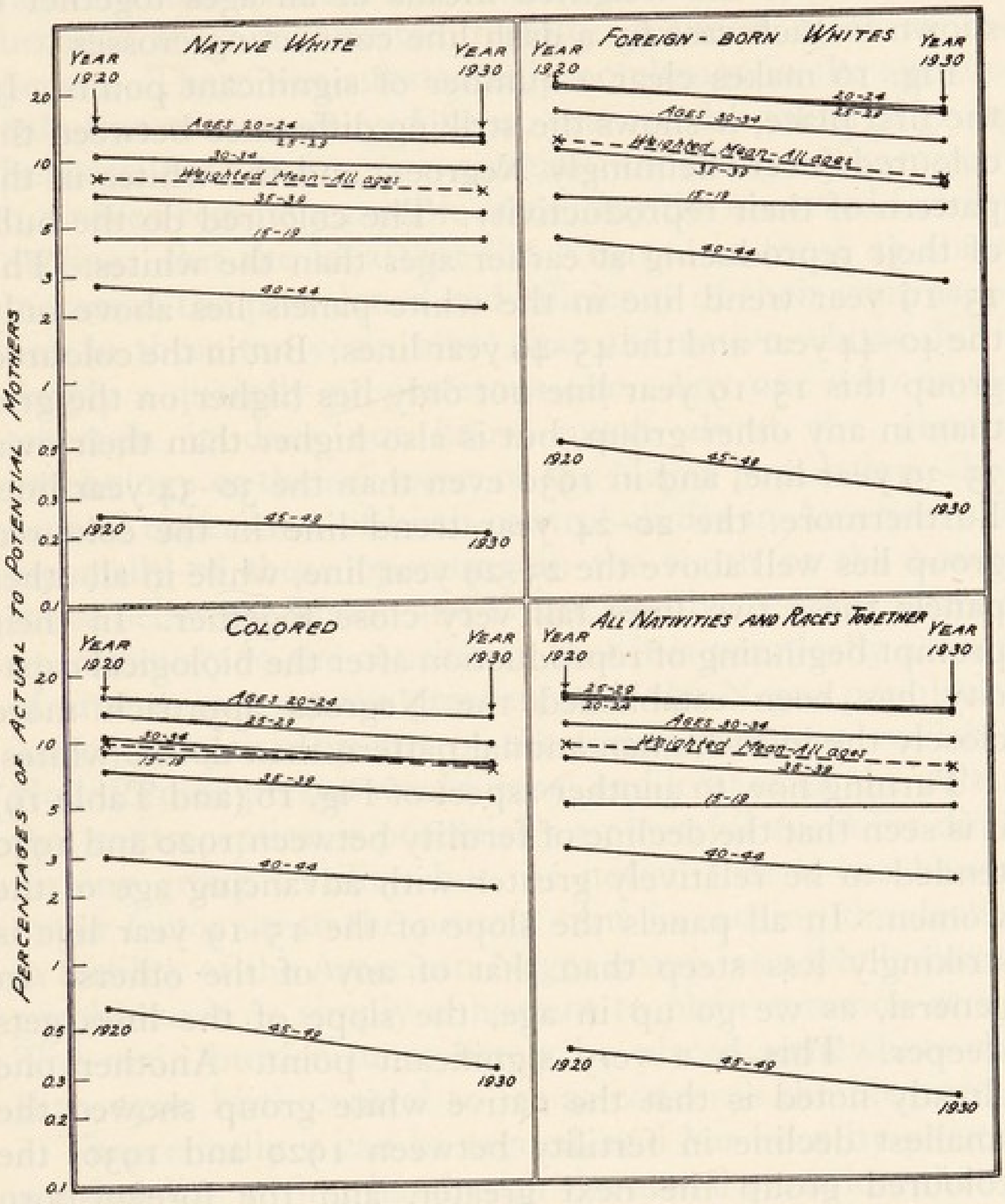


FIG. 16. The trend of fertility in 23 states in the United States between 1920 and 1930, as indicated by the percentages of potential mothers who became actual mothers in those years. Further explanation in text.

of each 100 in the cohort produced a live baby in 1920, while only 7·1 out of each 100 did so in 1930. The relative fertility decline on a 100 point scale was 39.

These fertility declines are shown graphically in all their details in Fig. 16. This diagram is plotted to an arithlog grid, so that the slopes of the lines may throughout be validly comparable visually. The trends of the separate age groups are shown as solid lines connecting solid circles. The trend of the weighted means of all ages together is shown in each case by a dash line connecting crosses.

Fig. 16 makes clear a number of significant points. In the first place, it shows the striking difference between the coloured (overwhelmingly Negroes) and the whites in the pattern of their reproductivity. The coloured do the bulk of their reproducing at earlier ages than the whites. The 15–19 year trend line in the white panels lies above only the 40–44 year and the 45–49 year lines. But in the coloured group this 15–19 year line not only lies higher on the grid than in any other group, but is also higher than their own 35–39 year line, and in 1930 even than the 30–34 year line. Furthermore, the 20–24 year trend line in the coloured group lies well above the 25–29 year line, while in all other panels these two lines fall very close together. In their prompt beginning of reproduction after the biological capacity has been established the Negroes approach more closely the infra-human animal pattern than do the whites.

Turning now to another aspect of Fig. 16 (and Table 19) it is seen that the decline of fertility between 1920 and 1930 tended to be relatively greater with advancing age of the women. In all panels the slope of the 15–19 year line is strikingly less steep than that of any of the others. In general, as we go up in age, the slope of the lines gets steeper. This is a very significant point. Another one already noted is that the native white group showed the smallest decline in fertility between 1920 and 1930, the coloured group the next greater, and the foreign-born white the greatest.

Now these two broad results, taken together, present interesting material for thought in connexion with the basic problem of the statistical effect of contraceptive efforts, as actually made, upon general population trends. If it be assumed, as it often is, that contraception is the major cause, if not the sole significant one, in producing the observed decline in fertility it logically is suggested from the data of Table 19 that the coloured women in this rather huge sample that we are dealing with practised contraception more, and more effectively than did the native whites in the United States between 1920 and 1930, because their manifested fertility declined more in the period. There was substantially no change in the age distribution of women aged 15–49 years in the coloured group between 1920 and 1930—certainly no change of a magnitude even remotely capable of causing the observed fertility decline. But the idea that the Negroes in these 23 states increased the prevalence and efficiency of their contraception in these ten years more than the native whites did is simply a quaintly preposterous one. Any one who would entertain it does not know much about the general psychology or the sex *mores* of the Negro population. The general experience of birth-control clinics in America, and especially of those operating in the south or the border states below the Mason and Dixon line, has led them almost unanimously to the conclusion that it is practically a waste of time to instruct the great mass of the Negro population in contraception by any of the techniques now available. No informed person would deny, and least of all the writer, that contraception is potentially a powerful agent for diminishing group fertility, but the notion that it has been a major factor up to the present time in causing the decline in fertility of the American Negro group, as a whole demographic unit, is simply abhorrent to plain common sense. The main burden must surely be placed somewhere else than upon birth control so far as concerns the Negroes.

Theoretically it can be argued, and has been by persons not familiar at first hand with the actual situation, that in 1920 the native whites under discussion were already familiar with and to some extent actively employing contraceptive techniques (which was true) while the Negroes as a group in 1920 were not using contraceptive techniques to any appreciable extent (which again was true). These persons then argue that because of these facts the native whites in 1920 were relatively farther along on their declining slope of fertility than the Negroes were on theirs.

It is then further argued that even a small increase in contraceptive effort and efficiency on the part of the Negroes between 1920 and 1930 would be expected to produce a greater decline in their expressed fertility than would a larger increase in contraceptive effort and efficiency on the part of the native whites upon their (the whites') fertility. Due consideration must, of course, be given to this argument, but it would be a mistake to give too much weight to it. As will be shown in Chapter IV *infra* (Table 32) in 1931 and 1932, in a substantial sample of urban Negroes (who are on the whole admittedly the most advanced portion of their race socially and educationally) only 17 per cent. were making any contraceptive effort at all, as against 45·9 per cent. of urban whites. Furthermore, the contraceptive efforts actually made by the Negroes were, on the evidence (Pearl 36), far less physiologically effective than those of the whites. If one considers the whole Negro group (urban and rural together), as do Table 19 and Fig. 16, it is at the best difficult, and to the writer wholly impossible, to believe that such small increase in contraceptive effort among the Negroes as may have occurred between 1920 and 1930 can have caused absolutely and relatively greater declines in expressed fertility in that group than appeared in the same time interval in the native white group.

Consider next the following facts. In all of the panels (groups) of Fig. 16 the 15–19 year age group showed the smallest decline between 1920 and 1930, and the 40–44 year and 45–49 year age groups the greatest declines. Now, on the prevailing assumption that contraception is the major factor involved, can it be justly supposed that in these years the women aged 40 and over increased the relative prevalence and efficiency of their contraceptive efforts from *two to four times more* than did the young things aged 15–19 years, just starting in upon the pleasant but hazardous business of practical sexuality? I do not think so. This is an expression of opinion only, and to be understood as such. Because of lack of data it is impossible to bring forward *statistical proof* that it is valid. But I venture to express it because general observation, experience, and study of relevant facts, even though they are not capable of precise statistical formulation, convinces me that it is sound. In part this opinion is based upon the sort of information contained in such works as those of Bromley and Britten (38) and of Yule (20).

6. *First Births*

Useful information as to patterns of reproductivity may be derived in other ways than those so far considered, and to some of these we may now turn.

In the course of an investigation of the parity order of births[32] (Pearl, 37) particular attention was paid to first births. Other factors being equal, it is generally true for a given population and time that a declining crude birth-rate has associated with it an increase in the proportionate number of first births to all births. This relationship is to be expected in a population where the practice of contraception is prevalent and increasing, because under such conditions women tend after their first successful pregnancy either to have no more at all, or only after a greater lapse of time than would be the case if reproduction were wholly unrestricted. Such procedure naturally tends to weight the births of any particular year unduly heavily with first births.

In Fig. 17 are shown the percentages of living first births to all live births in 1930 by age, nativity, and race (colour).

The first thing that strikes the eye from the most cursory inspection of Fig. 17 is the regularity of the expected decline in the proportion of first births to all births with advancing age of the mothers. Obviously, practically all births to mothers aged 10–14 years must, in the nature of things, be first births. But in the next age period, 15–19, the percentage of first births drops to about 80, and in the third age period, 20–24, generally fewer than a half of the women bearing offspring in 1930 were delivering their first products of conception.

It is evident from Fig. 17 that the curves for native and foreign-born white mothers are closely similar throughout their extent (except for the 50 and over age groups where the observations are necessarily very meagre). It is, however, somewhat unexpected to find at the height of the reproductive period (ages 20–24 and 25–29) that the curve for the foreign-born lies above that for the native women, indicating a higher proportion of first births. The curve for coloured first births (almost entirely Negro, of course) differs

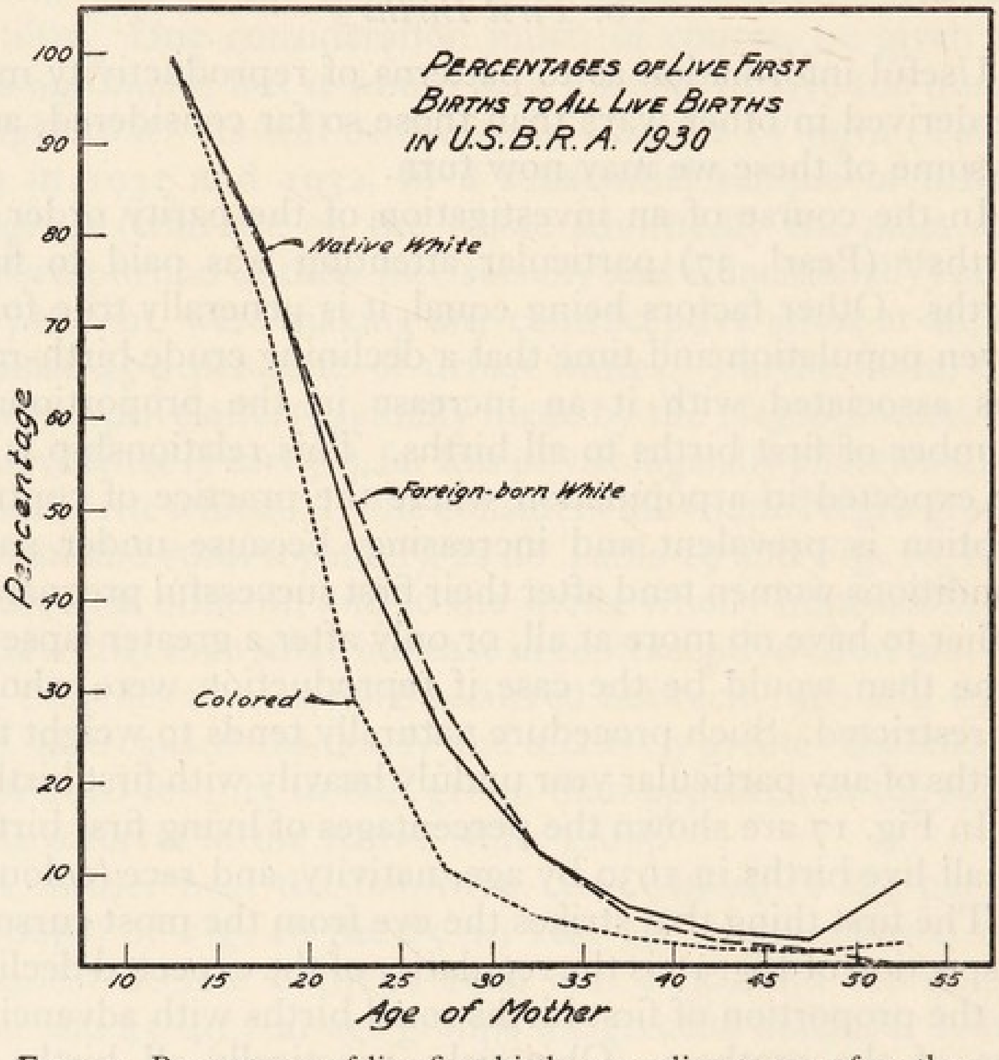


FIG. 17. Percentages of live first births according to age of mother.

considerably and systematically throughout its course from both of the white curves. The coloured women reproducing in 1930 exhibited generally a smaller proportion of first births than the whites, throughout the age range.

If we consider the proportion of first births to all births for mothers of all ages taken together some interesting and significant race (colour)–nativity differences appear. In general, the native white mothers exhibit a higher total proportion of first births than either the foreign-born white or the coloured mothers, and in turn the foreign-born white mothers a higher proportion than the coloured. The differences, with their probable errors, are shown in the following tabular arrangement.

Differences in percentages of first births

		Diff. ÷ P.E. Diff.
Native white live minus foreign-born white live	$(33 \cdot 38 - 24 \cdot 34) = 9 \cdot 04 \pm 0 \cdot 07$	129
Native white still minus foreign-born white still	$(40 \cdot 15 - 22 \cdot 93) = 17 \cdot 22 \pm 0 \cdot 39$	44
Native white live minus coloured live	$(33 \cdot 38 - 28 \cdot 98) = 4 \cdot 40 \pm 0 \cdot 07$	63
Native white still minus coloured still	$(40 \cdot 15 - 31 \cdot 35) = 8 \cdot 80 \pm 0 \cdot 28$	31
Coloured live minus foreign-born white live	$(28 \cdot 98 - 24 \cdot 34) = 4 \cdot 64 \pm 0 \cdot 09$	52
Coloured still minus foreign-born white still	$(31 \cdot 35 - 22 \cdot 93) = 8 \cdot 42 \pm 0 \cdot 43$	20

There can be no doubt about the statistical significance of these differences. They are, in each case, many times larger than could reasonably be expected to arise from errors of sampling. The apparent paradox that while, as is shown clearly in Fig. 17, the curves for native and foreign-born white mothers are rather close together throughout their course, the foreign-born mothers as a whole group have 9 per cent. fewer live first births than the native mothers, is explained by the differential weighting consequent upon the distorted age distribution of foreign-born white females in 1930 already discussed in the preceding section.

In each age group, and in each nativity–race (colour) class, first still-births form a higher percentage of all still-births in the class than do first live births of all live births. This result would reasonably be expected because of the known greater difficulties and hazards of pregnancy and labour in the primipara as compared with the multipara. These reflect themselves in part in the foetal mortality recorded statistically as still-births. The differences between the live and still-birth percentages of first births are generally greatest in the native white mothers and least in the coloured mothers, with the foreign-born white mothers falling somewhat nearer to the coloured in this respect than to the native whites. Paradoxically, the percentage of first still-births to all still-births (for mothers of all ages taken together) in the foreign-born white group is smaller than the percentage of first live births to all live births in the same group (for mothers of all ages taken together), even though in each separate age group the first still-birth percentage is higher than the corresponding first live-birth percentage. This, again, is a consequence of the differential weighting arising from the distorted age distributions of foreign-born white mothers, and especially of mothers producing still-births.

If man as a species operated in his reproduction as do other mammals in a state of nature, uninfluenced by any variables other than the strictly biological ones of innate fertility, unhampered sexual desire, and environmental opportunity, it would be expected that first births would be concentrated in a relatively narrow range of age of mother (or father) following rather closely after the establishment of the physiological capacity to reproduce, at or soon after puberty. Actually, from reasons of tradition and custom, education, prudence, artificial alterations of the normal functioning of the reproductive mechanism, and various others, the observed reproductive performance of the human species departs widely from the pattern of going away from the starting barrier of reproduction that prevails in lower animals. Just how wide this departure was for the American women reproducing in 1930 is indicated graphically in Fig. 18. The graphs of Fig. 18 are ended in each case a *half* space beyond the 40–44 years age interval, for the reason that on any scale of feasible plotting the frequencies in the two age classes above 45 years would not be distinguishable in the reduced cut.

Consider the first births of Fig. 18. It is at once evident that the coloured mothers of 1930 conformed much more closely to the lower animal pattern of first birth distribution by age than did either the native or foreign-born white mothers. The peak of first births in these coloured mothers fell in the age period 15–19 years, or, in short, as soon as physiologically possible (on a quinquennial age scale) after puberty. The coloured curves then quickly drop so that less than 10 per cent. of all the first births of the year, either live or still, were produced by mothers in the age period 25–29 years. Furthermore, among the coloured the live- and still-birth relative frequency curves are very close together throughout their courses. In other words, among these coloured mothers still-births occurred at all ages in a nearly

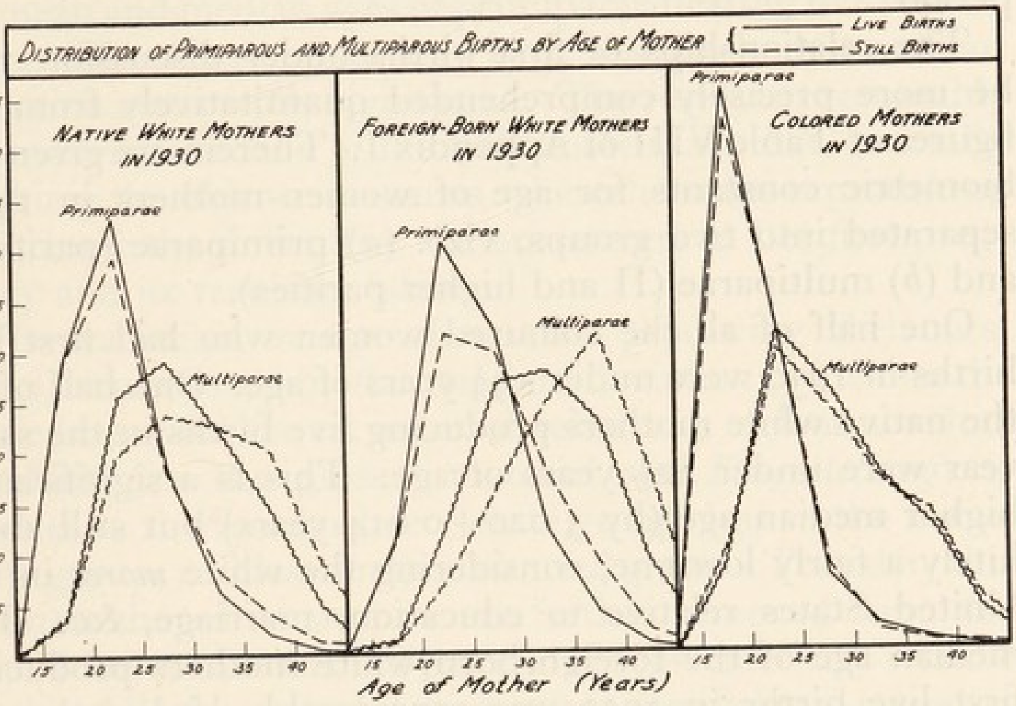


FIG. 18. Percentage frequencies of primiparous and multiparous births by age of mother.

constant proportion to the number of live births at the same ages.

Both the native and foreign-born white women reproducing in 1930 had the peak of their first births in the age period 20–24 years. The live- and still-birth curves in both white groups come down after age 20–24 at a more gradual slope than do those for the coloured mothers. There is a characteristic difference in this respect between the live- and the still-birth curves; the latter rise to the peak, and particularly descend from the peak, with a more gradual slope than the former. Generally speaking, the proportion of first still-births before mother's age 30 to all first still-births tends to be smaller than the proportion of first live births before mother's age 30 to all first live births. This relationship is reversed after age 30. While these relations are true of all the nativity–race (colour) groups they are least pronounced in the coloured and most so in the foreign-born white, with the native white in an intermediate position. The risk of a first pregnancy ending with a still-birth rather than a live birth, appears, in short, to increase as the woman's first pregnancy is postponed later and later in her fecund period.

The relationships of first births under discussion may be more precisely comprehended quantitatively from the figures of Table VIII of Appendix I. Therein are given the biometric constants for age of women-mothers in 1930, separated into two groups, viz.: (*a*) primiparae (parity I) and (*b*) multiparae (II and higher parities).

One half of all the coloured women who had first live births in 1930 were under $19\frac{1}{3}$ years of age. One half of all the native white mothers producing live births in the same year were under $22\frac{1}{3}$ years of age. This is a significantly higher median age (by $3{\cdot}020 \pm 0{\cdot}014$ years) but still absolutely a fairly low one, considering the white *mores* in the United States relative to education, marriage, &c. The median age of the foreign-born white mothers producing first live births in 1930 was considerably higher than in either of the other two nativity–race (colour) groups. Half the foreign-born white primiparae (bearing live offspring) were over 24·8 years of age. This reflects the relative scarcity of young females in the distorted age distribution of the foreign-born, to which allusion has been made before.

One half of all the coloured women who produced their second or higher order live births in 1930 were over 27 years (approximately) of age, while one half of the similarly parous native white women were over 29 years of age. The corresponding figure for the comparable foreign-born white women was approximately 32 years. The spread between the median ages of primiparae and multiparae, as groups, was, in other words, from $6{\cdot}223 \pm 0{\cdot}007$ years in the case of the native white women, through $7{\cdot}050 \pm 0{\cdot}021$ years in the foreign-born white women, to $7{\cdot}597 \pm 0{\cdot}018$ years in the coloured women, so far as concerns live births only. For still-births the figures would be substantially the same. These spreads reflect the comparative group failure of such higher age reproductivity.

In all three race (colour)–nativity groups the mean and median ages of primiparae bearing still-born offspring as the first product of their reproductive efforts are higher than the mean and median ages of primiparae bearing live babies. These differences are not very large absolutely, but without exception statistically significant. The result is presumably a biometric reflection of the well-known fact that, generally speaking, the older a woman is when she starts reproducing the greater the difficulties she encounters in her first pregnancy and its resulting labour.

The variation in age of women producing their first births, as measured by the standard deviation (which on the whole seems the fairest index of relative as well as absolute variability for the present material and *Fragestellung*), is greatest in the foreign-born white group, less in the native white group, and least in the coloured group. Tested by this criterion the white women are farther removed from the normal lower mammalian pattern of reproductivity relative to age, while the coloured women are significantly nearer to it. The differences are, by many times their probable errors, statistically significant. The coloured (chiefly Negro) group has its first babies more promptly after menarche than the whites, and its component members are more uniform (less variable) in this behaviour characteristic.

While, as we have seen, the coloured primiparae are the least variable in age (as judged by the standard deviation) of any of the race (colour)–nativity groups, the coloured multiparae are the most variable, confirming from another angle the conclusion reached above that this coloured group approaches most closely of the three to the lower mammalian reproductivity pattern. They not only start reproducing promptly after the menarche, but they scatter their total reproducing more generously, and more nearly evenly over the possible age span.

Because of the changing constitution of the Birth Registration Area prior to the most recent years it is impossible to make any exact comparison between the proportion of first births to all births in 1930 and any earlier year. But for its suggestive value in roughly indicating the general trend of events in regard to this important aspect of reproductivity Table IX of Appendix I has been prepared. This gives for the Birth Registration Area as constituted in 1920 and in 1930, the percentages of live first births to all live births, by age, nativity, and race (colour). From the data of Table IX there

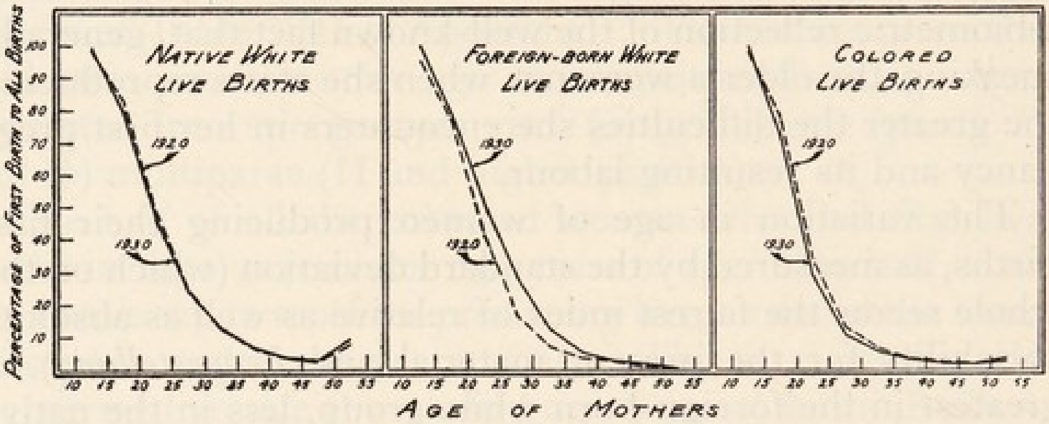


Fig. 19. Percentages of live first births in 1920 and 1930.

has been prepared Fig. 19, which shows graphically the trend of the differences in proportions of first births over the ten-year period.

In so far as the data may be relied upon to give an approximate idea of the trend in reproductivity that took place between 1920 and 1930, it is evident that there was relatively little change, on the whole, in the percentages of first live births to all live births in the native white and coloured portions of the population. What little change there was indicated a slightly higher aggregate proportion of first births in 1930 than in 1920 in these two elements of the population, though in many of the individual age groups the difference was in the other direction. This paradox arises because the differences in age distribution of the mothers in 1930, as compared with those of 1920, were sufficient to offset the small changes in first birth proportions in individual age classes. In the case of the foreign-born whites, however, the changes were larger in amount. In this part of the population the percentages of first births to all births were markedly higher in 1930 than in 1920, both in the aggregate, and in the separate age classes.

It is of some interest to compare the figures on primiparity among the women reproducing in 1930 in the U.S.B.R.A. with more or less similar data from the literature. In a study of 1,108 pregnant women who attended the Stockport (England) antenatal clinics, taken without 'selection of cases as to social circumstances or as to parity', Reid and Mackintosh (37) present figures from which we calculate that 39·7 per cent. of the pregnancies, taking all ages of mothers together, were of parity I. This is substantially the same as $40{\cdot}15 \pm 0{\cdot}15$ per cent. for the native white mothers of the present study bearing still-births in 1930. On the other hand, Sundin (09), in a study of 335 women in his private practice in Lund (Sweden), records data showing 25·5 per cent. as of parity I, a figure falling between $24{\cdot}34 \pm 0{\cdot}06$ per cent. for our foreign-born white mothers of live births, and the $28{\cdot}98 \pm 0{\cdot}06$ per cent. for our coloured mothers of live births. An analysis of the data in Kennedy's (33) very careful and thorough study of Edinburgh hospital records makes it possible to set up the following more detailed comparison of percentages of first parities to all parities:

Age class	*U.S.B.R.A., Total whites, 1930, live births*	*Edinburgh Hospital records (Kennedy)*
Under 25	55·5	63·8
25–34	19·7	28·8
35–44	5·5	18·8
45 and over	2·6	9·9

These figures suggest that the higher Edinburgh percentages probably reflect in part the selective tendency for women to have their first births in hospitals, in a higher proportion of cases than in subsequent parities. This tendency is well known. In the first 1,000 confinements in the then newly opened Sloane Maternity Hospital in New York, McLane (91) reported that 54·7 per cent. were first pregnancies. This is much higher than any of the percentages of primiparae (all ages together) in the general population. It is of interest to note that Peckham in 1936, or 45 years later, reported that 54·7 per cent. of the general obstetric clinic population of the Johns Hopkins Hospital were primigravidae.

Two other, and somewhat extreme, examples may be given to illustrate the fact that *selection* of groups of women relative to a wide variety of conditions and circumstances may alter greatly the proportionate amount of primiparity observed in the group, away from general population figures. The first example illustrates how pathological factors may be related to parity distributions. The percentages of I-para women are generally, for all groups and practically all age classes, higher among the mothers producing still-births than among those producing live births. Difficulties and disturbances of pregnancy generally occur more frequently in proportion among primiparae than among multiparae. Greenhill (26) reported that of 78 cases of eclampsia occurring among 29,587 obstetric patients 73·1 per cent. were primiparae. A wholly different sort of selection is involved in and implied by the processes that assemble together as a statistical group the clientele of a birth-control clinic. Robishaw (36) reports that of 4,000 women admitted to the Maternal Health Clinic of Cleveland, Ohio, 3,616 had been pregnant one or more times when admitted. Of these 3,616 women 491, or 13·6 per cent., had been pregnant once only.

7. *Age Patterns of Reproductivity*

Having seen how the pattern of human reproductivity departs in respect of the production of first births from the lower animal scheme both as regards the time relations relative to puberty and the variability in age, we may turn to a consideration of the age pattern of total human reproductivity.

The biometric constants for the distributions of all births of all parities relative to age of mother are shown in Table 20.

It has been pointed out above that, according to the normal pattern of reproduction among the mammals lower than man, it would be expected that the mean age of mothers of first births would be only a little above the mean age at puberty or menarche (taken as the beginning of the physiological possibility of reproducing by the female). Further, it would be expected that the amount of variation in the mother's age at first birth would, on the lower animal pattern, be small. Let us now examine more precisely into the question of the degree of departure, quantitatively, of the present-day human pattern of reproduction from this more primitive mammalian pattern.

TABLE 20

Biometric constants for age of mothers of all births of all parities in 1930

Constants for mother's age	Native white		Foreign-born white	
	All live births	All still-births	All live births	All still-births
Mean (*years*)	27·102±0·003	27·930±0·023	30·385±0·009	32·798±0·059
Median (*years*)	26·211±0·004	26·951±0·029	29·934±0·011	33·262±0·074
St. Dev. (*years*)	6·418±0·002	7·282±0·016	6·365±0·006	6·855±0·042
C. of V. (per cent.)	23·682±0·009	26·072±0·062	20·947±0·022	20·901±0·132

Constants for mother's age	Coloured	
	All live births	All still-births
Mean (*years*)	25·670±0·009	25·791±0·036
Median (*years*)	24·334±0·012	24·239±0·045
St. Dev. (*years*)	6·785±0·006	7·172±0·025
C. of V. (per cent.)	26·431±0·027	27·810±0·106

It was shown in section 5 of Chapter II that the inter-group mean age of the human female at menarche was 15·17 years, and the inter-group median age was 15·15 years. Now if we compare these figures with the mean and median ages of women having their first births in 1930, as set forth in Table VIII of Appendix I, we shall get the following set of differences in years. These differences represent the time gap, on the average, that American women are exhibiting in their initial demonstration of actual fertility after the potentiality has been established.

Group	Average years from menarche to	
	Living first birth	Still first birth
Native white . .	7·76	8·39
Foreign-born white .	10·31	11·81
Coloured. . .	5·14	5·58

From Chapter II it will be recalled that an inter-group mean value of 31·21 years was reached as the average span of reproductive life in the human female. Applying this to the above lag figures it appears that, on the average, the present-day pattern of human reproduction, as exemplified by American women who bore children in 1930, exhibits the following percentages of the total reproductive life span spent in the period between menarche and the bearing of the first child.

Group	Percentage of total reproductive span between menarche and	
	Living first birth	Still first birth
Native white . .	24·9	26·9
Foreign-born white .	33·0	37·8
Coloured. . .	16·5	17·9

In other words, it appears that, as American women currently practise reproduction, from roughly 16 to 36 per cent. of their total reproductive span elapses, as an average figure, between the time they become physiologically capable of reproducing and the time when their first product of conception appears upon the scene. While this statement is confined to American women, as is proper since the data presented are thus restricted, nevertheless it is quite certain on general grounds that other populations at similar cultural and economic levels would show the same general sort of results as to the time lag in beginning reproduction. Some countries would at the present time show an even greater lag than the United States. This delay in getting started at reproduction in itself accounts in no negligible degree for the fact that in general human beings are relatively poor breeders.

It may be plausibly argued that if women followed the lower mammalian pattern of reproductivity the average age of all women bearing children in a particular year would be at a period approximately half-way between the average ages at menarche and menopause, neglecting the effect upon realized reproductivity of the mortality of potential mothers between these two limits. Actually, this mortality effect is so small as to be practically negligible so far as concerns age-parity relations, as will be discussed later. So as a rough approximation let us say that this mean age should theoretically be $15{\cdot}17+(31{\cdot}21/2) = 30{\cdot}78$ years. Then from the mean values of age of mothers in 1930 we have the following system of differences:

Group	*Difference between theoretical and actual mean ages of mothers of*	
	Live births	*Still-births*
Native white . .	−3·68	−2·85
Foreign-born white .	−0·40	+2·02
Coloured. . .	−5·11	−4·99

These are considerably smaller differences, so far as concerns the whites, than were found relative to the departure from the theoretical mammalian pattern in the case of average age at first birth. For the coloured group the differences are of the same order of magnitude in both cases. On a relative basis the differences are also small, as the following figures show:

Group	*Percentage difference between theoretical and actual mean ages of mothers of*	
	Live births	*Still-births*
Native white . .	−12·0	− 9·3
Foreign-born white .	− 1·3	+ 6·6
Coloured. . .	−16·6	−16·2

The implications of these figures, highly approximate as they must be understood to be, are interesting. So far as the whites are concerned the indicated proportional departure of human reproductive performance from the theoretical mammalian pattern is less than a half as much relative to average age of all breeders at a given time as relative to age at first birth. This points to a considerable compensation for the lag in getting started at reproduction after menarche, as a result of the relatively heavy concentration of reproductive activity in the twenties. The coloured group appears to be relatively about as far away from the animal pattern in one respect as in the other.

The reproductive pattern may next be examined from its variation aspect. If women followed closely the lower animal pattern it is clear that the variation in age of mothers at the birth of their first babies should be of nearly the same order of magnitude as their variation in age at menarche.

Now the unweighted inter-group average of the standard deviations for age at menarche set forth in Table 8 *supra* is 1·85 years. By the use of this figure and the standard deviations in age at first birth given in Table VIII of Appendix I there can be set up the following system of differences between variation in age at menarche and in age at first birth, the degree of variation in both cases being measured by the standard deviation:

Group	*Differences in variation in age at menarche and age at*	
	Live first births	*Still first births*
Native white . .	2·86	3·72
Foreign-born white .	3·03	4·05
Coloured . . .	2·42	2·85

These figures indicate that the American primiparae of 1930 exhibited on the average much greater variability in age at their first births than the general average variation recorded for age at menarche. In this respect the coloured primiparae, as before, came nearest—though still a long way off from—the primitive animal pattern of reproductivity.

How great these differences in variability are relatively may be shown by translating them into percentages as follows:

Group	*Percentage differences in variation in age at menarche and age at*	
	Live first births	*Still first births*
Native white .	154·6	201·1
Foreign-born white .	163·8	218·9
Coloured . . .	130·8	154·1

Thus it is seen that the present practice of American women in reproduction leads to a variation in age at first birth that is from 131 to 219 per cent. greater than the general average variation in age at menarche.

On the primitive animal pattern of reproductivity it is clear that, except for the influence of a true physiological decline in innate fecundity and fertility with advancing age, the variation in age of women at births of all parities taken together should be of generally the same order of magnitude as variation in total duration of menstrual life. By taking the unweighted average of the standard deviations of Table IV of Appendix I it appears that this latter value may be taken as represented by a scatter of 5·40 years.

A comparison of this figure with the standard deviations of Table 20 leads to the following system of differences between the variability in duration of reproductive life, on the one hand, and in age of mothers of all parities producing offspring in a particular year, on the other hand:

Group	*Differences in variation of reproductive span and age of mothers of*	
	Live births	*Still-births*
Native white . .	1·02	1·88
Foreign-born white .	0·97	1·46
Coloured . . .	1·39	1·77

It thus appears that the women bearing offspring in 1930 were considerably more variable in age at the time of the event than women in general are in respect of duration of their total reproductive life span. It seems reasonable to suppose that whatever progressive diminution in innate fecundity and fertility with advancing age there may be would have the tendency to reduce the variability in age exhibited by women of all parities bearing children in a particular year (because it would tend to relative under-representation of higher as compared with lower ages). If this is so the differences shown above need no correction on account of this factor, because as they stand they represent at least minimal departures from the primitive animal reproductivity pattern. How great these departures are relatively is shown by the following percentages:

Group	*Percentage differences in variation between reproductive span and age of mothers of*	
	Live births	*Still-births*
Native white . .	18·9	34·8
Foreign-born white .	18·0	27·0
Coloured . . .	25·7	32·8

So then it appears that the American women bearing children in 1930 were from 18 to 35 per cent. more variable in age than women in general are in respect of the total duration of the physiologically possible reproductive span. These are not as large departures from the primitive animal reproductivity pattern as those exhibited by the primiparae, but still considerable.

To summarize briefly the discussion in this section it may be said that the women in the U.S. Birth Registration Area bearing children in 1930 showed a pattern of reproductivity widely divergent from that exhibited by mammals lower in the evolutionary scale, in all respects tested. The divergences were greatest in the performance of primiparae. Among the nativity–race (colour) groups the coloured came closest to the animal pattern, so far as concerns primiparae, and, on the whole, farthest from it in the respects in which the behaviour of women of all parities was tested.

8. *Adequate Reproduction*

Up to this point the discussion has been centred to a considerable extent about primiparae, with women of other parities brought in for purposes of comparison. It has been shown that roughly from 23 to 40 per cent. of the women bearing products of conception in 1930 were primiparae, an obviously high proportion when viewed from the angles of race survival and population growth. These figures take on a still more ominous cast when it is remembered that a definite though not now precisely ascertainable proportion of these primiparae will never bear any more children. It is evident that unless a woman produces more than one child in her lifetime she is not adequately reproducing even herself, to say nothing of her family (self and consort) or her strain.

Many years ago in discussing reproduction and survival in the domestic fowl, the present writer (17) pointed out the necessity of considering mortality before reproductive life began in appraising net adequate reproductivity, and developed a survival index number for the quantification of such appraisal. In recent years this general concept of net effective reproductivity has been applied by various students to the human situation. Notably Dublin and Lotka (25) have been pioneers in developing this field extensively and accurately. One of their conclusions was that for the population constituted as it was in 1920 and with prevailing mortality rates, there would be required 3·15 children per fertile married female just to maintain the population at a stationary level.

On this and other general grounds it seems a fair postulate to say that if, in a given year, a woman produces her *fourth living child*, she may be regarded as having adequately reproduced. On the basis of this postulate we may proceed now to examine the question as to what proportion of the women of different ages producing live births in 1930 had, with their performance of that year, completed the demonstration of adequate reproductivity as here defined.

Tables 8 and 9 in Pearl (37, p. 90) show that in round figures about 29 per cent. of all the native white women reproducing in 1930 were having their fourth or higher order birth, counting live births only in both cases, while about 40 per cent. each of the corresponding foreign-born white and coloured women were in the same position. In other words, over a tenth part more of the women in their respective classes had attained adequate reproductivity among the foreign-born white and the coloured groups than was the case among the native-born whites. Put in another way, it appears that whereas the native white women producing live births in 1930 had 4·05 per cent. *fewer* fourth and higher parity births than they did first births, the foreign-born white had 16·01 per cent. *more* fourth and higher parity births than first births, and the coloured had 11·28 per cent. more fourth and higher parity births than first births. The moral of these figures from the population viewpoint, both as to quantity (survival) and as to what the eugenist is pleased to regard as 'quality' composition, is evident without further elaboration.

The age differentials in respect of adequate reproductivity are interesting. To make the facts more apparent Fig. 20, plotted from the data of Table 9 of the writer's (37) paper is presented.

The most striking thing about the age distribution of adequate reproductivity in 1930 is the marked contrast between the white and the coloured women. While only just under 8 per cent. of the former in the age period 20–24 years were having their fourth or higher parity live birth, nearly 21 per cent. of the latter were so doing. In the next higher age class (25–29 years) just slightly under 60 per cent. of the coloured women had completed their proof of adequate reproductivity, as against about half as many relatively among the white women. Over three-quarters of the coloured women aged 30–34 years were quadriparous or better in 1930, as against only a little more than half the white women in the same period. In every age period of reproductive life the percentage of IV- and higher-parous women was greater among the coloured than among the white. The adequate reproductivity age curves of the native and foreign-born white women did not differ very markedly from each other throughout their courses.

How did the proportion of adequate reproducers to all mothers of the year change between 1920 and 1930? Again a precise answer cannot be given to this question, because the registration areas were different in their composition in the two years. But an examination of the data for the two years and areas as they existed may be suggestive of trends, though not exact. Table 21 gives the figures for what they are worth.

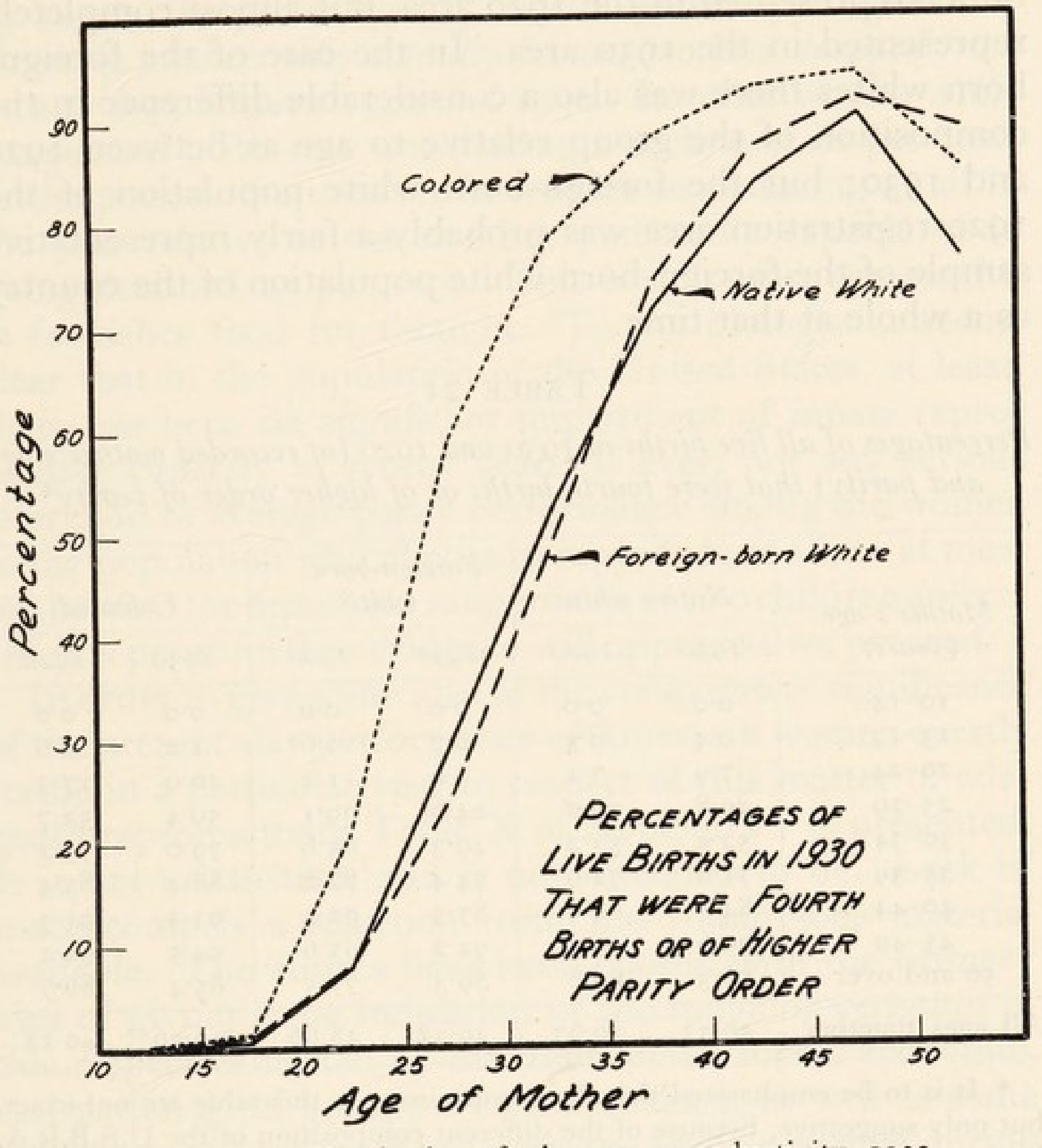


FIG. 20. Age distribution of adequate reproductivity, 1930.

The general impression that Table 21 gives is that, in the aggregate, there was but a slight change between 1920 and 1930 in the proportion of adequate producers among all mothers of the year, so far as concerns the native white and coloured portions of the population, while there was apparently a marked drop in the proportion in the foreign-born white group. Now the native white group in the

U.S.B.R.A. of 1920 was probably a very fairly representative sample of the native white population of the country as a whole at the time. The same cannot be said of the coloured group. The most rapidly multiplying elements of the coloured population (those of the deep south) were under-represented in the 1920 area, but almost completely represented in the 1930 area. In the case of the foreign-born whites there was also a considerable difference in the composition of the group relative to age as between 1920 and 1930; but the foreign-born white population of the 1920 registration area was probably a fairly representative sample of the foreign-born white population of the country as a whole at that time.

TABLE 21

*Percentages of all live births in 1930 and 1920 (of recorded mother's age and parity) that were fourth births or of higher order of parity**

Mother's age (years)	Native white		Foreign-born white		Coloured	
	1930	1920	1930	1920	1930	1920
10–14	0·0	0·0	0·0	0·0	0·0	0·0
15–19	0·4	0·3	0·7	0·6	1·2	0·6
20–24	7·9	7·1	8·0	11·4	20·9	17·3
25–29	29·8	29·2	24·6	39·1	59·4	52·7
30–34	52·5	53·2	49·3	65·6	79·0	73·2
35–39	71·6	72·9	74·4	82·2	88·4	85·5
40–44	84·1	84·9	87·5	90·4	93·3	91·3
45–49	90·6	90·7	92·2	95·6	94·5	92·2
50 and over	76·3	80·8	89·3	77·5	85·4	86·7
All ages together	29·33	30·67	40·35	48·66	40·26	40·22

* It is to be emphasized that the comparisons in this table are not exact, but only suggestive, because of the different composition of the U.S.B.R.A. in the two years cited.

The question naturally arises as to how it can be that there can have been such relatively small changes in the proportion of adequate reproducers between 1920 and 1930, when in the same period the general birth-rate declined from 23·7 per thousand population to 18·9. The answer is simple, and in principle precise. The proportions of adequate reproducers in Table 21 are proportions of

IV-para women to all women *who actually reproduced* in 1920 and 1930 (on a live-birth basis in both cases), and to such women *only*. Those proportions probably did not in truth change much between 1920 and 1930 (save perhaps in the foreign-born whites). But, as has been shown in Table 19 *supra*, *the percentages of women potentially capable of becoming mothers who actually became mothers dropped from* 9·12 *to* 6·99 *between* 1920 *and* 1930. In other words, while the general birth-rate was making a decline of 20 per cent. in the period, the number of women reproducing at all in the year relative to the number potentially capable of so doing declined 23 per cent. This is quite fair agreement. It furnishes food for thought. To the biologist it seems clear that in the population of the United States, at least, there has been no significant impairment of innate reproductive capacity in recent years, if ever, nor any serious alteration of average parity performance among the women in the population who choose to reproduce at all, or at most not beyond the minimum range of one or two children apiece. On this point further evidence will appear as we proceed.

In order to give some idea of the comparative significance of the present-day performance of American women overtly fertile in a particular year in respect of this matter of adequate reproductivity Table X of Appendix I is presented. It is not exhaustive, and is not intended to be. Lack of space compels a selection from the voluminous material available. The entries have been chosen with the primary idea of giving some indication of the range of variation in this respect exhibited by different racial, social, economic, and pathological groups of human beings, as well as some indication of how great has been the secular change during the last century. It is to be understood that in computing the percentages of adequate reproductivity from data in the literature all physiologically sterile and wholly childless matings have been excluded, because that is the situation relative to the U.S.B.R.A. mothers of births in 1930. The designations *Rep. Inc.* or *Rep. Fin.*, appearing in connexion with each item in the table, have the following significance: *Rep. Inc.* means that the total aggregate reproductivity of the group as a whole had not been completely finished at the time of record, because not all the women had passed the menopause; *Rep. Fin.* means that the total aggregate reproductivity of the group had been completed at the time of record because all the women had passed the menopause. The items in the table are arranged in descending order of percentages of adequate reproducers. The dates given in the first column of the table refer as nearly as possible to the period in which the group reproductive performance occurred. The indications here are in some cases rather rough, the date of publication of the paper cited being the only specific time record to be had in such cases.

It is obvious that all of the items of Table X are not strictly comparable with each other. Of the 27 items in the table, 14 are in the Rep. Fin. category and 13 in the Rep. Inc. category. This makes, of course, a real difference. The average (unweighted) percentage of adequate reproducers for the Rep. Fin. items is 67·9 as against 44·2 for the Rep. Inc. It will therefore be well not to make comparisons across this barrier. But the significant point that does appear from this table, incomplete and fragmentary as it is, is found by comparison of the sorts of folk that make up the end items in both categories. In the Rep. Fin. category the four groups with the *highest* percentages of adequate reproducers (items 1–4 inclusive) are respectively Tajik women, Russian peasants, foreign-born mothers of mentally defective children in the U.S.A., and Usbeg women; in short, either relatively uncivilized people in a low state of culture or people genetically defective. On the other hand, the four Rep. Fin. groups with the *lowest* percentages of adequate reproducers (items 16, 20, 25, 27) are Connecticut rural families, Connecticut native-born Protestant farm women, native-born up-state New York women, and university professors' wives; in short, the sort of people often called 'the salt of the earth'. The Rep. Inc. category tells the same kind of story. The four items there with the *highest* percentages of adequate reproducers (items 9, 11, 12, 13) are respectively mothers of delinquent boys in institutions, wives of Yorkshire miners, mothers of feeble-minded children, and the foreign-born in New Hampshire about 40 years ago; again, perhaps, not the most advanced sorts of people conceivable in a social point of view. On the other hand, the four groups in the Rep. Inc. category with *lowest* percentages of adequate reproducers (items 22, 23, 24, 26) are respectively native-born New Hampshire women, French and Belgian noble families, native white U.S.B.R.A. mothers of 1930, and English, Scottish, and Irish noble families. In sum, we arrive once more at the familiar social class differential fertility stopping place, though the approach has been along a somewhat different route.

9. *Parity Patterns*

The question to be discussed in this section concerns certain aspects of the biometric analysis of the variation in parity order of births of 1930 relative to age of mother. The basic biometric constants have been given by Pearl (36, tables 15–17 inclusive). Questions to which answers are desired are of the following sort: Given a group of women aged 30–34 years, for example, all bearing children in a particular year, what will be the mean or median parity order of their births in that year? What degrees of variation, absolute and relative, will they exhibit in parity? With this material at hand it will be possible, in connexion with the data already presented, to examine the phenomena of parity from the alternative and opposite points of view of variation in mother's age relative to specific parity, on the one hand, and variation in parity relative to specific mothers' ages (in five-year groupings).

The mean parity orders for live births are shown graphically in Fig. 21.

The mean (and median) parity orders rise with each age class of mothers from 10–14 up to and including 45–49. Prior to the age class 25–29 this increase of average parity with age is more gradual; after age 30 the rise is nearly linear up to 50. The small number of women aged 50–54 years who bore children in 1930 showed, in all nativity–race (colour) groups lower mean and median live-birth parities than the women in the 45–49 year age class. This is true of any year's births, so far as I have examined them. It is a curious fact, perhaps chiefly reflecting a considerably

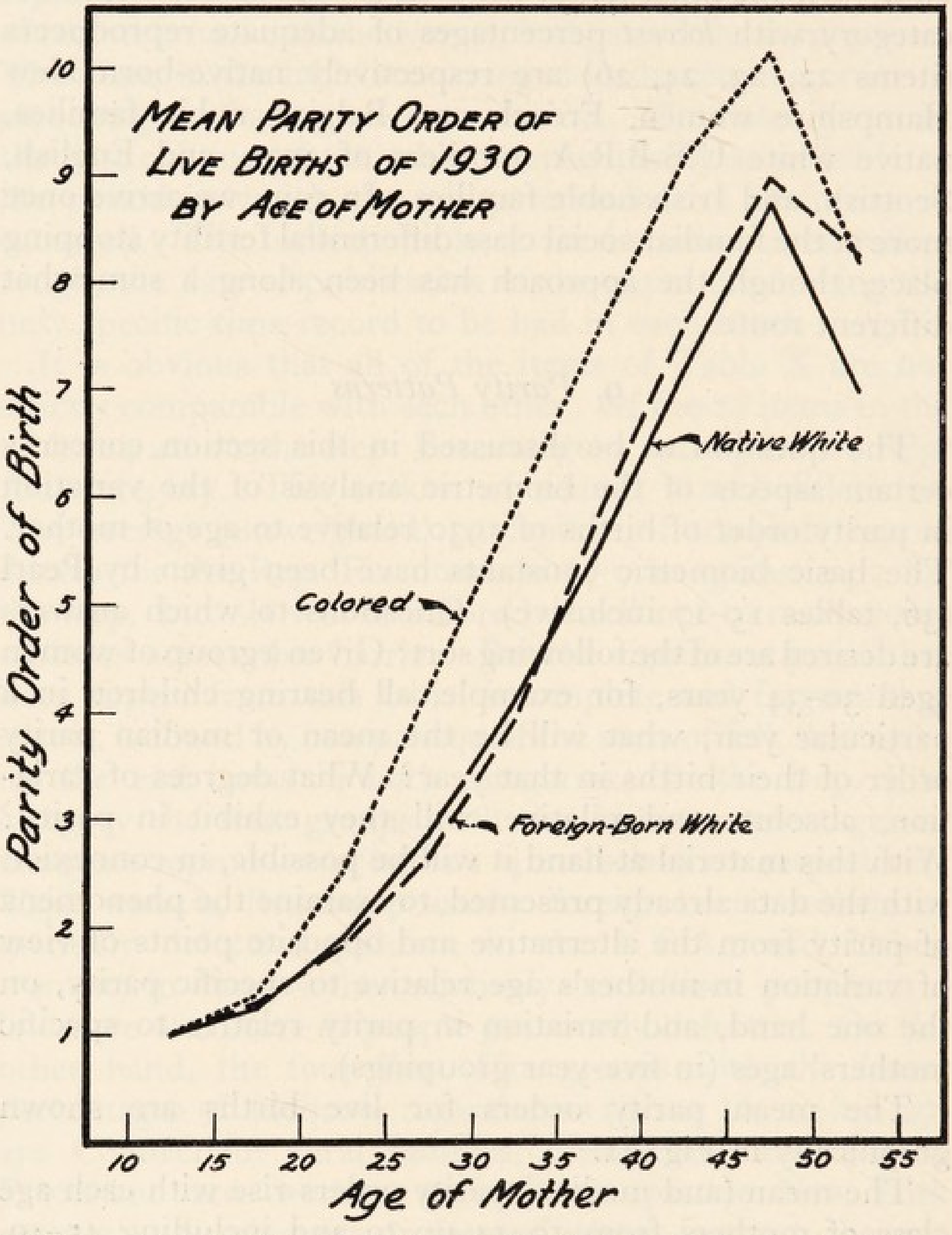


FIG. 21. Mean parity order of live births in U.S.B.R.A. by age of mother.

reduced ovulation rate in the women whose menopause is postponed into the fifties.

The most striking single feature of Fig. 21 is the relatively large superiority in mean parities of the coloured group over the native and foreign-born white groups at all ages (except for the means at 50 and over, where the coloured fall insignificantly below the foreign-born whites). The two white groups are not greatly differentiated from each other at any ages in mean (or median) parity, and while some of the differences are statistically significant in comparison with their probable errors a common-sense

TABLE 22

Superiority of coloured mothers over white in mean and median parities of live births in 1930

Age class	White Average		Absolute excess of coloured		Percentage excess of coloured		Excess ÷ P.E.	
	Means	Medians	Means	Medians	Means	Medians	Means	Medians
10–14	1·004	1·002	−0·001	0·000	−0·1	0·0	..	..
15–19	1·241	1·130	0·107	0·060	8·6	5·3	23	10
20–24	1·873	1·616	0·606	0·615	32·3	38·1	124	99
25–29	2·801	2·448	1·378	1·577	49·2	64·4	179	164
30–34	4·022	3·635	1·830	2·161	45·5	59·4	153	139
35–39	5·590	5·312	1·948	2·269	34·8	42·7	108	104
40–44	7·304	7·259	1·857	2·037	25·4	28·1	53	46
45–49	8·781	8·964	1·350	1·415	15·4	15·8	13	11
50 and over	7·240	6·635	0·950	0·765	13·1	11·5	1·2	0·8

view would seem to be that no important real biological differentiation is represented here. Therefore, in order to reach a reasonable judgement of the magnitude of the departure of the coloured mothers from the whites in the respect under discussion, Table 22 has been prepared. The procedure in forming this table for live births has been (*a*) to take a weighted average of the mean and median parities of the two white groups, the weighting being on the basis of the numbers involved; (*b*) to take the differences (absolute and as per cent. of the white averages) between these averaged mean and median parities for the whites and the corresponding mean and median coloured parities; and (*c*) to compute the probable errors of these differences on the assumption that the probable errors of the white averages are the same as those of the foreign-born white.

Actually they would, of course, be lower if accurately determined.

It is evident that except for the terminal age classes the differences between the coloured and white mothers in parity at specified ages are considerable in amount, whether estimated in absolute or relative terms, and so far beyond the magnitudes that might conceivably have resulted solely from the play of chance in sampling that it seems safe to conclude that they represent a real biological differentiation. The coloured women who bore living children in 1930 exhibited, in their reproductive performance of that year, mean and median parities from 5 to 64 per cent. higher than those exhibited by the white women who bore living children in the same year, at all ages from 15 to 54 years. The same result in principle would be got if the birth figures of any other recent year were to be analysed in the same way. Furthermore, if attention is focussed on the women who produced still-births in 1930 it will be found that a corresponding table to Table 22 constructed for them would lead to the same results in principle as those derived from the mothers of live births.

The absolute variability as indicated by the standard deviations of the parity distributions is uniformly higher for the coloured mothers of live births in all age classes from 15–19 up to and including 45–49, than for either the native or foreign-born white mothers, and in the 50 year and over age class the standard deviation for the coloured is higher than that for the native white, though a little lower than that for the foreign-born white. This would not unreasonably be expected in view of the higher mean and median parities in the coloured group. The excess of the coloured's standard deviations over those for the whites is, however, generally not as great proportionately as the excess in the means and medians. This results in smaller values for the coefficients of variation in the coloured group in all the age classes from 25–29 years through 45–49 years, indicating a tendency towards lower relative variability in respect of parity among the coloured than among the whites. And in the 20–24 and 50 year and over age classes the coefficients of variation for the coloured are lower than those for the foreign-born white.

We turn next to a more particular examination of the rate of ascent of mean parity with advancing age of mothers in the several groups. After considerable deliberation over the matter and the trial of various alternative plans the following scheme has been adopted as a first step to make clear what appear to be important relations in a complicated mass of figures and biological considerations. As a preliminary step let us consider what the mean parity relations to advancing age would be in a group of women postulated to be performing reproductively, throughout their total span of physiologically possible reproductive potentiality, at something approaching the maximum limit of harmless physiological capacity. A fair postulate of this sort would be that, starting with women producing on the average one birth in the age period 10–14 years (on the ground that a certain number of females do just that in each year's birth statistics), if in each five-year period of age thereafter each woman produced two births—an average spacing of 2·5 years between births which is generally regarded as reasonable hygienically—it would result that the mean parity for the age period 15–19 would be three, for the period 20–24 five, and so on to fifteen for the age period 45–49. There is no point in including the meagre and essentially abnormal data for the age class 50 and over in the comparisons from this point on. The few women bearing children after 50 do not exhibit reproductive histories that statistically fit in with those of younger women. They are evidently a differentiated group.

How then did the actual mean parity performance of the several groups in 1930 compare with this postulated 'ideal' performance? Table 23 and Fig. 22 give the answer to this question.

It is evident that the greatest departures from the postulated ideal performance in respect of mean parities occur in the two age periods between 15 and 24 years as limits. Starting all even for the 10–14 year old mothers the curves drop abruptly to mean parities in the next age period of around 40 per cent. of the assumed ideal. This drop is probably chiefly to be connected with age at marriage, or rather with its postponement.

TABLE 23

Percentages of observed to theoretically postulated mean parity orders of birth by age of mother

Age class	Postulated mean parity	Percentage of actual to postulated mean parity					
		Native white		Foreign-born white		Coloured	
		Live	Still	Live	Still	Live	Still
10–14	1	100·4	100·0	100·0	..	100·3	100·0
15–19	3	41·3	40·3	42·1	42·7	44·9	47·4
20–24	5	37·6	35·1	36·3	36·6	49·6	51·3
25–29	7	40·4	40·3	37·7	39·5	59·7	62·8
30–34	9	44·9	45·5	43·8	47·2	65·0	69·0
35–39	11	50·3	51·1	52·8	57·3	68·5	69·1
40–44	13	55·4	55·7	58·8	62·4	70·5	72·8
45–49	15	58·1	57·0	59·8	61·8	67·5	73·6

After mid-age 17·5 years in the case of the coloured mothers, and 22·5 years in the case of the white mothers, the percentages of actual to ideal mean parities increase steadily, until they reach high points at about 70 per cent. in the case of the coloured at mid-age 42·5 years, and of about 60 per cent. in the whites at mid-age 47·5.

Now it is evident that one reason at least why the observed parity means are below the postulated ideal after the starting age class 10–14 years is because the intrusion of primiparae—women just starting their reproductive life—will tend to lower the parity mean in each age class, and somewhat in proportion to the relative frequency of these 'first birth' women in the class. What is the actual quantitative effect of this factor?

The laborious statistical details necessary to answer this question need not be recounted here. It will suffice to say that the magnitude of this first birth effect upon mean parities is greatest in the earlier ages, as would be expected, and diminishes with advancing age of mothers for the obvious reason that the proportion of women having first births diminishes with advancing age.

The effect of primiparity in lowering the mean parities of all mothers is much more marked in the white than in the coloured mothers, taken as groups. This is plainly connected with the tendency of the coloured women to begin breeding early and to keep at it—in other words with a greater inherent tendency to multiparity among the

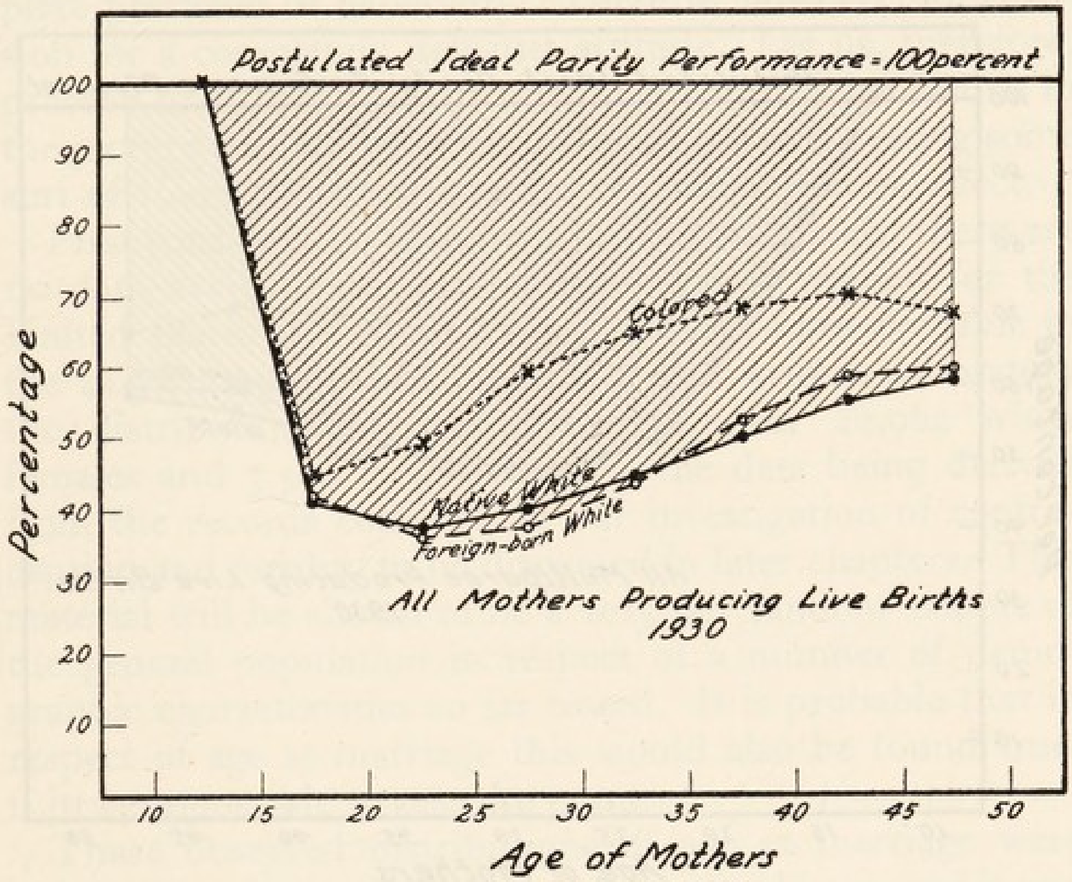


FIG. 22. Relation to postulated ideal mean parities of the actual mean parities of women producing live births in 1930. Data from Table 23.

coloured, which in turn is in part an expression of the smaller amount and lower efficiency of contraception among the coloured as compared with the whites.

The area cross-hatched in Fig. 23 represents the aggregate failure of mothers of live births in 1930 to keep pace in their mean parities at ages with a reasonable (in the sense of not making individually impossible physiological demands) postulated ideal parity performance, *after the effects of primiparity on average parity performance have been eliminated.* It is plain that this failure is, in the aggregate, still considerable. Also it is perfectly plain that eliminating the statistical effect of primiparity makes no practical difference in mean parity performance after age 25 is passed.

We must turn to other factors in any attempt to find out why these women bearing children in 1930 departed in their mean parity performance so far from the postulated

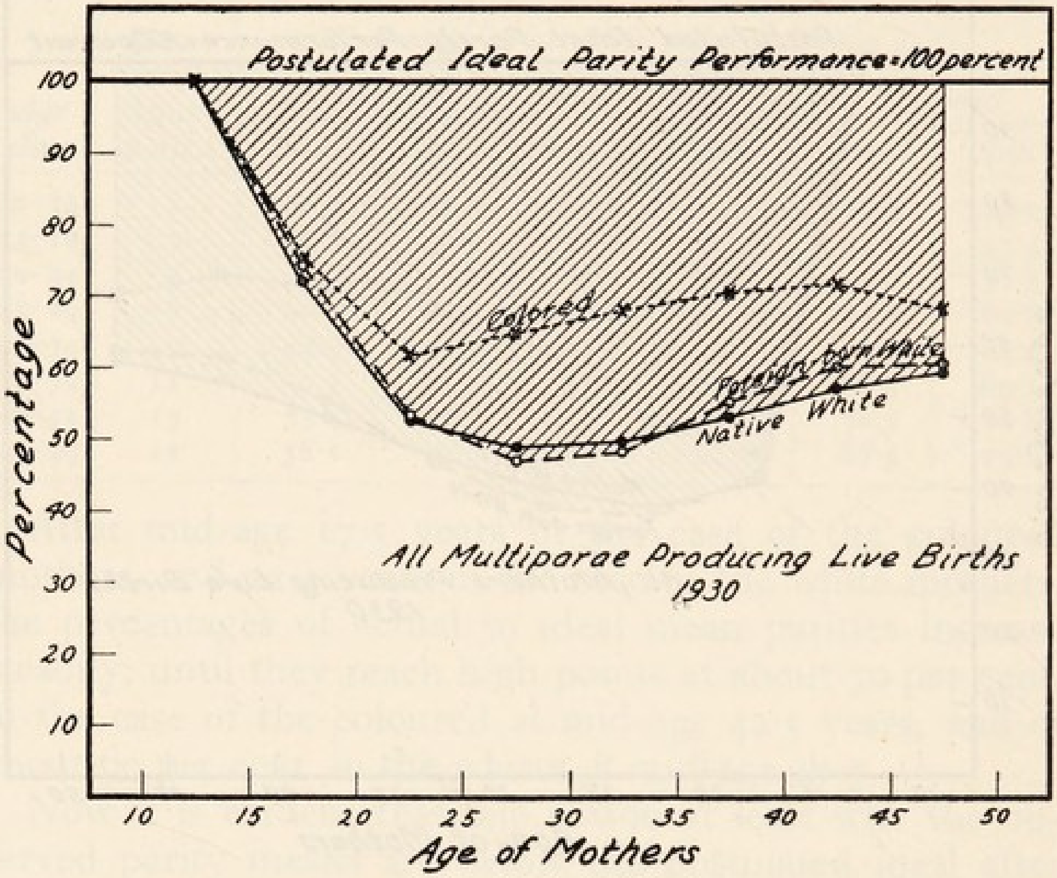


FIG. 23. Like Fig. 22, but for multiparae only.

ideal. It is reasonable *a priori* to suppose that, in a statistical sense, this aggregate failure in reproductivity is the consequence of the intermingled action of at least three important sets of factors:

(*a*) The postponement of marriage to varying extents after the attainment of the physiological ability to reproduce, shortly following menarche.

(*b*) Actual group physiological inability to keep up to the postulated ideal mean parity schedule as age advances, this inability being conceivably due to the interaction of a variety of causes, such as disease, gradually declining ovulation rates, gradual diminution of frequency of coitus, and others that may be conceived.

(*c*) The effective practice of contraception.

It is quite impossible with the data now available to appraise the relative influence of these factors with complete precision or generality. There is, however, no occasion for a completely defeatist attitude. Let us, therefore, proceed to examine one by one these three major factors in the picture and see what can be done towards getting some sort of rough approximation to their quantitative effect.

First consider *age at marriage*. Unfortunately, there are no data available for age at marriage of women for the United States as a whole. However, there are available in the as yet unpublished records of the writer's laboratory the distributions of age at marriage for 22,962 white females and 3,569 Negro females, the data being derived from the records collected in our investigation of contraception and fertility to be discussed in later chapters. This material will be shown to be a very fair random sample of the general population in respect of a number of demographic characteristics so far tested. It is probable that in respect of age at marriage this would also be found true, if it were possible to test the point.

These observed distributions of age at marriage were reduced to relative figures on a 10,000 total base, and it was then determined what the postulated ideal mean parities would be at successive quinquennial ages in a population that postponed its marriages after menarche in the way that the persons in these actual samples did. Then the observed mean parities at ages exhibited by the mothers of 1930 were compared with these new postulated ideal mean parity performances, now corrected for the postponement of marriage factor. In applying the correction to the postulated ideal figures it was assumed that the cohort of women marrying in *any* 5-year age period would produce an average of 1 live baby in that period, and of 2 in each succeeding 5-year period, leading to mean parities of 3 in the next age period after marriage, 5 in the next, and so on to and including the age period 40–44, which was the last age period in our data in which marriage occurred followed by pregnancy. This assumption is, of course, an extremely drastic one, in that it implicitly denies any diminution whatever of fertility with advancing age, and furthermore assumes that attitudes about having children are the same in all newly wed couples, regardless of their ages when they get married. But we are attempting to analyse one factor at a time, and therefore proceed this way.

To summarize, for the sake of complete clarity, what is now being done is to assume, as a postulated ideal mean parity performance, that women marry at ages corresponding to the actually recorded marriage ages of substantial samples of American women; produce an average of one birth in the age period in which they were married; and thereafter add two births in each succeeding quinquennium to their mean parity record, right up to the menopause.

The results are shown in Fig. 24.

It is evident at a glance that roughly something of the order of a half of the reproductive deficiency of the women of 1930 below the postulated ideal performance disappears when corrections are made for the effect upon mean parities of deferred marriages. In the age period 15–19 years the actually observed mean parities, for all the nativity–race (colour) groups are even higher than the postulated means.

With a rough approximation to the effect on mean parities of the first factor (age at marriage) in hand, we may turn to a consideration of the second factor, *the natural decline in innate fecundity and fertility with advancing age*. This is a phenomenon falling in the general category of senescence. Its quantitative appraisal in terms of mean parities here under consideration is difficult and uncertain, because of the meagreness of knowledge of the necessary physiological constants. As has already been pointed out in Chapter II the curves of declining fertility with advancing age to be found in the statistical literature are not particularly useful for the present purpose. On the basis of the data presented in Chapter II it has been assumed that the decline in true innate fertility with age is approximately linear from the 20–24 year age period through the 40–44 period, and that over the whole period the average rate of decline may be taken to be roughly about 3·3 per cent. per 5-year period in the case of the whites and about 2·1 per cent. per 5-year

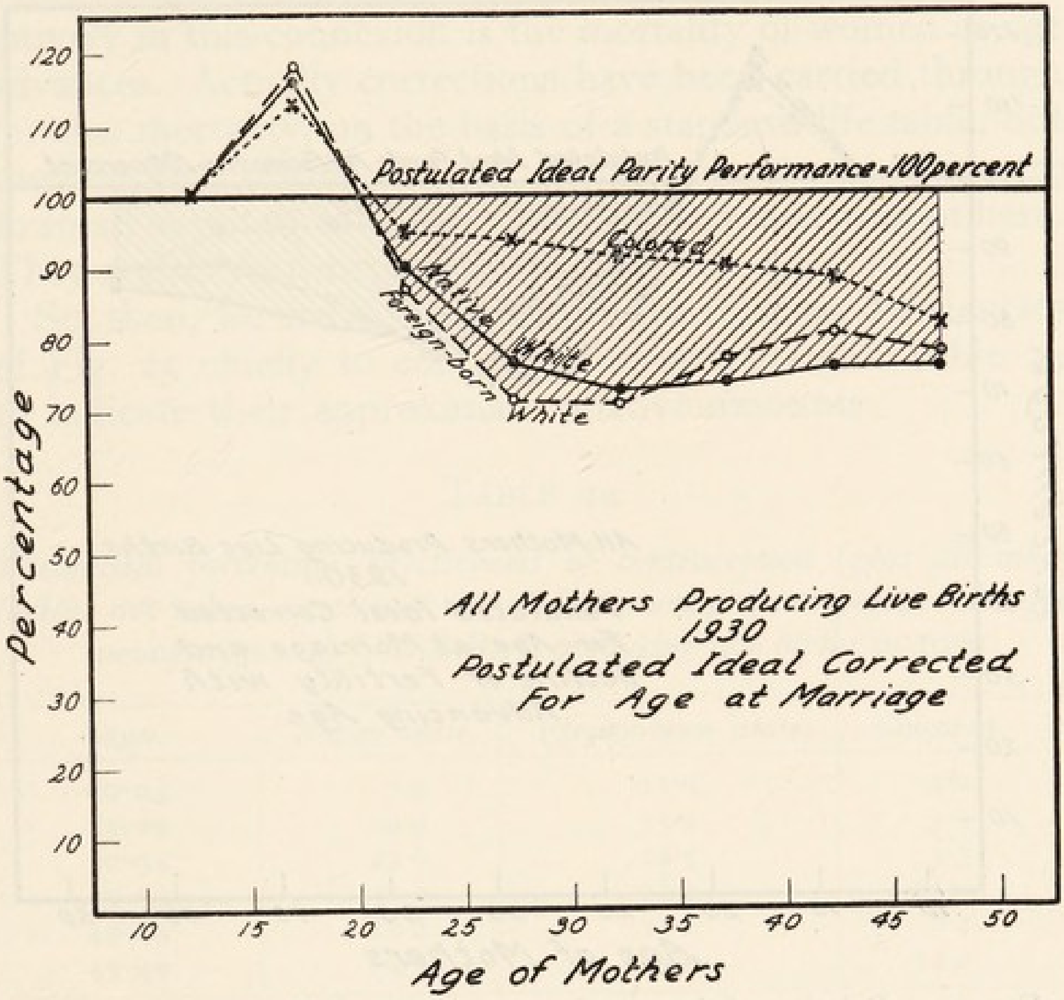


FIG. 24. Relation of the actual mean parities of women producing live births in 1930, to postulated ideal mean parities corrected for age at marriage.

period in the case of the Negroes. Corrections to embody these rates of decline were then applied to a population operating as to marriage age in the manner described in connexion with the correction for that variable already made above. The resulting relations of observed to theoretical mean parities after the double correction are shown in Fig. 25.

It is evident that after allowance has been made for postponement of marriage and for decline of innate fertility with advancing age there are left only relatively small deficiencies between the actual parity performance of women who bore live children in 1930 in the Birth Registration Area and a theoretical ideal breeding performance that would be not far below the maximal average for human

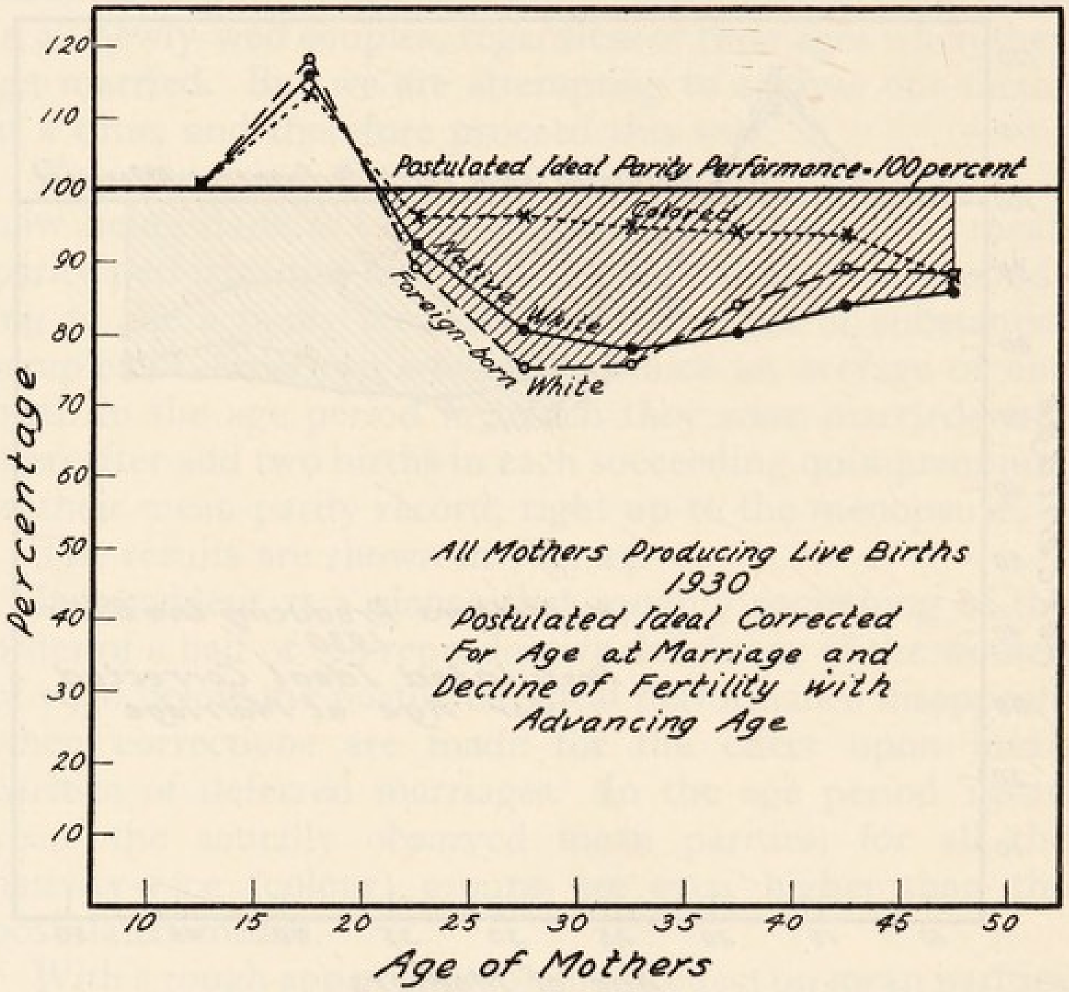


FIG. 25. Relation of the actual mean parities of the women producing live births in 1930 to postulated ideal mean parities corrected for age at marriage and for decline of natural fertility with advancing age.

populations. We have no sound basis for setting up postulates for the terminal age classes at either end of the reproductive life span, because too many variables are there involved about which adequate quantitative information does not exist. But in the period between the age intervals 20–24 years and 45–49 years inclusive the approximations seem fairly reasonable.

The differences between the observed and postulated parity performances (with corrections) shown cross-hatched in Fig. 25 are the net residuals left to be accounted for *as resultants of the practice of contraception in the general population* (factor (*c*) *supra*), plus whatever other factors not taken into account in making the corrections may be thought to be playing a significant role. The only other variable that seems likely to be worth considering quantitatively in this connexion is the mortality of women as age advances. Actually corrections have been carried through for this mortality, on the basis of a standard life table, but the resulting changes in the postulated mean parities are so small as not to be worth taking the space to present here. They are, in fact, negligible.

So, then, we are led to attribute the residual deficiencies of Fig. 25 chiefly to contraception and present Table 24 to indicate their approximate relative amounts.

TABLE 24

Theoretical percentage effectiveness of contraception (plus all other factors not taken account of above) in reducing mean parities at ages among women in U.S.B.R.A. producing live births in 1930

Ages	*Native white*	*Foreign-born white*	*Coloured*
20–24	7·9	11·0	4·0
25–29	19·9	15·2	3·7
30–34	22·6	24·5	5·3
35–39	20·0	16·1	5·9
40–44	16·2	11·0	6·4
45–49	14·5	12·0	12·2

It must be clearly understood, and for that reason it is re-emphasized, that the figures of Table 24 are not to be taken as indicating even approximately the total effect of contraceptive practices on the American national birth-rate. That table concerns only women overtly fertile in 1930, and the effect approximated is that produced by birth-control practices upon the mean parity performance of *these women only* over their whole reproductive lives to the date of record, and not the effect of birth control on the breeding of all women in the population. Obviously besides these women there exists a presumably large, but at present unknowable, body of women who were prevented from having a baby in 1930 as the result of their practice of contraception. If they could be brought into the picture naturally the total effectiveness of contraception would be numerically greater than is indicated in Table 24. How much greater it is impossible to estimate with accuracy. But a very rough approximation that suggests itself to the writer, after weighing all the evidence from the work we have so far done, is that the total effectiveness might be of the order of twice the figures of Table 24. But this is only the roughest of estimates and can claim no validity. It is, indeed, merely a suggestion.

The figures of Table 24, however, suggest with considerable force that contraception, as actually practised in the population, is not having nearly so great an effect in lowering the reproductivity of those women who from year to year are doing the national breeding as many would have us believe. Birth control appears to be producing its demographic effect mainly in another way. The further we proceed in the study of human fertility, the more evidence there appears to be for the idea that a distinction should be made between two classes of women: namely (*a*) those who appear as mothers in the annual birth statistics with considerable regularity, and whose total breeding performance once they are married is, as is shown in this chapter, not far below a theoretical ideal near the maximum for large population aggregates, and upon whose total breeding performance contraception has had no great effect; and (*b*) those women who, though married and potentially fertile, appear in the annual birth statistics either only once in their reproductive life span, or at most very occasionally, as a result either of their effective practice of birth control, or of a low innate fertility, or of a combination of both of these causes acting together. All the evidence appears to support the view that the proportion of women in the (*b*) category is steadily increasing and of those in the (*a*) category diminishing. It appears to us, subject to a revision of view if more knowledge of the real facts in this complex and difficult field compels it, that it is in the shifting of the proportions of women in these two categories that birth-control propaganda is having its most important effect upon the national birth-rate, rather than in any evenly distributed lowering of expressed fertility in the breeding population.

The crux of the matter, and next to the proportion of wholly childless marriages the most significant danger-signal for population pathology, is the proportion of first births to all births. A considerable fraction of first births are also *only* births. We are indebted to Notestein (31) for the most significant and precise contribution on this point in recent years. He showed that between 1890 and 1910 the percentages of so-called 'one-child sterility' in substantial samples of the population *increased* from 13·3 to 19·6 per cent. in professional-class families; from 14·0 to 21·5 per cent. in his 'business' category of occupations; from 13·3 to 17·0 per cent. in his 'skilled' class; from 12·4 to 14·9 per cent. in his 'unskilled' class; and from 8·8 to 10·1 per cent. in the 'farm owner' class. The implications of these figures are plain. Robinson (33) reports for Swarthmore College graduates 12 per cent. of 236 marriages of men (all ages) excluding widowers, and 16 per cent. of 227 marriages of women (all ages) excluding widows, producing only one child. In two French districts Neumann (11) reports percentages of one-child sterility of 24 and 20 respectively. Chervin (89), on the basis of the 1886 census returns, reported 24·4 per cent. of one-child families in France as a whole, and 27·0 per cent. for Paris alone. Turquan (01) gives figures for France in 1896 showing that among 1,993,033 families, of known and recorded size, where the marriage duration had been 25 years or over, the percentage of one-child families was 21·1, while the percentage of wholly childless families was only 12·4. These figures, however, probably include a certain number of families to which one or more children will be later added. Even where there is no significant voluntary contraception the amount of this one-child sterility can be very considerable, as a result of venereal disease (especially gonorrhea) and other less well understood causes. Külz

(20) found among the natives of Yap that of 306 women past the menopause 102, or 33 per cent., had been sterile after producing only one child. Mathews (06) in 1,000 consecutive gynecological dispensary histories found 8·2 per cent. of 'one-child sterility'. He concludes that it is at least as frequent as total sterility in its incidence. He quotes Schenk (*Die Pathologie und Therapie der Unfruchtbarkeit des Weibes*, Berlin, 1903) to the effect that it occurs in from 5 to over 8 per cent. of all marriages.

10. *Ages at Specified Parities*

Up to this point parity performance has been discussed from the viewpoint of mean parity associated statistically with age of mother in quinquennial classes. Let us now look at the matter from the opposite direction, namely, mean age of mother associated with each ordinal degree of parity performance. What is the average age of mothers at the birth of their first living child, their second, and so on? What degree of variation do mothers exhibit in age at these several orders of birth?

Table XI of Appendix I gives the biometric constants for age of mother at the birth of living children from parity order 1 to 14 inclusive, and orders 15–24 (native white), 15–23 (foreign-born white), and 15–25 (coloured) grouped. The mean ages from that table are shown graphically in Fig. 26.

The mean ages of mothers at successive parities rise in smooth curves. The foreign-born white mothers of 1930 showed the highest mean ages at all parities, by relatively large amounts up to and including parity 5, and thereafter by progressively smaller amounts. The coloured mothers had the lowest mean ages at all parities. This confirms from another angle the point that has been frequently alluded to above. The coloured (chiefly Negro) portion of the American population does its breeding early. The native whites take an intermediate position throughout in mean ages at the birth of their successive children.

There has been plotted on Fig. 26 the line that would result if it were assumed that all women started reproducing at the inter-group average age at menarche and kept steadily and evenly at it until the inter-group mean age at the menopause. The differences between this line and the curves of actual mean ages at successive parity orders show the extent to which the manifested age-parity per-

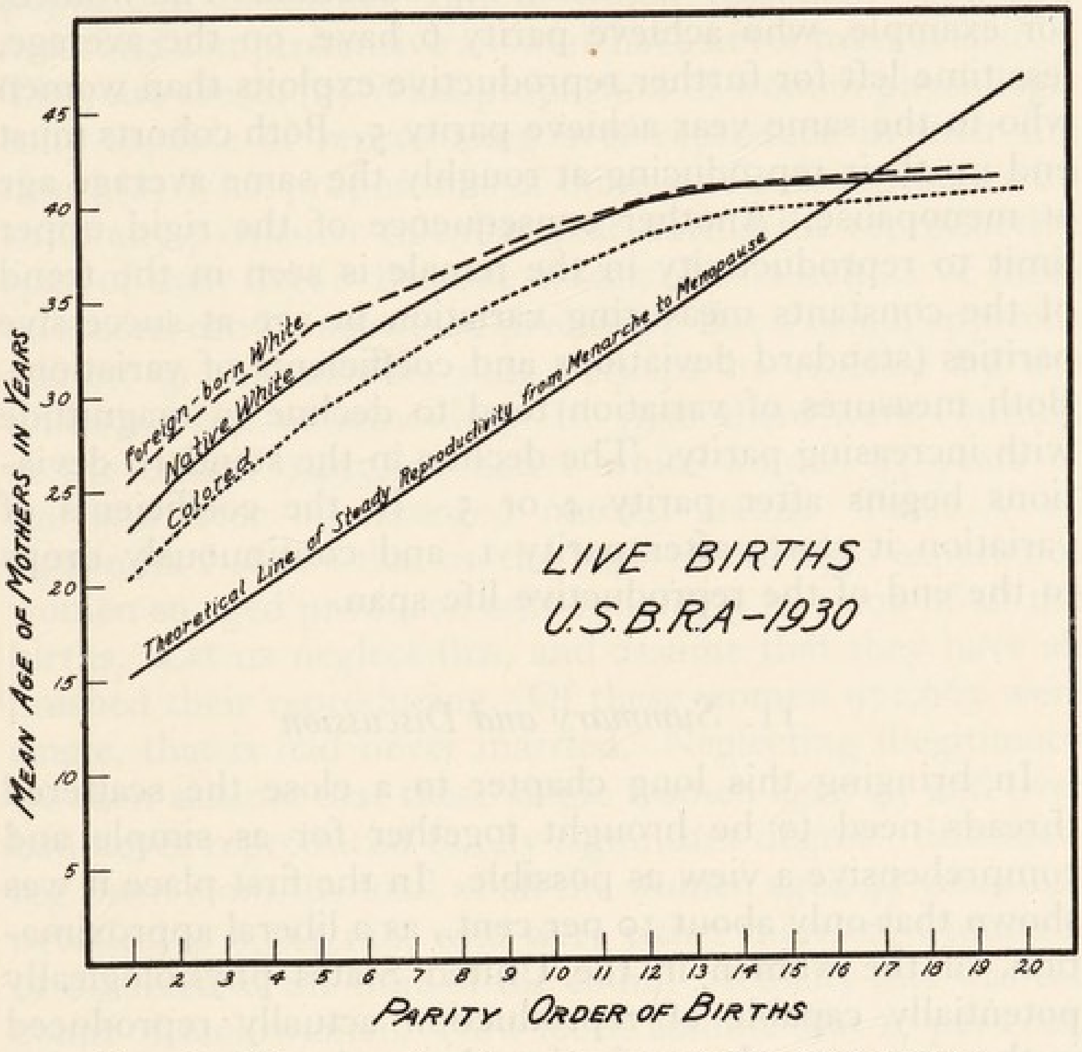


FIG. 26. Mean age of mother at successive live-birth parities.

formances of actual reproducers in the several groups lagged behind the theoretically perfect performance quantitatively. The lines do not cross (actual equal to theoretical performance) until parities of 16 or 17 are reached. The actual curves lie above the theoretical line for most of their course chiefly because of the combined effects of postponement of marriage after puberty, contraceptive practice, and smaller innate fertility of women actually reproducing than in the women postulated to give the theoretical performance.

The first order differences between the mean ages at successive parities become steadily smaller as parity order increases. This theoretically must be so, because both parity performance and age have upper limits imposed physiologically by the menopause, and by the long gestation period characteristic of human reproduction. The women, for example, who achieve parity 6 have, on the average, less time left for further reproductive exploits than women who in the same year achieve parity 5. Both cohorts must end up their reproducing at roughly the same average age at menopause. Another consequence of the rigid upper limit to reproductivity in the female is seen in the trend of the constants measuring variation in age at successive parities (standard deviations and coefficients of variation). Both measures of variation tend to decline in magnitude with increasing parity. The decline in the standard deviations begins after parity 4 or 5. In the coefficients of variation it starts after parity 1, and continuously drops to the end of the reproductive life span.

11. *Summary and Discussion*

In bringing this long chapter to a close the scattered threads need to be brought together for as simple and comprehensive a view as possible. In the first place it was shown that only about 10 per cent., as a liberal approximation, of the women in the United States physiologically potentially capable of reproduction actually reproduced in the year 1930. It was further shown that this proportion was definitely smaller, for all the age groups of mothers except the youngest, in 1930 than it was in 1920, and that there was some reason to believe that this change probably could not be wholly attributed to an increase of contraceptive efforts in the population in the ten-year period.

These results relate to the reproductive performance of a single year. But the figures on which they are based are relatively stable from year to year, except for slow secular trends. While the mothers in one calendar year are not altogether the same individual women who were mothers the year before, or will be mothers the next year, the absolute (and relative) numbers of mothers change only comparatively slowly from year to year.

There are two questions that were not discussed that have a great deal of intrinsic interest in any thinking about population problems, and to which reasonably approximate and comprehensive answers have never been available. They are these: (*a*) What proportion of women physiologically capable of reproducing ever reproduce in their life time? (*b*) What proportions of those who ever reproduce do so in any particular calendar year during the reproductive span of their lives? Because of lack of data neither of these questions can be answered precisely. But a rough approximation to the answers may perhaps be reached by the following line of reasoning. In 1930 there were counted in the census 9,495,811 native white women 45 years of age and over of recorded marital status. Table V of Appendix I shows that on the basis of the 1930 experience women so aged produced only roughly 3 in 1,000 of all the births. Let us neglect this, and assume that they have all finished their reproducing. Of these women 971,663 were single, that is had never married. Neglecting illegitimacy we then assume that these single women aged 45 and over had never reproduced to any significant degree. Subtracting them from the total of all the women aged 45 years and over leaves 8,524,148, who were either married, widowed, or divorced at the time of the count. Actually this was the count of such women. Now let us assume that 17 per cent. of the marriages in which the married women had been partners, were childless. This is the writer's estimate for the native white population of the country as a whole, based in part upon his interpretation and judgement of the findings of Notestein's (31) sample of completed families in 1920. This seems a conservative estimate because the trend observed by Notestein between 1910 and 1920 undoubtedly continued to 1930, and probably accelerated. This estimate is practically identical with that of Lotka (28) of 17·1 per cent. On account of the trend towards an increasing proportion of childless marriages already mentioned it seems conservative to put the proportion of childless marriages in 1930 for the whole group at 20 per cent. as a round figure.[33] On this basis we subtract 1,704,830 women for childlessness. This leaves 6,819,318 native white women who presumably reproduced to some greater or smaller extent during the period of their lives between 15 and 45 years of age. This is 17·8 per cent. of the total number with which we started. Considering the extremely approximate nature of the sum we have done, the tentative conclusion may be put that roughly about 70 to 72 per cent. of the native white women 45 years of age and over living in 1930 had probably done something towards reproducing their kind in the years prior when they were biologically capable of it. Let us boldly generalize this, solely for the sake of argument rather than as an ascertained fact, and say that of all women within the defined universe of discourse who are within the ages of 15–44 years inclusive some 70 per cent. will be reproducers at some time during their lives.

Now, accepting this as a datum in the argument we embark upon another sum. There were 22,120,424 native white women of recorded age and marital status who were aged between 15 and 44 years inclusive in 1930. Seventy per cent. of that number is 15,484,297. Neglecting some errors involved let us take these to be the number who will at some time in their careers make a reproductive contribution. In the year 1930, taking no account of various small errors involved, about 2,100,000 of them did so contribute. So then we are led to a second tentative conclusion that in round figures roughly about 14 per cent. of women who will ever reproduce in their lifetimes do so in any single particular year that might be chosen for observation, but of course not the *same* 14 per cent. in each consecutive year.

It must again be emphasized that these are highly speculative and approximate sums we have been doing. But it seems probable that if they were refined to the highest degree possible with any data now available the final percentages would not be greatly changed from those here set down.

The discussion of *patterns of reproductivity* started from the idea that the normal primitive pattern of reproduction in mammals implies (*a*) that the mean age of mothers of first births should be only a little above the mean age at puberty or menarche (taken as the beginning of the physiological possibility of reproducing by the female); (*b*) that the amount of variation in mothers in age at first birth should be small; (*c*) that the mean age of mothers of all parities should be at about the mid-point between the ages at menarche and menopause; and (*d*) that the variation in age of women at births of all parities taken together should be generally of the same order of magnitude as variation in total duration of menstrual life (the span of reproductive capacity). Quantitative appraisal of actual performance in relation to each of these four points showed that the women in the U.S. Birth Registration Area bearing children in 1930 exhibited a pattern of reproductivity widely divergent from that theoretically characteristic of mammals lower in the evolutionary scale, in all respects tested. The divergences were greatest in the performance of primiparae. Among the nativity–race (colour) groups the coloured came closest to the infra-human mammalian pattern, so far as concerns primiparae, and on the whole farthest from it in the respects in which the behaviour of women of all parities was tested.

Adequate reproductivity was discussed on the basis that if a woman produces in any given year her fourth living child (or child of parity order higher than IV) she may fairly be regarded as having demonstrated that she has adequately reproduced. The most striking result that emerged from the analysis of the data on this point was found in the age and nativity–race (colour) differentials. While only just under 8 per cent. of the white women *producing live births in 1930 in U.S.B.R.A.* in the age group 20–24 years were having their fourth or higher parity live birth, nearly 21 per cent. of the coloured mothers were so doing. In the next higher age class (25–29 years) just slightly under 60 per cent. of the coloured women had completed their proof of adequate reproductivity, as against about half as many relatively among the white women. Over three-quarters of the coloured women aged 30–34 years were quadriparous or better, as against only a little more than half the white women in the same age class. In every age period of reproductive life the percentage of IV- and higher-parous women is greater among the coloured than among the white. The adequate reproductivity curves of the native and foreign-born white women do not differ markedly from each other throughout their courses.

So far as it is possible to appraise them it appears that the trends of human reproduction in the American population at the present time are generally towards greater and greater departure from the infra-human mammalian pattern.

IV

THE EXTENT OF CONTRACEPTIVE EFFORT IN THE AMERICAN POPULATION

1. *The Need and Acquirement of* ad hoc *Data*

OFFICIAL statistics pertaining to the size and movement of population reveal directly only end results, and little or nothing about the biological processes by which those results were reached. As has already been emphasized in section 9 of Chapter II one of the most important of these processes affecting its expressed fertility and growth is the aggregate effort made by a population to prevent conceptions occurring that would be expected to follow the free and untrammelled exercise of sexual instincts.

Many years ago the writer began to give thought to the question of how it might be possible to get a large sample of homogeneous material with which to make a penetrating frontal attack upon the underlying problems of human fertility. What was plainly wanted was a collection of the entire reproductive histories of a considerable number of normal women, together with as much detailed information as possible about other relevant circumstances of their lives; educational, social, economic, &c. Most particularly was it essential to have complete and detailed records about contraceptive practices. At that time practically the only information available on this latter point was such as had come from birth-control clinics. Long experience with that kind of material had engendered deep and well-founded suspicion of its adequacy, comprehensiveness, and validity, when considered from a strictly objective scientific viewpoint. But how could one get anything better?

In 1924 the idea began to develop of turning to the obstetric services of first-class urban hospitals as a source for the desired material. There one had women under the observation of a trained medical personnel from before parturition through the puerperium and subsequent rest and convalescence, under conditions quite detached from the home and its inhibitions. As a part of the regular routine of the obstetric service the detailed medical and reproductive histories of these women were taken. Before the women left the hospitals with their babies friendly relations of trust, confidence, and gratitude had been, in the vast majority of cases, established with the attending nurses, interns, and senior physicians. It seemed probable that under these circumstances, if anywhere, it would be possible to get the kind of detailed, comprehensive, and accurate information that was wanted about intimate personal matters.

So, as an experimental trial, a plan to collect such data in this way was developed at that time. A record blank was drawn up, and the late Dr. J. Whitridge Williams, professor of obstetrics in the School of Medicine of the Johns Hopkins University, made arrangements to have the plan put into operation in the obstetric wards of the Johns Hopkins Hospital. A few records were collected from that source at that time, but only a few. The plan languished and eventually all attempts at its operation stopped, chiefly because everyone involved in the matter was too fully occupied with other things. Particularly the residents and interns on the service, upon whom devolved the labour of getting the data from the patients, were too busy to do it except in their spare time, and no funds were available to pay them anything for their trouble. The whole project consequently lay fallow until the autumn of 1929. During this period general interest in the problems of population had greatly developed. A World Conference on population had been held (cf. Sanger, 27), an International Union for the Scientific Investigation of Population Problems had been formed and put into operation; various university departments and other institutions had embarked upon the active promotion and prosecution of research in the field. Among the latter was the Research Division of the Milbank Memorial Fund, which had most generously aided the International Union in its work. In 1929 an interest was expressed by the late Mr. Edgar Sydenstricker and Mr. John H. Kingsbury of the Milbank Memorial Fund to have our old and then moribund project rehabilitated and continued to fruition on an adequate scale. This was made possible by a substantial grant for the year 1931. Subsequent grants of needed funds beyond what could be applied from the regular budget of the Department of Biology of the Johns Hopkins University have continued during the work. I wish to express here again my deep appreciation and gratitude for this generous aid.

With sufficient funds available to carry on the work the initial plans were critically reviewed and revised. At the writer's request the following persons agreed to serve as an Advisory Committee in connexion with the project: Dr. Carl G. Hartman, Dr. John R. Miner, Prof. Lowell J. Reed, Mr. Edgar Sydenstricker, and Dr. J. Whitridge Williams, with the writer as chairman. A staff was appointed and began work on July 1, 1931, and the inflow of record cards started in August.

2. *The Plan*

The plan adopted, in briefest outline, was to have a simple but rather comprehensive history card filled out for each woman delivered of a baby in the obstetric service of some hospital located in or near a large city east of the Mississippi River. This geographic restriction was imposed to keep down expenses. The history carried basically three broad categories of information: First, the entire reproductive history of the woman; second, an account of her use of contraceptives; third, information as to her social, educational, economic, health, and religious status. A facsimile of the history card actually used will be found in Appendix II, where there is also given a complete copy, with discussions and explanations, of the instructions to the medical personnel who recorded the histories. Essential elements of the plan were (*a*) that the basic records were all to be made only by medical persons, especially trained in the field of obstetrics, having the confidence of the patient on the one hand, and the technical knowledge and training on the other hand, to ensure the maximum degree of scientific accuracy and completeness of the records. (*b*) The records were to come from hospitals in large cities east of or on the

Mississippi River, and north of the southernmost tier of states. (*c*) No data were collected from hospitals controlled by the Roman Catholic Church. The reason for this voluntary limitation on the collecting of the material was a simple one. The Catholic Church is officially opposed to the practice of contraception. Even if the Catholic hospitals were willing to co-operate in such an investigation as this, it is improbable that a patient of that faith who had in fact practised contraception would be willing to admit it to a Catholic physician in a Catholic hospital. Catholic women are included in the data. But they attended non-Catholic hospitals for their deliveries. Other limitations of the material consequent upon its collection have been discussed in detail in Pearl (32) and need not be repeated here.

Our debt of gratitude to the hospital workers who made the basic records is enormous and beyond all adequate expression. The pittance that was paid for what they did was insignificant. Hospital interns, residents, and staff members lead a busy and harassed life at best. That they were willing to take on the additional burden of filling out these history records to aid a research enterprise in which they could, because of practical necessities, have no further part speaks in no uncertain terms of their fine spirit, both as scientists and as human beings.

Naturally not all the records they turned in were of equal value, in spite of all our checks and persistence in getting them set straight. Medical men and women vary just as much as do other human beings in their talents and intellectual abilities. Five or six of the workers who turned in relatively large numbers of histories uniformly produced extraordinarily fine and detailed records, at the expense, obviously, of a great deal of time. It would be a pleasure to single them out for especial mention by name. But on the whole it seems hardly fair to many others who also did excellent work to do this. To all go our sincerest thanks.

The handling of the records after they reached the laboratory fell naturally into four phases. They were:

(*a*) Checking and filing.

(*b*) Computation of derivative items.

(*c*) Coding.

(*d*) Punching on Hollerith cards, verifying, and tabulating the data.

Checking and Filing. When the record cards reached the laboratory they were first checked in, as to numbers and source of origin, for the purpose of keeping track of payments due the workers for the cards and postage, and knowing what to send back to the workers in the way of supplies (blank cards and envelopes) so that their stock on hand might not be unduly depleted.

Each card was then gone over carefully and critically in detail to be sure that each item of information called for had been duly entered, and that there were no inconsistencies or ambiguities in the record as it reached us. If the card satisfactorily passed this scrutiny it was stamped with a serial number in the upper right-hand corner, and filed. If the card did not pass the inspection, a duplicate of it, *verbatim et literatim*, exactly as it reached us, was made. On this copy were placed blue pencil marks indicating the missing or doubtful items, and this copy together with a letter discussing the matter and making plain what further information was wanted, was promptly mailed to the worker who originally sent it in, with a request that it be put in order and sent back to us as soon as possible. In the meantime the original was held in the laboratory, without any serial number, until the case was cleared up, or it was found impossible to get the desired information. Only when the case had been disposed of in one or the other of these ways was it given a serial number and filed. The original record cards were filed in order of their serial numbers in steel cabinets.

Computation of Derivative Items. On the original records no ages were directly given. Instead dates of birth and marriage were recorded by the hospital worker.[34] From these dates, ages and lapses of time were computed and entered on the card in red ink, use being made of the tables of Pearl and Miner (32).

In addition to these simple age and lapsed time data it was necessary to make much more elaborate derivative computations of data necessary for a critical and scientific expression of fertility rates (pregnancy and birth-rates). The reasoning on which the method used was based, which was developed by the author (Pearl, 33) for the purpose of this investigation, has been fully described in section 8 of Chapter II, and need not be repeated here. The formula for live-birth rate used in the work was identical with that for the pregnancy rate, except for the substitution, in the numerator, of the number of live births produced, in place of the number of pregnancies.

A computation form[35] was filled out for each of the original history cards. Since there were 30,949 of these histories the magnitude of the computational task is apparent.[36]

On the finished computation sheets the last two lines (Items 14 and 15) were entered in red ink, and from these two lines the rates were punched on Hollerith cards. To indicate the meaning of the final results Items 14 and 15 from a typical case record may be reproduced here and interpreted. This is the case of a white woman, number 19,346 in our records. She was married when 19 years old and experienced her first pregnancy when 20 years old. Altogether she had experienced 11 pregnancies up to the time of record, that is in 12·11 years of actual net exposure in the sense of years in which she was not already pregnant. Of these, 9 pregnancies resulted in live births and 2 in spontaneous miscarriages. Items 14 and 15 of the computation sheet read as follows:

	Age periods							
	10–14	*15–19*	*20–4*	*25–9*	*30–4*	*35–9*	*40+*	*Total*
Item 14. Pregnancy-rate—Code Nos.	XX	00	26	04	00	11	XX	06
Item 15. Birth-rate—Code Nos.	XX	00	17	04	00	11	XX	05

Interpreted, this record means that the woman was not exposed to risk of pregnancy during the age period 10–14 because not married. She was exposed to risk during a part of the age period 15–19, but no fertility was exhibited in that period. In the period 20–24 she exhibited a pregnancy-rate of 26 per hundred computated ovulations and a live-birth rate of 17 per hundred computed ovulations. In the period 25–29 she exhibited, to the nearest whole number, a pregnancy and live-birth rate each of 4 per hundred computed ovulations. In the age period 30–34, though exposed to risk of pregnancy, she exhibited pregnancy and birth-rates of zero. In the age period 35–39 she exhibited pregnancy and birth-rates, each to the nearest whole number, of 11 per hundred computed ovulations. In the age period 40+ she was not exposed to risk because at the time of observation she had not reached the age of 40. In her total reproductive life to the time of record she had exhibited a pregnancy rate of 6, and a live-birth rate of 5, each per hundred computed ovulations.

Coding. The intricate statistical tabulations essential to the analysis of so large and complex a body of material as that to be dealt with necessitated the employment of a mechanical system of tabulation. As a preliminary to this it was necessary to assign code numbers to all items of information not already in numerical form. The job of coding in this way the 30,949 reproductive histories of this material was a heavy and time-consuming one. It was handled in the following way. First of all the writer drew up a code book, assigning code numbers to each item of information requiring coding. The code used for occupation of husbands and made a part of the code book was one already published by Pearl (33). Then a most careful and intelligent assistant, Mrs. Augusta K. Hibbitts, marked on each original history card the proper code numbers for all the simple routine items that required merely the translation into the numbers of the code book of facts directly stated in the history. These items included:

1. The name of the hospital.
2. Religion.
3. Occupation.
4. Contraception species.

Each card was then checked individually by the writer to ensure the accuracy of Mrs. Hibbitts's coding relative to those four items.

The coding of all other items of information on the histories, without exception, was done *in the first instance* by the writer. It was a tedious business, but worth the trouble. Two great advantages resulted from this procedure. In the first place the writer got a first-hand, direct, personal knowledge of each individual case history in the entire material, an invaluable balancer and governor of his general judgements in all the subsequent analytical treatment of the data. In the second place, uniformity of judgement was assured in the coding of all points where judgement and technical knowledge of the field and its background were involved.

The punching was a somewhat more complicated process than usual, in that the first 46 columns were punched from the two sides of the original record card, while columns 47–80 inclusive were punched from the computation sheet belonging to this case. This meant that a prerequisite was to have the original record cards and computation sheets sorted in identical order.

To check and verify the accuracy of the punching it was decided to punch two complete sets of cards independently from the original data, and then have them mechanically compared on a machine especially designed for this purpose. So then, after the whole 30,949 cards had been punched they were stored away, and the work was started again from the beginning. Besides furnishing the best of all checks for accuracy of punching the possession of two complete duplicate sets of cards had the great advantage of facilitating in many ways the subsequent tabulating operations.

All of the punching was done by Mrs. Hibbitts, and the speed and accuracy that she developed proved to be nothing short of marvellous. Of the total of 61,898 cards only 219 turned out to be incorrect as originally punched. Considering the complications involved this can justly be regarded as something of a record.

The tabulations have been made on a large horizontal counting sorter, rented from the International Business Machines Corporation, the results being taken off from the counters by hand.

3. *General Characteristics of the Data*

There will now be presented some general demographic characteristics of the material, in order that some judgement may be formed as to the extent to which it may be regarded as constituting a representative sample of the general population from which it was drawn.

Table 25 shows the geographical distribution of the cases, by states, cities, and race (white or Negro). The material involves 30,949 women resident in or near 26 large cities in 15 states, east of (or on) the Mississippi River, and north of the southernmost tier of states (Alabama, Mississippi, &c.). Eleven cities in 4 states (New York, Illinois, Ohio, and Missouri) furnished 16,900, or 54·6 per cent. of the cases. The others are scattered as indicated in the table.

TABLE 25

Geographical Distribution

States and Cities	*Number of co-operating hospitals*	*Total white cases*	*Total Negro cases*	*Grand total all cases*
New York (New York City, Rochester, Buffalo, Syracuse)	31	4,729	838	5,567
Illinois (Chicago)	20	4,155	193	4,348
Ohio (Columbus, Cleveland, Cincinnati, Toledo, Akron)	16	3,212	861	4,073
Missouri (St. Louis)	7	2,017	895	2,912
Minnesota (Minneapolis, St. Paul)	12	2,729	44	2,773
Michigan (Detroit, Ann Arbor)	10	2,161	393	2,554
Pennsylvania (Philadelphia and suburbs, Pittsburgh)	16	1,901	619	2,520
Maryland (Baltimore)	9	1,654	684	2,338
Tennessee (Nashville, Memphis)	6	567	738	1,305
Indiana (Indianapolis)	3	738	46	784
Kentucky (Louisville)	3	429	305	734
Wisconsin (Milwaukee)	3	643	1	644
Massachusetts (Boston)	1	248	9	257
District of Columbia (Washington)	1	120	..	120
New Jersey (Jersey City)	1	13	7	20
Totals	139	25,316	5,633	30,949

	White	Negro
Percentage of women in present sample . .	81·8	18·2
Percentage of living births in the 15 states in 1931 and 1932	94·5	5·3
Percentage of living births in Birth Registration Area in 1931 and 1932	87·3	11·3

Negroes are somewhat more frequently represented in the sample than in the general population of the states from

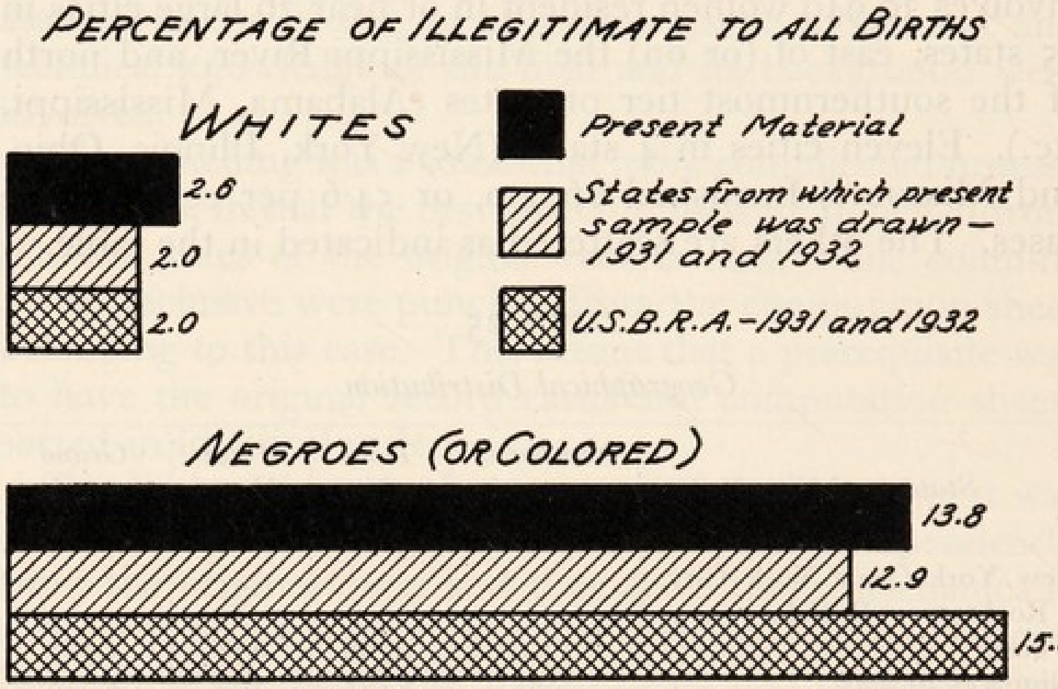


FIG. 27. Percentages of illegitimate to all births in (*a*) the present material, (*b*) the states from which the present sample was drawn (excluding Massachusetts), and (*c*) the U.S.B.R.A. for births of 1931 and 1932 together.

which it was drawn, or than in the United States as a whole. This, however, is rather an advantage than otherwise, because even 5,633 Negro cases are not enough, as will presently appear, to furnish adequate data when we come to finer categorical divisions relative to contraception, &c.

The 15 states from which the present data are drawn included in their population (in 1930) 61·7 per cent. of all white women in the United States 15 years of age and over, and 30·4 per cent of all Negro women in the country in the same age category. It is therefore probable that if the present sample fairly represents the population from which it was drawn it will also be fairly representative of the population of the United States as a whole, particularly so far as concerns white women.

Fig. 27 shows that the present sample agrees rather closely with the general population of the states from which it was drawn (excluding Massachusetts which keeps no records of illegitimacy), and with the general population of the United States as a whole, in respect of percentage of *illegitimacy*. On purely *a priori* grounds it might have been thought that the percentage of illegitimacy shown in a

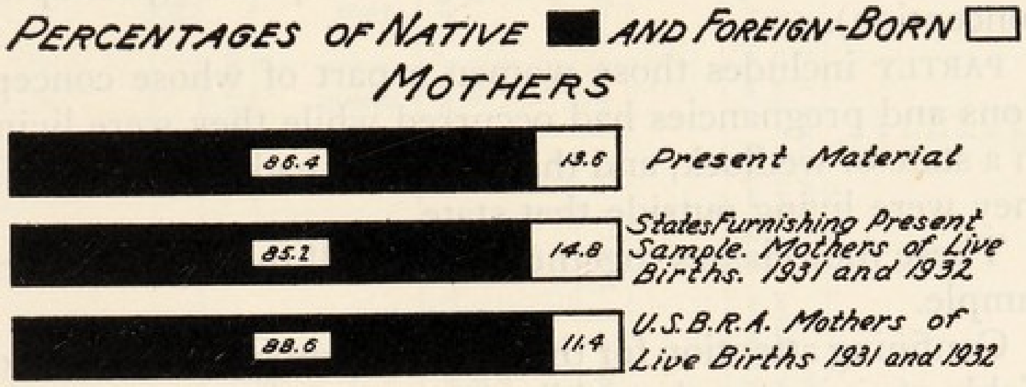


FIG. 28. Percentages of native and foreign-born mothers in specified groups.

sample of urban-dwelling women resorting to hospitals to have their babies would be considerably higher than in the general population, but the data plainly give no significant support to such a view. In short the present sample appears to be fairly representative of the general population in this respect. Similarly it is evident from Fig. 28 that in respect of *nativity* of white women, the present sample is very fairly representative of the general population not only of the states from which it was drawn, but also of the United States as a whole.

Table 26 deals with the *religion* of the women in the present sample. In Part A of the table the material is thrown into five broad religious groups. In this classification 'Christians' includes the women who expressed no denominational affiliation or preference, but wished it to be understood that they were neither Jews nor atheists.

The groups at the head of Part A of Table 26 have the following meanings:

INWED includes those women who experienced all their pregnancies while they were living in the state of wedlock.

OUTWED includes those women who experienced all their pregnancies while living outside the state of wedlock. This class includes two subclasses. Of these the first (ILLEG) includes those women who had never married up to the time of record. The second (PRENUP) includes those women who had conceived outside of wedlock, but who had subsequently married before the time of record and before the delivery of the products of their conceptions (prenuptial conception).

PARTLY includes those women a part of whose conceptions and pregnancies had occurred while they were living in a state of wedlock, and the other part had occurred while they were living outside that state.

These four classes together include all the women in the sample.

Confining attention for the moment primarily to Part A of Table 26, it is seen that while among the whites just under half are Protestants, the Catholics are a rather close second in total representation. Actually, as Part B shows, there were more than twice as many Catholic women proportionately in the sample as there were of any other single denomination. The Protestants overtop the Catholics in the total because of the cumulative effect of their numerous separate denominations or sects. Among the Negroes, the Protestants overwhelmingly predominate.

A point of particular interest in Part A of Table 26 is the extremely low proportion of Jews, as compared with other religious categories, found in the OUTWED and PARTLY classes. The figures speak well for the extent to which the standards of sexual morality in the Jewish code are lived up to, even in present-day urban populations.

Turning attention now to Part B of Table 26 it is evident that the present sample is very fairly representative of the general population of the United States as a whole in respect of affiliation with the six principal separate denominations, which together include just under 80 per cent. of all persons having any religious affiliations at all. The greatest departure

TABLE 26

Religion

PART A

Religion	Whites							Negroes							Totals
	INWED	OUTWED			PARTLY	*Total White*	*Per cent. White*	INWED	OUTWED			PARTLY	*Total Negro*	*Per cent. Negro*	*Both races*
		ILLEG	PRENUP	*Total*					ILLEG	PRENUP	*Total*				
Protestants	10,703	379	436	815	442	11,960	47·2	3,291	706	420	1,126	779	5,196	92·2	17,156
Catholics	8,842	245	368	613	360	9,815	38·8	233	49	28	77	33	343	6·1	10,158
Jews	2,805	18	15	33	27	2,865	11·3	137	..	..	..	..	1	0·05	2,866
Christians	402	12	11	23	10	435	1·7	15	2	2	4	3	22	0·4	457
No religion	213	13	6	19	9	241	1·0	31	20	8	28	12	71	1·3	312
Total	22,965	667	836	1,503	848	25,316	100·0	3,571	777	458	1,235	827	5,633	100·05	30,949

PART B

Denominational Groups	*Percentage of women (both races) in present material*	*Percentage of members of denomination in the United States in 1926*
Catholic	32·8	34·1
Baptist	14·7	14·7
Methodist	11·4	13·9
Jewish	9·3	7·5
Lutheran	7·9	5·0
Presbyterian	3·1	4·3
Six Denominations together	79·2	79·5

of the present sample from the general population is for the Lutherans, probably connected with the fact that we are dealing only with residents of large urban centres. But, taken as a whole, Part B of Table 26 shows clearly that there is no reason to mistrust the present sample on grounds of religious distribution.

TABLE 27

Education

PART A

Highest degree of formal education	*Total White*	*Per cent. White*	*Total Negro*	*Per cent. Negro*	*Grand total*
Illiterate . .	526	2·1	294	5·2	820
Elementary schools	14,605	57·7	3,657	64·9	18,262
High school . .	8,513	33·6	1,575	28·0	10,088
College or university	1,672	6·6	107	1·9	1,779
Total . .	25,316	100·0	5,633	100·0	30,949

PART B

Percentages of ILLEG, PRENUP, *and* PARTLY *classes, by extent of formal education*

Highest degree of formal education	ILLEG		PRENUP		PARTLY		*Total of three classes*	
	White	*Negro*	*White*	*Negro*	*White*	*Negro*	*White*	*Negro*
Illiterate . .	3·6	14·3	0·8	1·7	5·7	28·6	9·5	44·6
Elementary schools . .	2·8	14·5	3·6	7·2	4·2	15·7	10·6	37·4
High school .	2·5	12·7	3·5	11·5	2·2	10·4	8·2	34·6
College or university . .	1·7	5·6	1·0	7·5	0·9	4·7	3·6	17·8

PART C

Illiteracy percentages

Illiteracy percentage in	*Whites*	*Negroes*	*Both races*
Present sample	2·1	5·2	2·5
Females in states from which present sample was drawn, 1930 (Ages 15 and over)	3·3	7·4	3·5
Females in U.S.A., 1930 (ages 15 and over)	3·1	16·7	4·4

Table 27 deals with the formal *education* of the women in the sample. Part A shows that about 40 per cent. of the white women, and about 30 per cent. of the Negro women, received some high school or higher educational training. Unfortunately no statistics are known to the writer that would make it possible to determine whether these proportions are fairly representative of conditions in the general population or not. It appears probable from general considerations that the sample is not widely divergent in this respect, but there seems no way available to test the point adequately for the whole educational range.

A little light may perhaps be thrown on the matter from statistics compiled by Lang (37, 37*a*) from the census of the city of Chicago, taken in 1934. Naturally the comparison cannot be exact for a number of reasons. In the first place Chicago alone cannot be regarded as representative of conditions in all the cities treated together in the present material displayed in Table 27. Furthermore, Lang tabulates his statistics by school grade numbers, and it is not certain that the aggregation of grades into broader categories, as has been done in Table 27*a*, is entirely just, though from Lang's discussion of his own data (37, p. 188) it appears to be reasonably so. Finally, it is impossible practically to put the present material into combined nativity–colour groups by educational status as Lang has done with his material. But recognizing these disabilities, and others not mentioned, it still may be of some interest to compare the figures of Table 27*a* with those of Table 27. It is, of course, to be understood that Lang's category 'None' does not correspond to our category 'Illiterate'.

On the whole the comparison, inexact as it is and must necessarily be, seems rather to support the idea that the present material is probably quite fairly representative of the general urban population (in large cities) of the United States in respect of degree of formal education that child-bearing women have achieved in their lives.

In respect of one educational category (the illiterate) there are general population statistics for comparison. This comparison is made in Part C of Table 27. The first two lines of the tabulation indicate that, in so far as illiteracy may be used as a criterion, the present sample is fairly close to the general population of the states from which it was drawn. On the basis of this criterion the present sample, where it diverges at all, is better (that is, indicates more educational training) than the general population from which it came. This would seem to be not only a harmless divergence, but indeed a satisfactory one rather than otherwise, considering the basic objectives of the investigation as a whole. The percentage of illiteracy among the Negroes in the present sample is less than a third of that in the general population of the country as a whole. But this is reasonably to be expected since we are dealing only with urban and nearby suburban dwellers. Negro illiteracy is much higher generally in the rural South than in large cities located farther North.

TABLE 27*a*

Percentages of Chicago's female population 18 years of age and over that had completed different grades in school, Census of 1934. [Compiled from data of Lang (37, Table I) by R. P.]

Highest degree of formal education	*Percentages*
Native whites, native parentage:	
None	0·3
Elementary schools (Grades 1–8 incl.)	37·9
High school (Grades 9–12 incl.)	47·4
College or university (Grades 13 and over)	14·0
Native whites, foreign or mixed parentage:	
None	1·1
Elementary schools (Grades 1–8 incl.)	56·6
High school (Grades 9–12 incl.)	35·7
College or university (Grades 13 and over)	6·0
Foreign-born:	
None	15·5
Elementary schools (Grades 1–8 incl.)	71·5
High school (Grades 9–12 incl.)	10·3
College or university (Grades 13 and over)	1·8
Negroes:	
None	3·3
Elementary schools (Grades 1–8 incl.)	64·3
High school (Grades 9–12 incl.)	27·3
College or university (Grades 13 and over)	4·6

Part B of Table 27 brings out the interesting fact that (with a curious and so far unexplained discrepancy in respect of illiterate white and Negro PRENUPS) the overt consequences of loose sexual morality diminish with increasing extent of formal education. It would be rash in the extreme to conclude from the figures that adherence to a high code of sexual morality increases with extent of formal education, because in fact the data give no warrant for such a conclusion. Just possibly the precise opposite may be the case. All that the figures in Part B definitely demonstrate is that, in this sample, the overt consequences of sexual immorality expressed in pregnancy are less frequent proportionally (with the discrepancy noted above excepted and reserved) the higher the extent of formal education, in both whites and Negroes. A reasonable way of putting the matter is that while more highly educated girls may or may not be more moral than their educationally less fortunate sisters, at least they know better, on the average, how to forefend the dire consequences of such excursions as they may choose to make into the realm of amatory dalliance.

Turning now to the consideration of *economic status* it will be recalled that the original plan required the recording of this variable under five broad categories: Very Poor, Poor, Moderate Circumstances, Well-to-do, and Rich. As the collection of material progressed it became apparent that, under the prevailing circumstances of the time, the last category (Rich) was for all practical purposes entirely superfluous. During the early years of the depression almost nobody was subjectively rich. Every one tended to moan about poverty—absolute or relative. On the whole relative poverty tended to elicit somewhat louder and more earnest groans than absolute, so oddly do humans behave when annoyed. Under the stress of this united poverty clamour the kind-hearted interns and residents whose task it was to fill out the histories for this study plainly lost a good deal of whatever sense of economic reality they might have hitherto had, and with practical unanimity refused to set any subject down as rich, even though the objective facts about the person plainly showed that she and her husband were in reality only a little less rich than they were before 1930, and by any reasonable objective standard still belonged in the Rich category. The same consideration applied in lessening degree all down the line. Persons who plainly belonged in the Well-to-do class were recorded as of Moderate Circumstances; persons really in moderate circumstances were recorded as Poor. This situation led us to query many histories on this point, and get them corrected. But it has also led in the end to the combining into one of the two highest categories, Well-to-do and Rich, leaving us with four instead of five economic classes.

It is beyond question unfortunate that the collection of material for this investigation happened to coincide in time with the worst years of the depression. It resulted in the whole distribution of the subjects relative to economic status being slid along to the left (towards lower positions) on the abscissal axis. Part of this shift was real; but part was an artificial product of the combined psychology of the subjects and the recorders. We have done all that it was humanly possible to do by querying and correcting to eliminate this artificial element in the picture, but we do not for a moment delude ourselves with thinking that we have been wholly successful.

Another thing that obviously influences the distribution of the present material relative to economic status is the fact that the great bulk of it came from the wards of hospitals. A part of the reasons that induced many of the women in this sample to go to hospitals for their confinements was that they could bring off the event in that way cheaper than they could by having it at home, and expense was a significant consideration at that time, more or less independently of the absolute economic position.

Table 28 gives the absolute and percentage distributions of our material relative to economic status.

Since there are available no general and comprehensive data as to the distribution of the population of the United States relative to wealth, income, or economic status, it is impossible to check the adequacy or representative character of the present sample in this regard save on one point.

The Well-to-do and Rich category of the present material includes families (husband and wife) which make income-tax returns, and virtually only such families. Furthermore it is practically certain that there is no significant number of income-tax payers included in any of the three groups of lower economic status, American laws and customs being what they are about income tax.

TABLE 28

Economic status

Economic group	*Whites*		*Negroes*		*Totals*	
	Absolute	*Per cent.*	*Absolute*	*Per cent.*	*Absolute*	*Per cent.*
Very poor . .	5,014	19·8	3,021	53·6	8,035	26·0
Poor . . .	11,792	46·6	2,492	44·2	14,284	46·2
Moderate circumstances . .	6,961	27·5	118	2·1	7,079	22·9
Well-to-do and rich	1,549	6·1	2	0·1*	1,551	5·0
Totals . .	25,316	100·0	5,633	100·0	30,949	100·1

* Actually 0·04 per cent.

Taking the whole material together, 5 per cent. fall in the Well-to-do and Rich group. The income-tax authorities in Washington were good enough to supply figures for 1930 showing the percentages of the population that filed income-tax returns in that year in each of the 15 states from which our sample was drawn. The average percentage for these states, whether unweighted or weighted with the male population 15 years of age and over, worked out to 3·7 per cent. This result again, so far as it goes, suggests that the present sample is probably not seriously distorted from the general population that produced it, in respect of economic status in the uppermost brackets at least.

The question of the distribution of the husbands (and unmarried consorts so far as known) of the women in the material in respect of *occupations* may be considered next. Table XII of Appendix I gives a fairly detailed distribution of the data on this point.

The fact that the present sample was preponderantly urban in character, containing only such rural women as came into nearby city hospitals for delivery of their babies, is clearly reflected in Table XII. Agriculture, forestry, fisheries, and mining are but slightly represented.

In order to show more clearly the general occupational picture from a social-economic point of view, and to facilitate comparison with the general population from which the present sample was drawn, Table 29 is presented. This gives the percentage distribution (according to the writer's (33) broad threefold classification of occupations that has already been described in section 8 of Chapter II and Note 17) of the following groups: (*a*) the present material, taking account only of individuals where the occupation was known and recorded (i.e. omitting the last line in Table XII); (*b*) New York City in 1930 from Pearl (33, p. 496); (*c*) gainfully occupied males aged 10 years and over in the U.S.A. in 1930 (compiled by the writer from Table 3, pp. 306–20, of *Abstract of the Fifteenth Census of the U.S. 1930*); (*d*) gainfully occupied males aged 10 years and over in the U.S.A. in 1930, but omitting the classes of farm owners, farm tenants, and farm labourers, in order to bring the general population roughly into a more justly comparable position with our urban sample.

TABLE 29

Occupation of husbands

	Percentages exhibited in			
Occupational group (Pearl's Classification)	*Present material. Known occupations only*	*New York City. 1930 total*	*U.S.A. 1930 total*	*U.S.A. 1930 omitting agriculture*
I. Owners, managers, officials, and professional men .	13·0	18·7	21·6	17·0
II. Skilled and semi-professional workers .	52·5	53·7	44·9	51·1
III. Labourers—unskilled and semi-skilled .	34·5	27·6	33·5	31·9
Totals . .	100·0	100·0	100·0	100·0

It appears from Table 29 that in our present material there is a relative under-representation of occupation Class I, with a corresponding over-representation of Class III.

Comparing the first and last columns of the table with each other, it is seen that this disparity amounts to about 4 per cent. in each case. This is presumably the expression of the combined effects of the strictly urban character of the sample, and of the delivery-in-hospital selective restriction. The low cost or free services generally provided by American hospitals in large cities to the poor and very poor classes would tend to a relative over-representation of these classes in our material. Furthermore, at the other end of the scale there was evident a certain reluctance on the part of some of the co-operating physicians to bring their private patients (relatively well-to-do) into the net we spread, with their help, to collect our material. This appears to be reflected more in the occupational than in the economic classification, as we have set them up. But in any case it is evident that the present material is not grossly, or even seriously, divergent in its husband-occupation distribution from that of the general population of the United States at the time, when the latter is roughly adjusted for urbanization by dropping agricultural occupations.

Finally we turn to the examination and comparison of the *ages* of the women in the present material. As a first step it is desirable to see whether the married women (since the chief concern will be with that category) in the general population of the 15 states from which the present material was drawn are a fair sample in respect of age of the married women of the whole United States. The mean and median ages for the pertinent groups involved in this question are given in Table 30.

While the group differences in mean and median ages in Table 30 are statistically significant in comparison with their small probable errors, ranging from only about 7 hours to a little over 3 days, nevertheless it is plain that the differences are absolutely so small, even in the case of the Negro population, as to have no practical significance. In regard to ages of married women the population of the 15 states from which the present material was drawn may certainly be taken as fairly representative of the population of the United States as a whole.

TABLE 30

Ages of married women in general population, according to the Census of 1930

Groups in 1930	Mean age (years)	Median age (years)
White married women in 15 selected states	34·588±0·002	34·643±0·002
White married women in continental U.S.A.	34·258±0·001	34·255±0·002
Negro married women in 15 selected states	33·824±0·008	32·947±0·009
Negro married women in continental U.S.A.	33·415±0·004	32·449±0·006

In the next place comes the question as to how well the ages of the mothers in the present material as a whole group compare with those of mothers in the U.S. Birth Registration Area for the same years in which the mothers in our material were observed and recorded, namely 1931 and 1932. As close an approach as is possible to this comparison is made in Table 31, which gives the mean and median ages for (*a*) all mothers in the present material; (*b*) all white mothers; (*c*) all coloured mothers, and (*d*) all mothers together, of live births in the U.S. Birth Registration Area in the years 1931 and 1932 separately. Unfortunately this comparison is not of precise equivalents, because the present material includes all mothers (at the time of observation) regardless of the manner in which their latest pregnancy terminated. Most terminations were by live births, but there are included also all the terminations by still-births and abortions. Precisely comparable data in this respect cannot be got from the official U.S. Birth Registration Area birth statistics. This fact makes a small difference in mean and median ages of mothers.

It is seen from Table 31 that the mothers in the present material average, as a whole group, about a year younger in age than mothers of live births only in the U.S. Birth Registration Area in 1931 and 1932. This is, of course, a statistically significant difference. It arises in part from the fact, already noted, that the present material included all kinds of pregnancy terminations as against only live-birth terminations in the U.S.B.R.A. data. It also in part probably reflects a selective effect on age, of the restriction of the present material to hospital deliveries. But the divergencies in average age are not differential as regards the race (colour) groups, the Negro averages being below the U.S.B.R.A. averages by about the same amount as in the whites; and, though statistically significant, cannot reasonably be regarded as of any serious practical importance relative to any use to be made of the data.

TABLE 31

Mean and median ages of specified groups of mothers

Group	*N*	*Mean age (years)*	*Median age (years)*
White mothers in present material	25,313	26·682 ± 0·026	25·907 ± 0·032
All white mothers of live births, U.S.B.R.A. 1931 .	1,722,804	27·528 ± 0·005	26·730 ± 0·006
All white mothers of live births, U.S.B.R.A. 1932 .	1,682,171	27·516 ± 0·003	26·721 ± 0·004
Negro mothers in present material	5,631	24·289 ± 0·056	23·208 ± 0·070
Coloured mothers of live births, U.S.B.R.A. 1931 .	256,372	25·778 ± 0·009	24·485 ± 0·011
Coloured mothers of live births, U.S.B.R.A. 1932 .	260,723	25·799 ± 0·009	24·492 ± 0·011
All mothers in present material	30,944	26·247 ± 0·024	25·377 ± 0·030
All mothers of live births, U.S.B.R.A. 1931 . .	1,979,176	27·301 ± 0·003	26·463 ± 0·004
All mothers of live births, U.S.B.R.A. 1932 . .	1,942,894	27·285 ± 0·003	26·447 ± 0·004

In general it may be reasonably concluded that the present material appears to be a fair and representative sample of the general population from which it was drawn, in respect of a variety of important variables. The results that it reveals, to be discussed in this and the next chapter, may therefore be accepted with a considerable degree of confidence, as indicative of conditions in the general population, and particularly the urban population, of the United States.

4. *The Prevalence of Contraception*

We come now to the primary objective of the present chapter, namely, the appraisal of the *prevalence or extent of contraceptive efforts* actually made in this sample of the American population that has been under discussion.

Table 32 presents the data as to the frequency of the practice of contraception. Considering first the totals for the whites it is seen that 42·7 per cent. of the women had practised contraception before the time of record, regularly or intermittently, intelligently or stupidly, as the case may have been. Fifty-four per cent. of the women stated that, to the time of record, they had never practised contraception. The medical co-operators who took and recorded their reproductive life-histories for this investigation found no reason in their demeanour, behaviour, or histories to doubt their statements. Nor did the writer, who went carefully and critically over every detail of each individual history with this particular point in mind, find any internal evidence in the history itself to justify doubt as to its truthfulness on this point.

In addition to this 54 per cent. of the white women, 822, or 3·2 per cent., also stated that they had never practised contraception, but either the medical co-operators or the writer, or both, found reasons to doubt their statement on the point. If a woman's record showed too long gaps between pregnancies, unexplained in the history by illness or otherwise, and she affirmed that she had not practised contraception, her record was forthwith thrown into the doubtful category. This was unjust to many women—for the most part they probably were in fact telling the truth—but the adoption of the procedure followed had the effect of measurably increasing confidence in the residual 54 per cent. accepted as not practising contraception. In a later chapter statistical evidence will be presented that indicates that the pregnancy rates shown by these women objectively justify in high degree this confidence. In passing it may be of some interest to note that, of the 822 white women whose statements that they had never practised contraception were doubted, 44·6 per cent. were Catholics. For 6 white women out of the total of 23,316 it was impossible to get any clear information as to whether contraception had been practised or not. This was chiefly because of the low level of mentality of these women.

TABLE 32

Contraception

PART A. *Whites*

Practice of Contraception	INWED		OUTWED		PARTLY		*Totals*	
	Number	*Per cent.*	*Number*	*Per cent.*	*Number*	*Per cent.*	*Number*	*Per cent.*
No contraception	11,849	51·6	1,322	88·0	511	60·3	13,682	54·0
Contraception attempted in some form	10,318	44·9	177	11·8	311	36·7	10,806	42·7
No contraception stated, but record doubted	792	3·4	4	0·2	26	3·1	822	3·2
No information	6	0·03	..	..	..	..	6	0·02
Total	22,965	99·93	1,503	100·0	848	100·1	25,316	99·92

PART B. *Negroes*

Practice of contraception	INWED		OUTWED		PARTLY		*Totals*	
	Number	*Per cent.*	*Number*	*Per cent.*	*Number*	*Per cent.*	*Number*	*Per cent.*
No contraception	2,828	79·2	1,152	93·3	696	84·2	4,676	83·0
Contraception attempted in some form	717	20·1	82	6·6	126	15·2	925	16·4
No contraception stated, but record doubted	26	0·7	1	0·1	5	0·6	32	0·6
No information	..	..	..	..	..	..	..	..
Total	3,571	100·0	1,235	100·0	827	100·0	5,633	100·0

Among the Negro women only 16·4 per cent. in total had practised contraception. As for the remainder, 83 per cent. of the total stated that they had never done so, and no reason was found by anybody to doubt their statement. This left 32 Negro women, or 0·6 per cent., whose statements that they had not practised contraception were doubted for one reason or another.

Taking everything into account there seems to be no reason to doubt that the percentages of Part B of Table 32 represent with substantial accuracy the relative frequency of contraceptive efforts in the particular part of the general population from which the present sample was drawn. They indicate that roughly only about a third as many Negro women as white women resort to contraception. It seems probable that there will be little serious disagreement with this figure on the part of those acquainted with the sex attitudes and *mores* of the American Negro.

As would be expected the proportion of women practising contraception in both racial groups is much higher in the INWED class than in either the OUTWED or PARTLY classes. Obviously one important reason why most of the women who found themselves in these latter two unenviable classes got there was that they had failed to control conception.

There are two classes of women who do not appear in the present sample by reason of the way in which it was collected. These are: (*a*) Women who were themselves permanently sterile physiologically or belonged to matings that were permanently sterile. (*b*) Women who on all other grounds might have been included, but who did not become pregnant between about October 1930 and April 1932. Presumably some portion of these women did not become pregnant because they were effectively practising contraception during this period. Of such women two categories may be distinguished: namely, (1) those who desiring a family, but a small one, did not time a pregnancy to fall into the period covered by this study, and (2) those who desired never to have any children at any time, and successfully practised contraception to the realization of that end.

It is reasonable to suppose that if there were a just representation of women of category (*a*) in the sample it would tend to raise by a small amount the total percentage in Table 32 of those not practising contraception, on the ground that sterile women and women in sterile matings seem in actual experience to discover their sterility fairly soon after marriage and stop any attempts at contraception that might otherwise be made.

Of the women in category (*b*) those in the two subclasses are on a somewhat different footing statistically. Those in subclass (1) may probably safely be completely disregarded so far as concerns any potential effect they might be supposed to have upon the percentages of Table 32. The reason for this opinion is found in the great statistical stability of official birth statistics from year to year relative to age and other characteristics of the mothers involved. For the most part the women who appear as mothers in the birth statistics of calendar year $n+1$ are individually different women from those who appear as mothers in the statistics of the year n. Yet the relative age distributions of mothers of the years n and $n+1$ are almost precisely identical. By parity of reasoning it appears probable that the proportion of women practising contraception among mothers of one year will not be greatly different from the proportion among mothers of the previous year, except in so far as it may be increased by women beginning for the first time in their lives the practice of contraception—that is, leaving the 'no contraception' cohort to which they had always previously belonged and passing over into the 'contraception' cohort. The proportion of such new recruits in the total at any given moment is probably not large, but is probably increasing more rapidly per unit of time under present conditions than it has in the last fifty years, and doubtless will continue to increase. But if we consider not the percentages of Table 32, which are by definition percentages of *mothers*, and consider inferentially the percentages of *women* in the whole population exposed to risk of pregnancy (i.e. indulging in sexual intercourse) it is reasonable to suppose that the percentage of them practising contraception will be somewhat, but probably not greatly, higher than that of Table 32, because of the existence of the subcategory (*b*) (1).

Finally, it is reasonable to suppose that there may be some women really falling in the subcategory (*b*) (2), that is, women not physiologically sterile but actually never pregnant because of their unfailingly effective practice of contraception from first coitus to menopause. But all the evidence available seems to indicate that the percentage of such women in the general population must be fairly small. It would doubtless be somewhat larger if absence of live births were taken as the criterion of a sterile mating (as in Notestein's analysis of census data) than if the criterion were taken to be absence of any product of conception. Thus it would be statistically tempting, but probably biologically dubious, to charge all the increase in sterility percentages between 1890 and 1910, found by Notestein (31), to the practice of contraception by women in the subcategory under discussion.

To summarize, it seems probable that the percentages of white women definitely recorded in Table 32 as practising contraception somewhat underestimate the corresponding percentage for the general population from which the sample was drawn, but not greatly so. Considering the fact that the figures of Table 32 include all ages; all durations of marriage; the whole range of variation in number of pregnancies experienced; and all sorts of social, economic, and educational levels, it would seem hazardous to estimate the percentage of white contraceptors among the women in the general population of the 15 states dealt with at more than 55 to 60 per cent. (that is, $42{\cdot}7+3{\cdot}2+$about 10 to 15).

This estimate will be objected to by some as too low. It will be pointed out that women coming to birth-control clinics for the first time show a much higher percentage than those reporting here to have previously attempted contraception.[38] But women attending upon birth-control clinics are known to be a highly selected and differentiated group. It has been shown by the writer (32) that they are a much more fertile group than the generality of women. Furthermore, as a group they are heavily over-weighted with multiparae[39] and the present material shows unequivocally an increase in contraceptive practices with increasing number of pregnancies experienced. Relatively few women, aside from those in the upper social and economic strata, begin contraception in the first years of conjugal life.

An interesting additional sidelight is thrown upon this discussion by the following figures. Considering only white women married once only and free of gynecological disease, the data show that, among the total number of women exposed in each age period, the following percentages *had practised contraception* in some form or other:

Age period	*Per cent. who had attempted contraception*
10–14	33·2
15–19	43·3
20–24	53·1
25–29	57·2
30–34	55·2
35–39	49·9
40 and over	39·7

It will be seen that these figures tend to confirm the writer's estimate stated above of 55 to 60 per cent. as a rough maximum of contraceptive effort for the general population from which the present sample was drawn.

After prolonged study of the matter and examination of all the available evidence the writer has come to the conclusion that the proportion of married women in the general population practising contraception is a statistic that cannot be precisely determined or proved. The best that can be hoped for is a judgement that shall take into account as justly as may be all the evidence direct and indirect. The writer's present judgement on the point has been stated. It is not to be regarded as dogmatic or final, but on the contrary is subject to revision whenever any new sort of evidence appears that warrants a change. It merely represents the best present judgement of one student of the problem.

V

THE EFFECTS UPON NATURAL FERTILITY OF CONTRACEPTIVE EFFORTS

In this chapter it is proposed to discuss the relation between contraceptive efforts as actually made in the reproductive histories of the women in the material described in Chapter IV, on the one hand, and the differential fertility exhibited by (A) groups differing in *economic status*, (B) groups differing in amount of formal *education* experienced, and (C) groups differing in *religious affiliations*, on the other hand. The discussion throughout will *not* be concerned with the theoretical possibilities of different particular contraceptive techniques. The discourse will, instead, be of actual performances and results as manifested in random samples of the general population, which include among others, ignorant, stupid, and feckless folk, who furthermore all too often are economically so situated as to make the physiologically adequate practice of contraception by any methods now known extremely difficult if not impossible. Birth-control practices involve to a considerable extent mental attitudes and habituations—in short individual and group psychological factors. It is a matter of interest to know whether there are significant differences in degrees and kinds of controlled fertility in socially differentiated groups, known to differ in their attitudes and outlooks in regard to other matters.

All the women discussed in this chapter were married and were living in wedlock; had been married once only, and were free of any form of gynecologic disease recognizable in the hospitals in which they were delivered. Restricting the material in this way obviously enhances its statistical homogeneity and reliability. The tables include all the women in the total sample who qualify under all the above restrictions.

PART A

Differential Fertility in Economic Classes

Table XIII of Appendix I gives the number of women in total, and separately in four economic groups, together with their average ages in years at the time of record. The separation into groups of primiparae (women who have experienced only one pregnancy) and multiparae (women who have experienced two or more pregnancies) is occasioned by the fact that all earlier studies have shown that the extent and results of contraceptive practices are significantly different in these two groups. 'Non-contraceptors' are women who have made no attempt whatever at any time to prevent conception. 'Contraceptors', for purposes of present discussion, are, on the other hand, all those women who have ever at any time in their reproductive lives made any sort of attempt to prevent conception from occurring after sexual intercourse, however perfect or adequate the attempt on the one hand, or alternatively however inept, irregular, or physiologically stupid.

From a sentimental point of view this mode of dealing statistically with contraception is regrettable, because it unfailingly irritates birth-control propagandists, who always desire to see the best case possible made for contraception in general, and for the particular contraceptive technique most in favour at the moment. It is hoped that at some later time it will be possible to analyse our data from this latter point of view. But this is not the present objective. Here the concern is with the problems of populations as whole groups. In populations contraception is practised with widely varying degrees of frequency and prevalence. Taking this plain fact as a datum base—something given—what has been the actual effect upon the potential fertility of the population as a whole of the contraceptive efforts really made? It may be conceded, and in fact cheerfully is, that if the most efficient contraceptive techniques known had been uniformly and perfectly employed by all the women in the contraceptor class the results would have been different. But what of it? If John Smith had made more money than he did he would to-day be a rich man. But his bank and the income-tax people are solely interested in what he *actually did* make. So precisely are we interested, here and now, solely in how much the contraceptive efforts

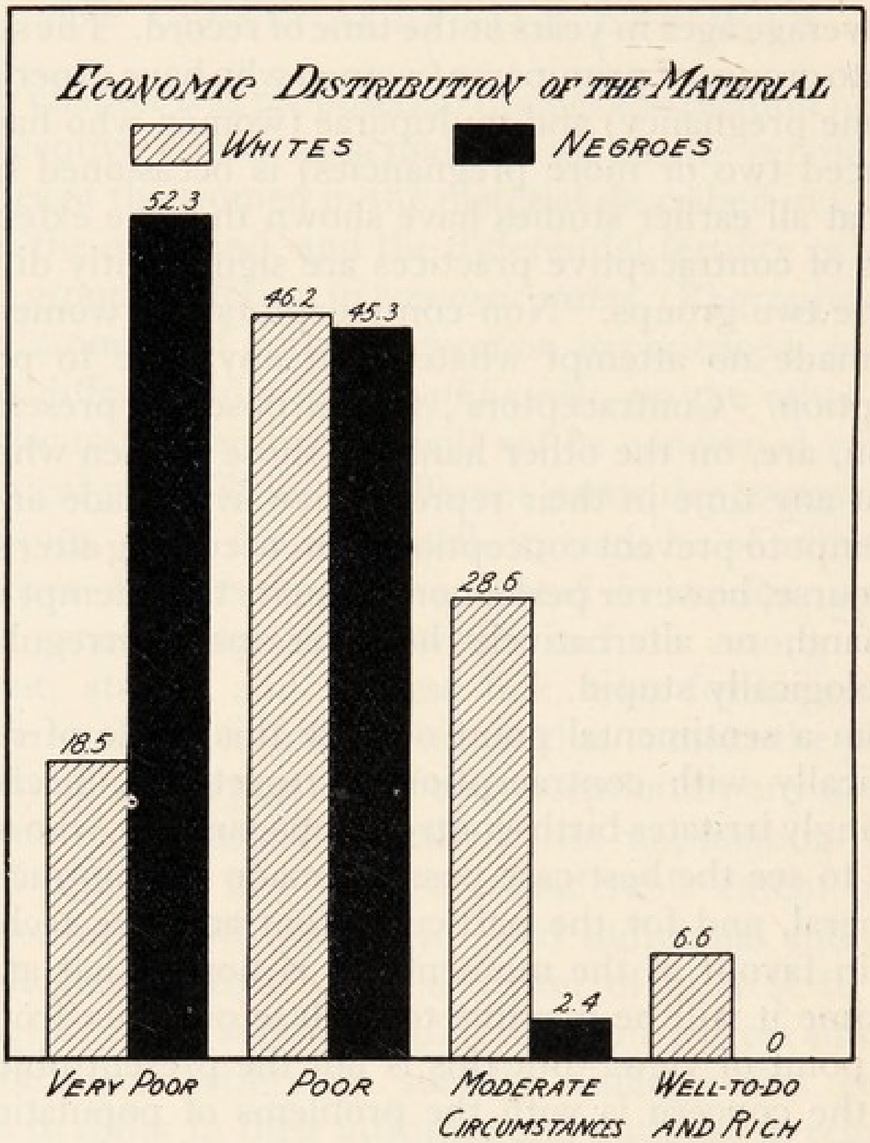


FIG. 29. Percentage distribution of the material by economic classes and colour. Cross-hatched bars are for whites; solid black bars are for the Negroes.

of the women in the contraceptor class of the population lowered the fertility they manifested below that of the non-contraceptor women.

The relative or percentage distribution of the material among the economic classes is shown graphically in Fig. 29. The figures at the top of each bar give the actual percentages.

It is evident that the economic class distributions are quite different in the two racial (colour) groups, as would be expected under American urban conditions. Nearly 98 per cent. of the Negroes in the sample fall in the Very Poor and Poor classes together, and over half of the total Negro sample in the Very Poor class. The distribution of the whites by economic classes is of a sort that would be considered more nearly normal; especially when it is remembered that the data were collected during the depression. But it must also be remembered that the economic distribution of the American urban Negro population would at all times be considerably lower than that of the white population, provided both samples were fairly representative of actual conditions.

Among the whites 38·2 per cent. of the women in the material are primiparae and 61·8 per cent. are multiparae. These figures correspond to $33{\cdot}38 \pm 0{\cdot}03$ per cent. of the primiparae among the native white women bearing live children in 1930 in the U.S. Birth Registration Area as a whole, and $40{\cdot}15 \pm 0{\cdot}15$ bearing still-births in the same year. The average for the two groups is 36·76 per cent. These figures indicate that the present sample is quite fairly representative of the general population in this respect. Among the Negroes in the material the percentage of primiparae is 27·3 per cent., and of multiparae 72·7 per cent. This corresponds to a percentage of $28{\cdot}98 \pm 0{\cdot}06$ for coloured primiparae producing live births in the U.S.B.R.A. in 1930, and of $31{\cdot}35 \pm 0{\cdot}25$ per cent. for coloured primparae producing still-births in the same year and area. Again reasonably close agreement of the sample with the general population is indicated.

Also in respect of mean age at the time of record the women of the present material are so nearly in agreement with the women producing live births in the U.S.B.R.A. in 1930 as to make it clear that our sample is in no serious way biased in this respect, but may be taken as reasonably representative of American general population conditions. This is true not only for the group of women as a whole, but also for the division into primiparous and multiparous groups, as is shown graphically in Fig. 30.

It appears that the primiparae of the present material tend to be a little older in average age at the time of record than the roughly comparable class in the U.S.B.R.A. of 1930, and that the multiparae of the present material tend to be a little younger than the general population group to

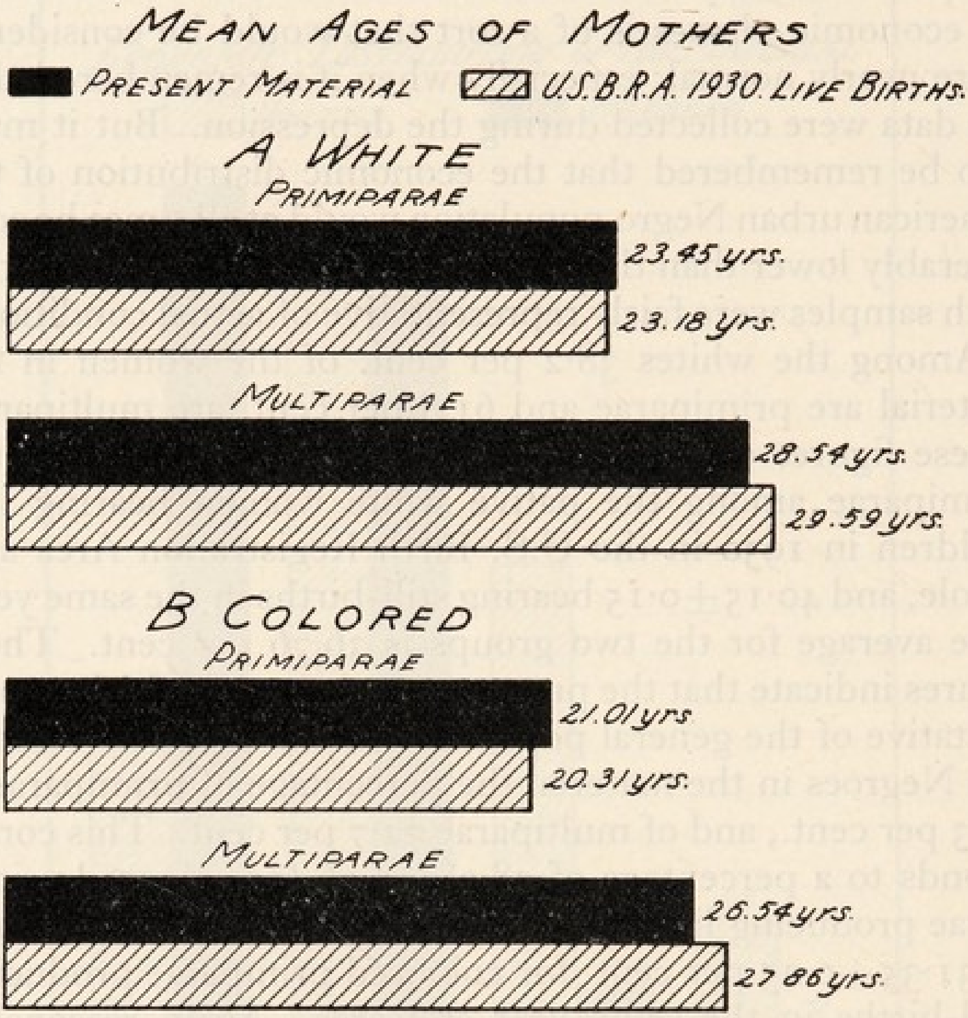


FIG. 30. Mean ages of primiparous and multiparous mothers.

which they roughly correspond. But it is evident that in general the agreement is sufficiently close to give confidence in the fairly representative character of the present material so far as age is concerned.

Item 3 in Table XIV of Appendix I gives the mean ages at marriage, and Item 4 the mean duration of marriage to the time of record, for the several classes of women included in the investigation.

It appears that the multiparae, whether white or Negro, non-contraceptors or contraceptors, married at slightly younger mean ages than the corresponding classes of primiparae. The differences are more than four times their probable errors in every one of the four such comparisons possible to make, taking all economic classes together, and are therefore to be regarded as statistically probably significant.

The contraceptors, whether white or Negro or primiparae or multiparae, married at slightly older mean ages than the corresponding classes of non-contraceptors. The differences in the means in the case of the whites are to be regarded as probably significant statistically; in the case of the Negroes they are not.

The Negroes on the average married at younger ages than the whites, and in both races the mean age at marriage increased with advancement in economic status. The better off economically the women were, the more on the average was the marriage postponed to higher ages. These relations are shown numerically in relative figures in the following tabular arrangement:

Taking the mean age at marriage of Very Poor whites as 100, the mean ages at marriage of the other classes are as follows:

	Whites				Negroes		
	V.P.	*P.*	*M.C.*	*W.-R.*	*V.P.*	*P.*	*M.C.*
Primiparae non-contraceptors	100	105	116	128	97	99	104
Primiparae contraceptors .	100	104	113	120	96	99	127
Multiparae non-contraceptors	100	104	115	126	95	97	109
Multiparae contraceptors .	100	103	111	118	96	96	99

Table 33 shows the percentages that the contraceptor women form of all women in their respective classes.

TABLE 33

Percentages of contraceptors to all women in class

	White					Negro			
Items	*Totals*	*Very Poor*	*Poor*	*Mod. Circ.*	*Well-to-do and Rich*	*Totals*	*Very Poor*	*Poor*	*Mod. Circ.*
5. *All women in sample* (Totals)	46·0	30·0	41·0	56·5	80·1	19·7	16·5	22·5	38·4
(*a*) Primiparae .	37·8	18·4	28·3	50·3	76·2	13·1	10·9	14·5	25·0
(*b*) Multiparae .	51·1	34·5	48·6	61·8	82·7	22·2	18·4	25·9	46·7

Table 33 establishes with numerical precision for the present urban material the relationship that has long been alleged on general grounds, namely, that the higher the economic position of a group the greater is the average prevalence of contraceptive effort within it. In both white and Negro groups, and for both primiparae and multiparae this trend is manifested in the clearest fashion. Another significant point is that the practice of contraception was more prevalent among multiparae (women who had already been pregnant two or more times) than it was among primiparae who were just beginning their reproductive lives and had been pregnant only once. This was true of the Negroes as well as of the whites. The third result made clear is that much smaller proportions of the Negro women than of the whites made contraceptive efforts. This result is corroborated by the experience of American birth-control clinics dealing with both races.

The important factors in producing the trends relative to the proportional amount of contraceptive effort shown in Table 33 are probably four in number, namely:

1. *Different degrees of ignorance* of contraceptive techniques, and of many other important elements in the physiology of reproduction.
2. Different degrees of *carelessness and indifference* as to the reproductive consequences of copulation, especially when contrasted with the temptations to and pleasures of sexual congress.
3. Different degrees of *economic ability* to provide the mechanical accessories for contraception and the environmental surroundings favourable to its adequate practice.
4. Different degrees of *desire for children* regardless of economic consequences to them or to the parents.

The results of Table 33 are shown graphically in another form in Fig. 31, which explains itself and needs no further textual comment.

It has already been shown in Chapter II that in reaching a critically adequate measure of fertility it is necessary to introduce the consideration of *the physiological restrictions* *upon the possibility, and consequently the statistical liability, of becoming pregnant.* The next essential step in the analysis of the economic fertility differential is to examine the data

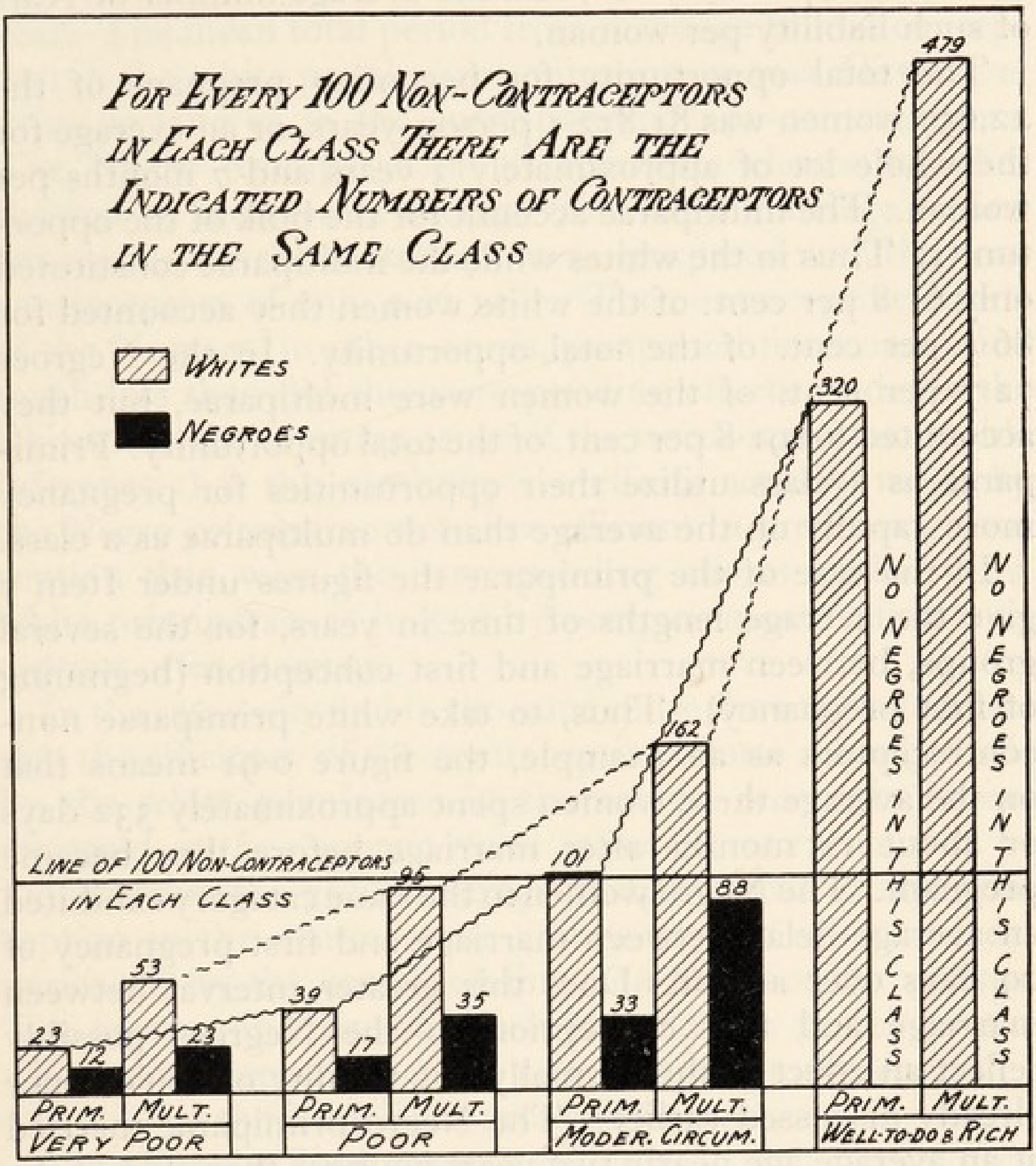


FIG. 31. The number of contraceptor women per 100 non-contraceptor women in the indicated economic, parity, and race classes. The wavy lines are inserted to make it easier visually to connect comparable bars for the white primiparae and multiparae.

regarding this liability, which are presented in Table XV of Appendix I. Since a woman is not capable of becoming pregnant when she is already pregnant or in the puerperal state, the figures given in Table XV state the aggregate time in years spent during their married lives by the women in the samples *while they were not pregnant or in the puerperium*. Table XV in other words gives the aggregate opportunity for (or possible liability to) pregnancy in the material, in person-years, and the average number of years of such liability per woman.

The total opportunity for becoming pregnant of the 22,657 women was 81,852·1 person-years, or an average for the whole lot of approximately 3 years and 7 months per woman. The multiparae account for the bulk of the opportunity. Thus in the whites while the multiparae constituted only 61·8 per cent. of the white women they accounted for 86·5 per cent. of the total opportunity. In the Negroes 72·7 per cent. of the women were multiparae, but they accounted for 91·8 per cent. of the total opportunity. Primiparae as a class utilize their opportunities for pregnancy more rapidly on the average than do multiparae as a class.

In the case of the primiparae the figures under Item 7 give the average lengths of time in years, for the several groups, between marriage and first conception (beginning of first pregnancy). Thus, to take white primiparae noncontraceptors as an example, the figure 0·91 means that on the average these women spent approximately 332 days or about 11 months after marriage before they became pregnant. The Negro women in the same category exhibited an average delay between marriage and first pregnancy of 29 days over a year. Does this greater interval between marriage and first conception in the Negroes possibly reflect an effect of the normally low fertility of adolescence already discussed earlier? The Negro primiparae married at an average age nearly two years younger than that of the white primiparae. Both groups obviously contained a good many adolescents, and the Negroes more than the whites. The figures give no proof that this is the explanation, but they are at least suggestive.

Item 7 of Table XV, Appendix I, gives some indication of the effectiveness of the contraceptive efforts actually made by these women. It is evident that the contraceptive efforts made have increased the time interval between marriage and first conception, as they were intended to do, and would in fact be expected to. For white primiparae of all economic classes together this increase in the average time from marriage to first conception in the contraceptor class, as compared with that experienced by the non-contraceptor class, was 0·95 year. The mean total period from marriage to first conception in the white primiparae contraceptors was a little over twice as long as in the corresponding non-contraceptors. The Negro primiparae of all economic classes together showed an increase in average time from marriage to first conception for the contraceptors as compared with the non-contraceptors of only 0·22 year. The contraceptive efforts of the Negroes, in other words, postponed first conception much less than did the corresponding efforts made by the whites. In the common sense of the words it is a reasonable inference that the contraceptive efforts actually made by the Negro primiparae were less efficient in preventing conception than were the corresponding efforts made by the white primiparae, as judged by postponement of first conception after marriage.

In the same way and in the same sense the results indicate that the efficiency of the contraceptive efforts actually made by the white primiparae in the several economic classes *increased as the economic status increased*, so far as may be judged from the group average postponement of first conception in the contraceptor groups beyond what was experienced by the corresponding non-contraceptor groups. The average increases in postponement (in years) for the white contraceptors over the non-contraceptors were:

1. For the Very Poor group, 0·65 year.
2. For the Poor group, 0·76 year.
3. For the Moderate Circumstances group, 0·81 year.
4. For the Well-to-do and Rich group, 1·39 years.

In other words when judged by the criterion of postponement of first conception the contraceptive efforts of Well-to-do and Rich white primiparae were more than twice as effective as those of the Very Poor white primiparae.

Let us consider next the average number of years of married life spent outside the pregnant and puerperal states. These averages are higher, class for class, in the contraceptor groups than in the non-contraceptor groups, as would be expected if the attempts at birth controlling had any practical effect at all. The relative effectiveness of efforts at contraception in increasing total time free of pregnancy can be simply indicated by the same device that was used for the primiparae. *The average increase per woman in married years free of pregnancy* among the white contraceptor multiparae over the white non-contraceptor multiparae were:

1. For the Very Poor group, 0·40 year, or 8 per cent. of the non-contraceptor mean.
2. For the Poor group, 0·88 year, or 20 per cent. of the non-contraceptor mean.
3. For the Moderate Circumstances group, 0·96 year, or 23 per cent. of the non-contraceptor mean.
4. For the Well-to-do and Rich group, 2·13 years, or 57 per cent. of the non-contraceptor mean.

So then it appears that among the white multiparae the contraceptive efforts of the Well-to-do and Rich were over five times as effective as those of the Very Poor, when judged by the criterion of keeping out of the pregnant state.

The corresponding figures for the Negro multiparae are:

1. For the Very Poor group, 0·41 year, or 8 per cent. of the non-contraceptor mean.
2. For the Poor group, 0·46 year, or 11 per cent. of the non-contraceptor mean.
3. For the Moderate Circumstances group, 1·60 or 42 per cent of the non-contraceptor mean.

It is of some interest to note that on the face of the figures the increase in effectiveness of contraceptive efforts with advancing economic status, as between the Very Poor and Moderate Circumstances groups, is relatively greater for the Negroes than for the whites. Whereas the increase in the whites is only a little more than twice it is almost four times in the Negroes. Too much weight, however, should not be put upon this apparently superior showing, because of the small size of the Negro Moderate Circumstances group. It does seem probable, though, that the differentials between the Very Poor group and the Moderate Circumstances group are really much greater generally in the Negroes than in the whites, in respect of standards of living, intelligence, education, and other socio-economic variables. Because of the important influence of these variables upon the efficiency of contraceptive efforts generally, it may well be that the apparent result indicated above is really true, though the figures cannot be regarded as proving it.

Table XVI of Appendix I gives the number of pregnancies experienced and live births produced per 100 years of opportunity for becoming pregnant in the several classes, and the percentage lowering of these rates in the contraceptor groups as compared with the non-contraceptor. These percentages may be taken as indications of the effectiveness of the contraceptive efforts actually made in the several classes in producing the results for which they were intended and practised. The figures under Items 9 and 10 are obtained by the following plan: Let N = the non-contraceptor rate (pregnancy or live birth as the case may be), and let C = corresponding contraceptor rate. The percentages tabulated in Items 9 and 10 are $100(N-C)/N$.

Before discussing the results set forth in Table XVI it will be well to explain an apparent paradox. Item 9*a* indicates that the white primiparae non-contraceptors in the Poor economic group produced 122·1 live births per 100 person-years exposed to risk of pregnancy. At first glance this may strike one as a physiologically impossible paradox. It is not so. The numerical situation arises from the fact that time is a factor in the rates. When a pregnancy or live-birth rate is greater than 100 it means that the intervals (in years) of freedom from pregnancy (including the puerperal state) were in each case numerically less than the number of live births (or pregnancies) experienced. In large samples this usually happens only relative to first births, where conception takes place soon after marriage. It can, however, in particular samples occur in non-contraceptor multiparae groups, but it is unusual.

Comparing white primiparae of all economic classes taken together with white multiparae as a whole group it appears that the contraceptive efforts actually made by the former group were relatively about twice as effective as those made by the latter group in lowering average pregnancy and live-birth rates. The same relationship in principle is shown by the smaller and statistically less steady Negro groups.

Comparing the economic classes as whole groups, includ-

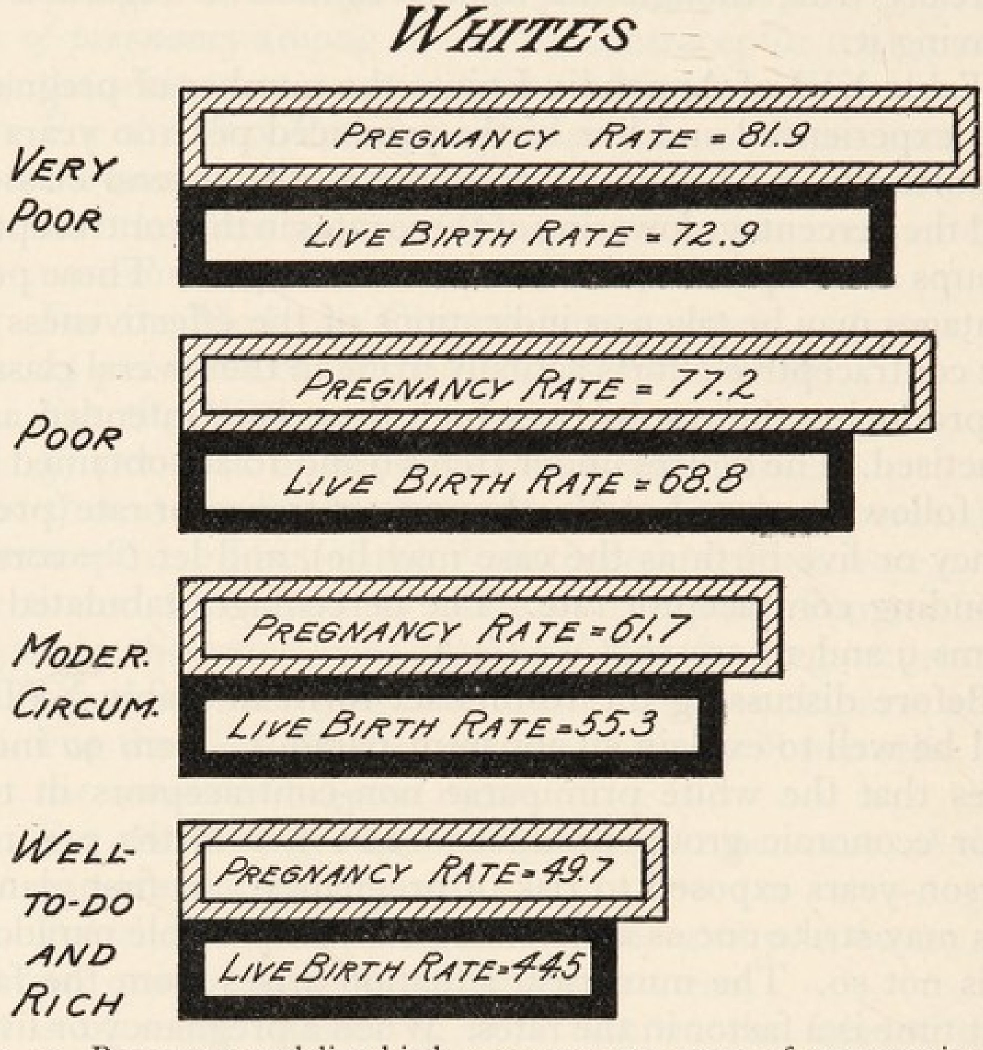


FIG. 32. Pregnancy and live-birth rates per 100 years of opportunity for pregnancy in white women in the several economic classes.

ing both non-contraceptors and contraceptors together, it appears that there is a steady lowering of both pregnancy and live-birth rates associated with advancing economic status. This relationship holds for both the whites and the Negroes in the material, though to a somewhat smaller degree (as would be expected) in the latter. This is shown graphically for the whites in Fig. 32.

The change of mean pregnancy and live-birth rates with economic status just set forth may possibly not be wholly accounted for by the more prevalent and effective contraceptive efforts in the higher economic classes, because a slight tendency towards a similar trend seems to be suggested in the non-contraceptor rates. This trend, if real, is certainly less marked and less regular among the non-contraceptors, but still appears to be slightly indicated in the whites; and also in the Negroes, so far as concerns the multiparae in the Very Poor and Poor classes, where alone are there enough Negroes in the sample to give any approach to reliable results. Before discussing this possibility seriously, however, it will be well to wait until further data upon the matter, to be presented farther on, are in hand.

From Table XVI is further to be noted the negligible effectiveness of the contraceptive efforts actually made by the Negro multiparae in lowering pregnancy and live-birth rates.

The percentage of effectiveness of the contraceptive efforts actually made by the whites in lowering pregnancy and live-birth rates tended to increase markedly in association with advancing economic position so far as concerns the multiparae, as is shown graphically in Fig. 33, and definitely less markedly so far as concerns the primiparae.

A more refined analysis of the effectiveness of the contraceptive efforts actually made by these women may now be undertaken through the medium of age specific pregnancy rates per 100 computed ovulations, calculated in the manner described in detail in Chapter II.

Table XVII of Appendix I gives the mean rates, and the numbers of women in each quinquennial age period from 10 to 40 years of age. The age period 40 and over is omitted from the table in each group, because the method by which the original data were collected was such as to make the biometric constants for that period misleading.[40] In reading Table XVII it is to be understood that the whole reproductive experience of each woman (save for that after age 40) is included in the table. So it results that the same women may appear under several age rubrics. It is further to be understood that we are dealing exclusively with the same women already discussed, who were all living in wedlock, married once only, and free of gynecologic disease.

Table 34 shows the extent of contraceptive effort in the

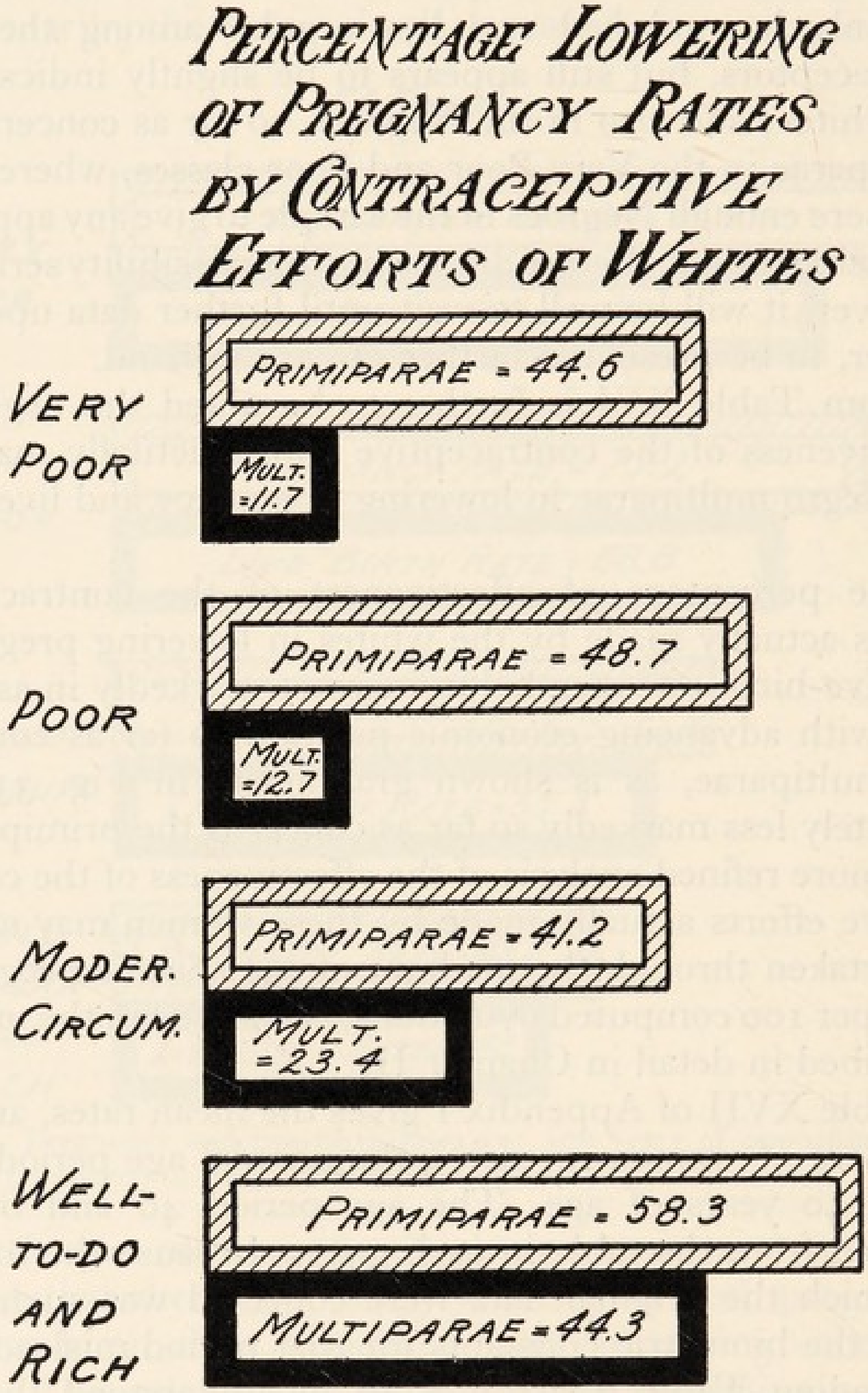


FIG. 33. Percentage lowering of pregnancy rates with advancing economic status associated with the contraceptive efforts actually made by the whites.

several age periods and economic groups, as percentages of women attempting contraception in any form or manner to all women exposed to risk in the period and group.

TABLE 34

Percentages of contraceptive effort by economic groups and age periods. Derived from Table XVII

	A. *White Primiparae*				C. *Negro Primiparae*		
Age period	*Very Poor*	*Poor*	*Moderate Circumstances*	*Well-to-do and Rich*	*Very Poor*	*Poor*	*Moderate Circumstances*
10–14	4·5	15·2	25·0	. .	5·0	0	0
15–19	16·8	26·1	47·1	70·0	11·1	13·3	16·7
20–24	24·9	34·6	55·7	80·3	12·2	16·1	12·5
25–29	26·9	35·7	56·7	80·6	16·3	18·6	57·1
30–34	21·4	33·3	49·0	78·3	10·0	15·4	100
35–39	28·6	25·0	41·7	57·9	. .	0	. .
	B. *White Multiparae*				D. *Negro Multiparae*		
10–14	31·0	37·8	38·5	0	18·6	25·9	. .
15–19	33·2	47·6	65·8	87·1	16·6	26·6	54·5
20–24	36·1	51·2	64·4	86·5	19·6	27·7	54·3
25–29	37·1	52·2	63·9	86·0	20·3	29·3	45·8
30–34	34·9	50·3	61·1	82·8	22·0	29·5	50·0
35–39	30·9	47·3	58·6	80·0	27·8	25·0	60·0

From Table 34 it is seen that the increase of contraceptive effort with rising economic status, already shown to be characteristic of the sample as a whole, is also manifested in each age period and for both races, wherever the sub-sample is large enough to give reliable indications. Furthermore there is evident among the whites an interesting tendency in all the economic groups, but most marked in the lower ones, Very Poor and Poor, for the percentages of contraceptors to be low in the lowest age periods. These percentages rise with age until the 20–24 year age period, and thereafter remain practically constant. This tendency seems plainly to reflect the commonly observed desire of young newly wed couples to experiment with reproduction (child-bearing) as well as with sex early in married life.

The story that Table 34 tells is clean-cut and clear in its revelation of present conditions. What of the future? The ardent birth-control philosophers in general take the position that why the Very Poor and Poor classes practise contraception less than the Well-to-do and Rich is because they are ignorant as to how to go about it, and that if complete freedom is permitted for the dissemination of contraceptive information their effort percentages will shortly rise to the same level as those now exhibited by the upper economic groups. Perhaps so, but it is permissible to have some doubts on the point. The case does not seem quite so simple. Many other factors are involved in complex ways. The more one studies the matter the more it becomes evident that the practice of contraception rests upon an extremely complicated psychological pattern of attitudes and motivations that are interwoven with social situations and integrations. The balance held between present goods and pleasures and anticipation and preparation for future goods and pleasures is at a very different level as between the Very Poor and Poor and the Well-to-do and Rich, not only as regards prospective children and their welfare, but in relation to virtually every aspect of life. It is this that seems basically much more important than relative ignorance or knowledge of contraceptive techniques. Many an honest, though poor, working man and his wife think this way: 'Our parents did nothing for us except bring us into the world and raise us until we were able to go to work. Well, that was all right. We didn't do so badly. Anyhow we are having a pretty good time together. We like children—they are a lot of fun to have around, and besides they'll probably be a help in our old age. This birth-control business is a lot of trouble, interferes with our pleasure, and besides is sort of unnatural. So, let's have none of it.' It is not meant that the thinking is consciously phrased in just these words. Probably it only rarely is. But in a vague way this general idea is there, and to an important degree. As people get better educated generally, and achieve a bigger economic and social stake in the scheme of things as they are, this attitude changes usually imperceptibly as to stages, but to a marked degree. The point that seems important is that probably what brings about such a change in attitude is very much more general social and economic forces, rather than specific instruction in contraceptive techniques, or general birth-control propaganda.

Table 35 gives percentages measuring the *effectiveness* of the contraceptive efforts actually made by the women in the several age periods and economic groups. These percentages are derived from the data of Table XVII by the following procedure and reasoning. The mean pregnancy-rate per 100 computed ovulations exhibited by each contraceptor sub-group is subtracted from the rate exhibited by the corresponding non-contraceptor sub-group. The difference, with due regard to sign, is then expressed as a percentage of the non-contraceptor mean.

TABLE 35

Percentages of contraceptive effectiveness by economic groups and age periods

	A. *White Primiparae*				C. *Negro Primiparae*		
Age period	*Very Poor*	*Poor*	*Moderate Circumstances*	*Well-to-do and Rich*	*Very Poor*	*Poor*	*Moderate Circumstances*
10–14	..	−57·6	..	..	..	..	..
15–19	43·9	54·8	54·6	84·0	9·2	24·0	..
20–24	50·8	53·7	56·8	58·0	10·4	42·0	..
25–29	28·6	48·1	43·0	69·3	67·2	51·1	85·0
30–34	79·4	43·7	37·8	42·0	..	..	..
35–39	..	42·6	−7·3	67·6	..	..	..
	B. *White Multiparae*				D. *Negro Multiparae*		
10–14	−51·5	−109·0	−82·3	..	−7·6	−143·2	..
15–19	3·6	22·5	20·3	63·7	3·8	23·1	30·5
20–24	18·7	26·4	31·6	48·7	5·4	8·2	−4·5
25–29	12·5	18·2	23·1	42·1	−22·0	−19·6	67·5
30–34	5·5	9·6	7·3	36·1	10·4	−33·6	66·4
35–39	15·5	17·0	20·2	−5·7	−7·8	−38·5	..

The figures of Table 35 make it plain that, just as was the case with contraceptive effort, the percentage effectiveness of contraception as practised increased with advancing economic status. The effectiveness percentages are less regular in their trends among the primiparae than among the multiparae, but generally higher, as is the usual finding. Amongst the white multiparae, where the larger sizes of the sub-samples make the results more reliable, it is seen that the increase in effectiveness of contraception is marked as we pass from the Very Poor to the Poor group. The Poor and Moderate Circumstances groups appear to stand at about the same level in this respect. But again there is a very sharp rise in effectiveness of contraception in passing from the Moderate Circumstances to the Well-to-do and Rich groups. In the groups of both primiparae and multiparae contraceptive efforts in the 10–14 year age period appear to be extremely ineffective—indeed the percentages for both whites and Negroes are all negative in sign in this period, meaning that the average pregnancy rates were actually higher in the contraceptor groups than in the non-contraceptor. The Negro sub-samples are, however, too small in size throughout and the Negro contraceptive behaviour too irregular, to give reliable results.

Still another way in which the effectiveness of group contraceptive efforts and their relationship to economic class differential fertility may be demonstrated is by an examination of the percentages of their total married lives to the time of record spent in the pregnant (and puerperal) state by the women in the several classes. At the time of record the women included in the present study had been married an aggregate total of 124,672·2 years. The proportions of this time spent in the pregnant (and puerperal) state are shown in Table 36.

From Table 36 it appears that while in the white non-contraceptor classes from 33 to 45 per cent. of the total married life to the time of record was spent in the pregnant state, the corresponding portions of married life dropped in the contraceptor classes to from 22 to about 34 per cent. In the white and Negro multiparae contraceptor classes the proportion of married life spent pregnant declined steadily with advancing economic status, again reflecting the increasing group prevalence and effectiveness of contraceptive efforts at successive higher levels of economic circumstances. The small effectiveness of the Negro contraceptive efforts as compared with those of the whites is here again apparent.

Using percentage of married life spent in pregnancy as an index of reproductive activity, as in Table 36, there does not appear any definite indication of a decline with advancing economic status in the non-contraceptor classes, such as was suggested by the rates of Table XVI. This finding engenders still further scepticism as to the validity of the suggestion.

TABLE 36

Average percentage of married life spent in pregnant (and puerperal) state

Items	White					Negro			
	Totals	Very Poor	Poor	Mod. Circ.	Well-to-do and Rich	Totals	Very Poor	Poor	Mod. Circ.
12. *Percentage of married life spent pregnant (total)* .	33·6	36·8	35·1	30·0	25·6	38·8	39·2	38·2	36·7
(*a*) Primiparae non-contraceptors .	42·3	45·0	45·6	36·3	39·7	37·7	37·7	37·0	54·2
(*b*) Primiparae contraceptors	26·2	30·9	29·3	25·2	22·0	34·6	36·0	37·6	18·3
(*c*) Multiparae non-contraceptors .	36·8	37·6	37·4	33·7	36·1	38·9	39·2	38·4	41·4
(*d*) Multiparae contraceptors . .	30·4	34·5	31·8	28·1	24·2	38·8	39·8	38·3	32·3

Using the same criterion as in an earlier chapter that a demonstration of the inherently adequate reproductivity of a particular mating may be taken as the production of a fourth living child at any stated confinement, or a child of higher parity order, it may now be inquired as to what performance the women in the present material had made up to the time of record in respect of this matter of adequate reproductivity.

Table XVIII of Appendix I gives the frequency distributions, by economic, contraceptive, and race (colour) groupings of the multiparae in the material according to the number of live births produced up to the time of record. The table includes only multiparae because plainly primiparae (women who had been pregnant only once) could not possibly have satisfied the criterion of adequate reproductivity.

Table 37 shows the percentage of the multiparae of Table XVIII who, at the time of record, had produced 4 or more live births, assorted by economic status, race (colour), and contraceptive efforts.

TABLE 37

Percentages of multiparae who had demonstrated adequate reproductivity at time of record

Items	Whites					Negroes			
	Totals	Very Poor	Poor	Mod. Circ.	Well-to-do and Rich	Totals	Very Poor	Poor	Mod. Circ.
13. *Percentages of multiparae who had reproduced their fourth or higher order live birth at time of record (totals)* . .	28·5	42·9	30·3	17·0	10·7	40·8	45·4	35·9	26·7
(*a*) Non-contraceptors .	32·9	43·8	32·3	19·5	20·6	40·0	44·8	33·9	29·2
(*b*) Contraceptors .	24·2	41·3	28·3	15·4	8·6	43·7	48·0	41·6	23·8

Table 37 has interesting implications. Its figures exhibit the combined effects of age at marriage and contraception, and are realistically important from the point of view of population theory. Taking all the women together, contraceptors and non-contraceptors, it is seen that fewer than a quarter as many of the white Well-to-do and Rich multiparae as of the Very Poor had proved adequate reproductivity at the time of record. The decline of the percentages of adequate reproductivity with advancing economic status is steady and regular in both non-contraceptor and contraceptor classes, but naturally more rapid in the latter. This same relationship is shown by the Negroes, though in lesser degree. Fig. 34 makes the facts graphically clear.

The decline in the percentages of adequate reproductivity among the *non-contraceptor* women shown in Table 37 might seem at first glance to indicate the existence of an economic fertility differential apart from that produced by contraception. Further consideration, however, gives no support for such a conclusion. The apparent downward trend of adequate reproductivity with advancing economic status among the non-contraceptors is probably wholly due —making proper allowance for sampling fluctuations—to relative degree of postponement of marriage (see Table XIII of Appendix I). That this is so is plainly indicated by the data of Table 38.

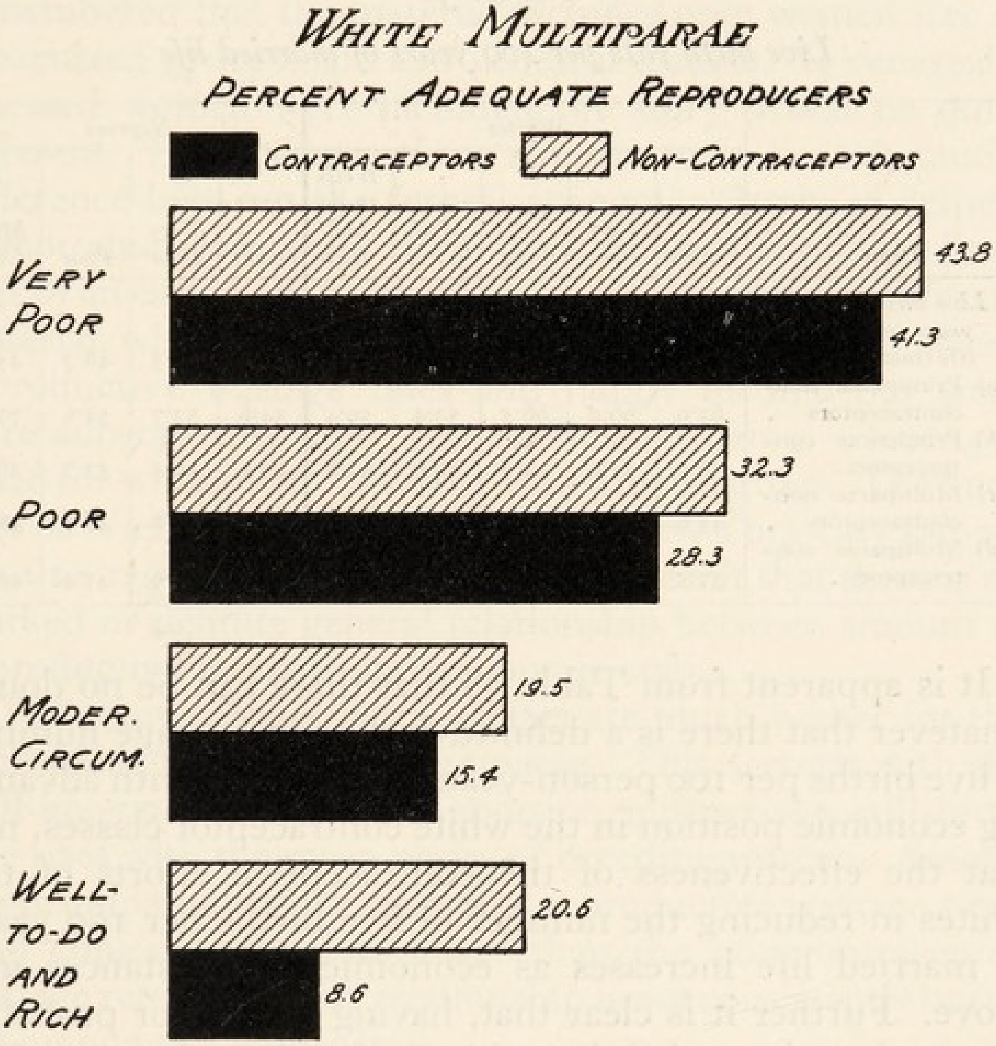


FIG. 34. Percentages of women who had produced four or more live births at the time of record.

In connexion with the subject of adequate reproductivity it may be of interest to consider the facts presented by this material regarding the total number of live births produced relative to duration of marriage in the several classes. This is biologically a less refined rate than that discussed earlier which related live births to ovulations, but on the other hand it has a certain realistic significance for students of population, because it furnishes a kind of synthesis of the factors that have been separately analysed, and shows how many live children were added to the population in each class for a standard period of marriage duration.

Table 38 sets forth these rates.

TABLE 38

Live birth rate per 100 years of married life

Items	Whites					Negroes			
	Totals	*Very Poor*	*Poor*	*Mod. Circ.*	*Well-to-do and Rich*	*Totals*	*Very Poor*	*Poor*	*Mod. Circ.*
14. *Live births per 100 years of married life (totals)*	42·7	46·0	44·6	38·7	33·1	48·2	48·3	48·3	45·5
(*a*) Primiparae non-contraceptors	62·0	66·0	66·5	53·4	59·4	54·6	53·7	54·6	77·2
(*b*) Primiparae contraceptors	39·0	47·0	44·7	36·9	32·6	49·1	50·2	53·7	26·6
(*c*) Multiparae non-contraceptors	45·6	46·4	46·5	41·9	44·8	47·7	47·8	47·7	48·8
(*d*) Multiparae contraceptors	37·5	42·2	39·2	34·9	30·4	47·7	48·9	47·4	40·2

It is apparent from Table 38 that there can be no doubt whatever that there is a definite decline in average number of live births per 100 person-years of marriage, with advancing economic position in the white contraceptor classes, nor that the effectiveness of the contraceptive efforts of the whites in reducing the number of live births per 100 years of married life increases as economic circumstances improve. Further it is clear that, having regard for probable errors, there is no definite evidence for the existence of an economic fertility differential in the live-birth rates of the non-contraceptor classes.

As has been discussed in an earlier chapter, the sum total of pregnancies that terminate in miscarriages, abortions, or still-births—in short in any other way than by a live birth—constitutes reproductive wastage. The maternal organism has been put to physiological trouble and no useful biological end has been served. The extent of this wastage in the present material is shown in Table XIX of Appendix I. In that table the reproductive wastage rates per 100 pregnancies experienced, given under Item 16, are obtained by subtracting each figure of Item 15 from 100.

Comparing the white and Negro samples as wholes it appears that there is no substantial difference between these two race (colour) groups in total reproductive wastage rates. In connexion with this result it is particularly to be remembered that the material includes only women free of recognized gynecologic and venereal disease. If venereally diseased women were included the story would be quite different. Furthermore there appears to be no substantial difference between the several economic classes in respect of reproductive wastage rates. This result confirms the findings of an earlier study (Pearl, 32) based on entirely different material, wherein it was shown that the correlations between reproductive wastage rates and family income per week were substantially zero, the coefficients being $+0{\cdot}0024 \pm 0{\cdot}028$ for whites and $+0{\cdot}117 \pm 0{\cdot}055$ for Negroes. The findings of Wiehl and Berry (37) on their New York City sample are also in general agreement with the result that there is no marked or definite general relationship between amount of reproductive wastage and economic status.

The reproductive wastage rates are much higher for the multiparae than for the primiparae. This accords with the well-known fact that the abortion–miscarriage–still-birth rate rises with the mean parity of breeding women. Among the primiparae the contraceptor reproductive wastage rates tend consistently to be lower than the non-contraceptor wastage rates. But this relationship is not consistently borne out among the multiparae.

The figures of Table XIX include all reproductive wastage. A part of this wastage is due to such 'natural' causes as disease, injury, &c. The remaining part is due to abortions deliberately induced by the pregnant woman herself, or by some other person acting criminally at her request, for the purpose of relief from an unwanted pregnancy. It is desirable to examine the extent of such induced abortions in the present connexion. The data are presented in Table 39. It is to be understood that abortions ethically induced by reputable physicians for therapeutic reasons are not included in the figures. The table includes only wilful terminations of unwanted pregnancies.

TABLE 39

Induced abortions (self or criminal)

Items	Whites					Negroes			
	Totals	*Very Poor*	*Poor*	*Mod. Circ.*	*Well-to-do and Rich*	*Totals*	*Very Poor*	*Poor*	*Mod. Circ.*
17. *Induced abortions (self or criminal) per 100 pregnancies experienced (totals)*	1·4	1·3	1·5	1·3	1·0	0·5	0·6	0·4	1·0
(*a*) Among non-contraceptors . .	0·7	0·8	0·7	0·4	1·1	0·4	0·5	0·2	0
(*b*) Among contraceptors . .	2·3	2·4	2·6	2·0	1·0	1·0	1·1	0·8	2·4
18. *Percentage of total reproductive wastage due to induced abortion (totals)* .	11·9	11·8	13·6	12·5	9·6	4·3	4·6	3·9	6·9
(*a*) Among non-contraceptors . .	6·9	7·7	6·9	4·0	9·4	3·4	3·9	2·0	0
(*b*) Among contraceptors . .	20·0	19·4	21·7	18·8	9·9	9·1	9·9	7·3	24·9

The number of induced abortions per 100 pregnancies experienced, and the percentages of total reproductive wastage due to induced abortions, are from three to four or more times greater, generally speaking, among contraceptors than among non-contraceptors in this material. The figures give numerical evidence of the minimal extent, at least, to which induced abortion is being used to correct the failures and inadequacies of contraception. It is to be understood that the results are based upon the women's own admission of the extent to which they have resorted to the dangerous practice of induced abortion. They probably understate the true facts by a certain unknown amount. But on that account their significance as minimal values is enhanced. It is further to be remembered that these data come from families living together in wedlock, that generally are not representative of immoral elements or forces in the community.

In this material the Negroes, generally speaking, resorted to induced abortions only about half as frequently and caused thereby only about half as much of their total reproductive wastage as the whites.

There appears to be no very regular or consistent association between the practice of induced abortion and economic status, until the Well-to-do and Rich class of the whites is reached. There the situation appears to be that the practice of contraception is so highly efficient relatively that induced abortion is less often resorted to, and on the whole not more by the contraceptors than by the non-contraceptors.

Without entering upon any further discussion of the social and medical implications of induced abortions it is evident that it must be a matter of grave concern in present-day American urban life when a large and representative sample of women *admit* that a fifth or more of their total reproductive wastage is deliberately so caused.

This chapter has so far been devoted to an *ad hoc* investigation of the part played by contraceptive efforts in producing fertility differentials between economic classes. The study is based upon the most extensive, accurate, unbiased, and representative material yet to be brought to bear on the problem, so far as the writer is aware. It includes the reproductive histories of 22,657 women, of whom 19,615 were whites, and 3,044 were Negroes. They were all married and living in wedlock; had been married once only; and were free from gynecologic disease of any sort recognized in the urban hospitals where they were delivered of the products of their latest conceptions at the time of record. In mean age at the time of record these women agreed closely with the women bearing children in any given recent year in the United States.

The mean ages at marriage of these women varied with their socio-economic position, being youngest in the Very Poor group, higher in the Poor, still higher in the Moderate Circumstances group, and highest in the Well-to-do and Rich group. In the same way the proportion of the women who had practised contraception during their wedded life increased as economic status rose from 30·0 per cent. among the Very Poor whites to 80·1 per cent. among the Well-to-do and Rich whites. The extent of contraceptive efforts among the Negroes was at all economic levels lower than among the whites, but the same tendency to increased prevalence of contraception with advancing economic position was exhibited by the Negroes.

The effectiveness of the contraceptive efforts actually made, however measured, increased with advancing economic position, the lowest effectiveness being exhibited by the Very Poor, and the highest by the Well-to-do and Rich.

The proportion of multiparae who had demonstrated, up to the time of record, adequate reproductivity (by the production of four or more live births) was greatest among the Very Poor and least among the Well-to-do and Rich, with intermediate gradation of the Poor and Moderate Circumstances groups.

Reproductive wastage was not found to be significantly correlated with economic status. Induced (self or criminal) abortions were found to be relatively much more frequent among contraceptors than among non-contraceptors.

The innate fertility of the Negroes, uninfluenced by contraception, was substantially the same as that of the whites. But the Negroes practised contraception less frequently and their contraceptive efforts were less effective than those of the whites. The Negroes exhibited substantially the same total reproductive wastage rates as the whites (all the women being free of recorded gynecologic diseases), but resorted to induced abortion less frequently.

The results of the study make it quantitatively clear that *the major factors immediately associated statistically with the observed economic class differential fertility in this American population sample were* (a) *increasing age at marriage with advancing economic position;* (b) *increasing prevalence of contraceptive efforts with advancing economic status; and* (c) *increasing effectiveness of the contraceptive efforts actually made with advancing economic status. The evidence indicates that in the absence of these factors there would be but little if any fertility differential between the several economic classes.*

PART B

Differential Fertility in Classes of Different Educational Levels

The degree of formal educational influences and forces to which individuals and groups have been subjected is a social variable of the first rank of importance. It is highly correlated with attitudes, outlooks, and motivations in regard to all aspects of living, and also with material prosperity and social position.

The mean pregnancy rates per 100 computed ovulations for the same group of women that has been discussed in Part A of this chapter, are arranged in Table XX of Appendix I, by age periods at risk and by groups according to the highest category of educational influence to which each individual had been subjected. The definition and meaning of these categories have been discussed in Chapter IV and Appendix II. It may be re-emphasized here that each woman was placed in tabulating in the highest educational category with which she had contact, regardless of how long continued or complete that contact was. Thus if a woman attended a college or university for one year only, or even a part of a year, she was put in the College category.

Before examining the data of Table XX with any particularity it will be well to look into the mean ages of the women in the several educational sub-groups. To this end Table 40 is presented.

Some interesting facts emerge from Table 40. In general, as has been seen before in connexion with the economic analysis, the contraceptor groups tend to be older, on the average, at the time of observation than the non-contraceptor groups. There is, however, in general no marked or even significant difference in mean age at marriage of contraceptor and non-contraceptor groups. What this means is that we have drawn a general sample in which the average age at marriage was about the same for all educational categories. But when these women are divided into contraceptor and non-contraceptor groups the former turns out at a given moment of observation to have been, on the average, longer married than the latter group. Since the time of observation was determined by the delivery of each woman of her latest product of conception, it is evident that the contraceptor group must in the nature of the case be expected to have been married longer, on the average, if birth controlling had any realistic effect at all.

TABLE 40

Mean ages of women by educational categories

Group	A. *At observation*		B. *At marriage*	
	White (years)	*Negro (years)*	*White (years)*	*Negro (years)*
(*a*) All women in sample	26·60 ± 0·03	25·03 ± 0·07	21·13 ± 0·02	19·02 ± 0·04
1. Primiparae. Illiterate. Non-contraceptors	24·09 ± 0·54	23·50 ± 1·30	21·59 ± 0·56	21·50 ± 0·88
2. Primiparae. Illiterate. Contraceptors	27·00 ± 1·07	. .	23·00 ± 0·68	. .
3. Primiparae. Elementary Educ. Non-contraceptors	22·53 ± 0·05	20·96 ± 0·14	20·91 ± 0·05	19·21 ± 0·11
4. Primiparae. Elementary Educ. Contraceptors	23·44 ± 0·09	22·06 ± 0·42	20·95 ± 0·07	19·61 ± 0·25
5. Primiparae. High School Educ. Non-contraceptors	22·66 ± 0·07	20·46 ± 0·13	21·06 ± 0·06	19·07 ± 0·11
6. Primiparae. High School Educ. Contraceptors	24·65 ± 0·08	20·96 ± 0·36	22·00 ± 0·07	19·04 ± 0·27
7. Primiparae. College Educ. Non-contraceptors	26·50 ± 0·22	23·10 ± 0·39	24·56 ± 0·19	21·90 ± 0·35
8. Primiparae. College Educ. Contraceptors	26·64 ± 0·12	25·68 ± 0·85	24·12 ± 0·11	24·32 ± 0·85
(*b*) All primiparae	23·45 ± 0·04	21·01 ± 0·09	21·46 ± 0·03	19·36 ± 0·07
9. Multiparae. Illiterate. Non-contraceptors	33·30 ± 0·30	26·68 ± 0·37	20·72 ± 0·19	18·06 ± 0·23
10. Multiparae. Illiterate. Contraceptors	32·65 ± 0·32	26·50 ± 0·42	20·93 ± 0·21	23·50 ± 0·42
11. Multiparae. Elementary Educ. Non-contraceptors	28·21 ± 0·07	26·92 ± 0·12	20·38 ± 0·04	18·78 ± 0·07
12. Multiparae. Elementary Educ. Contraceptors	28·98 ± 0·07	27·94 ± 0·21	20·46 ± 0·04	18·86 ± 0·12
13. Multiparae. High School Educ. Non-contraceptors	27·10 ± 0·10	24·58 ± 0·16	21·38 ± 0·07	19·16 ± 0·09
14. Multiparae. High School Educ. Contraceptors	28·08 ± 0·07	25·67 ± 0·29	21·29 ± 0·05	19·01 ± 0·14
15. Multiparae. College Educ. Non-contraceptors	30·40 ± 0·23	27·78 ± 0·74	24·80 ± 0·19	21·94 ± 0·39
16. Multiparae. College Educ. Contraceptors	30·51 ± 0·14	26·83 ± 0·65	24·15 ± 0·10	20·50 ± 0·57
(*c*) All multiparae	28·54 ± 0·04	26·54 ± 0·08	20·92 ± 0·02	18·89 ± 0·05
(*d*) All Illiterate	31·93 ± 0·22	26·45 ± 0·34	20·94 ± 0·14	18·68 ± 0·24
(*e*) All Elementary Educ.	26·66 ± 0·04	25·82 ± 0·09	20·58 ± 0·02	18·90 ± 0·05
(*f*) All High School Educ.	25·77 ± 0·04	23·17 ± 0·11	21·40 ± 0·03	19·10 ± 0·06
(*g*) All College Educ.	28·55 ± 0·09	25·54 ± 0·35	24·29 ± 0·07	21·99 ± 0·26

Mean age at marriage is practically the same in the Illiterate and the Elementary educational categories, considered as whole groups. But the High School and College groups postpone marriage, on the average, to higher ages. This is particularly so, for obvious reasons, in the College group. These relations appear as clearly in the Negro as in the white portion of the material.

The oldest group, on the average, at observation is the Illiterate, with the College group standing second in rank. This again is true for both whites and Negroes. Why the Illiterates are in this position is a minor puzzle for which the answer is not apparent. As will presently appear they are very indifferent about contraceptive efforts. Few attempt birth controlling, and when they do it is generally rather inadequate as to effectiveness. If the same mean age relations did not appear in the Negroes as in the whites, one might be tempted to connect the matter in the whites with the fact that the greater part of the illiterates are foreign-born. As the matter stands, however, we are unable to offer any rational explanation for this age difference of the Illiterate group.

A general picture of the nature and degree of the fertility differentials by educational classes, together with data about some contributory factors, is given in Table 40*a*.

From Table 40*a* the general fertility differentials [cf. items (*d*) to (*g*)] according to educational status of the women, as indicated by live-birth rate per 100 person-years of married life, is seen to present a somewhat different picture in the Negroes from what it is in the whites. In the whites the educational group of lowest mean fertility is the College (and university) group, as would be expected. But the College group is not significantly different in mean fertility, as here measured, from the Illiterate group in the whites—a finding that was *not* expected. Again, in the whites, the Elementary Schools group and the High School group exhibit mean live-birth rates per 100 person-years of married life that are substantially identical to each other. But both are definitely higher than the rates exhibited by the College and Illiterate groups. This result seems immediately related to the prevalence of criminal abortion among these educational status groups, as is shown by the last column of the table, though again not in quite the manner one would have expected. But it is clear that the groups are differentiated in respect of criminal abortion practices in the same way that they are in live-birth rates. The Elementary Schools and High School groups have relatively high criminal abortion rates, whether related to total pregnancies experienced or to total reproductive

TABLE 40*a*

Live-birth rates per 100 years of married life; total reproductive wastage rate per 100 pregnancies experienced; criminal abortion rate per 100 pregnancies experienced, and percentage of total reproductive wastage due to criminal abortion; by educational classes

A. *In white women*

Group	*Live births produced per 100 years of married life*	*Total reproductive wastage per 100 pregnancies*	*Criminal abortions per 100 pregnancies*	*Percentage of total reproductive wastage due to criminal abortions*
(*a*) All women in sample	42·6	10·8	1·39	12·9
1. Primiparae. Illiterate. Non-contraceptors	48·6	11·4	0·0	0·0
2. Primiparae. Illiterate. Contraceptors	25·4	10·0	0·0	0·0
3. Primiparae. Elementary schools. Non-contraceptors	62·0	2·1	0·15	7·1
4. Primiparae. Elementary schools. Contraceptors	40·3	1·8	0·0	0·0
5. Primiparae. High school. Non-contraceptors	63·7	2·8	0·23	8·3
6. Primiparae. High school. Contraceptors	39·1	1·3	0·15	11·2
7. Primiparae. College. Non-contraceptors	53·1	4·0	0·0	0·0
8. Primiparae. College. Contraceptors	36·9	2·2	0·0	0·0
(*b*) All primiparae	50·7	2·2	0·13	6·1
9. Multiparae. Illiterate. Non-contraceptors	43·3	11·3	0·69	6·1
10. Multiparae. Illiterate. Contraceptors	33·5	16·2	2·07	12·8
11. Multiparae. Elementary schools. Non-contraceptors	45·6	11·8	0·79	6·7
12. Multiparae. Elementary schools. Contraceptors	38·0	12·8	2·63	20·5
13. Multiparae. High school. Non-contraceptors	46·5	11·9	0·68	5·7
14. Multiparae. High school. Contraceptors	37·7	12·4	2·63	21·2
15. Multiparae. College. Non-contraceptors	45·2	12·2	0·60	4·9
16. Multiparae. College. Contraceptors	34·8	13·4	1·70	12·7
(*c*) All multiparae	41·4	12·3	1·62	13·1
(*d*) All illiterate	39·8	12·8	1·10	8·6
(*e*) All elementary schools	43·2	11·1	1·41	12·7
(*f*) All high school	42·7	9·9	1·47	14·9
(*g*) All college and university	38·2	10·3	1·02	9·9

TABLE 40*a—continued*

B. *In Negro women*

Group	Live births produced per 100 years of married life	Total reproductive wastage per 100 pregnancies	Criminal abortions per 100 pregnancies	Percentage of total reproductive wastage due to criminal abortions
(*a*) All women in sample	48·2	11·6	0·52	4·5
1. Primiparae. Illiterate. Non-contraceptors	42·1	10·0	0·0	0·0
2. Primiparae. Illiterate. Contraceptors	23·3	0·0	0·0	0·0
3. Primiparae. Elementary schools. Non-contraceptors	50·8	5·8	0·0	0·0
4. Primiparae. Elementary schools. Contraceptors	42·2	4·4	0·0	0·0
5. Primiparae. High school. Non-contraceptors	59·9	3·9	0·0	0·0
6. Primiparae. High school. Contraceptors	60·0	0·0	0·0	0·0
7. Primiparae. College. Non-contraceptors	63·2	8·0	0·0	0·0
8. Primiparae. College. Contraceptors	43·1	9·1	*	*
(*b*) All primiparae	53·8	4·8	0·12	2·5
9. Multiparae. Illiterate. Non-contraceptors	46·6	11·9	0·43	3·6
10. Multiparae. Illiterate. Contraceptors	49·8	6·7	0·0	0·0
11. Multiparae. Elementary schools. Non-contraceptors	46·4	12·9	0·41	3·2
12. Multiparae. Elementary schools. Contraceptors	47·3	10·4	0·70	6·8
13. Multiparae. High school. Non-contraceptors	53·2	11·3	0·43	3·8
14. Multiparae. High school. Contraceptors	48·1	13·1	2·09	15·9
15. Multiparae. College. Non-contraceptors	58·5	6·9	0·0	0·0
16. Multiparae. College. Contraceptors	54·9	24·2	0·0	0·0
(*c*) All multiparae	47·7	12·2	0·55	4·5
(*d*) All illiterate	46·5	11·7	0·41	3·5
(*e*) All elementary schools	46·8	11·9	0·45	3·8
(*f*) All high school	52·9	10·5	0·75	7·1
(*g*) All college and university	56·4	14·1	0·64	4·5

* Only one criminal abortion and 11 total pregnancies in class.

wastage, whereas the Illiterate and College groups have relatively lower criminal abortion rates, just as they have lower live-birth rates. The interpretation of these results is not entirely clear. The higher age at marriage of the College group helps to explain the lower live-birth rate there, but the Illiterates married at an earlier average age, not significantly different from that of the Elementary Schools group.

Turning to the Negroes a different picture is presented

—more consistent to be sure, but exactly opposite in sense to prevailing *a priori* expectation. Among the Negroes the Illiterates exhibit the *lowest* live-birth rate, though not significantly lower than that of the Elementary Schools group, and the live-birth rate *rises* steadily as we go up the scale of educational status to end with the highest fertility in the College group, as a whole group. As in the whites prevalence of criminal abortion tends to parallel live-birth rates, with the College group alone forming an exception. A very striking feature of Table 40*a*, however, is its demonstration of the much less frequent resort of the Negroes than of the whites, generally speaking, to criminal abortion as a means of escaping unwanted pregnancies. This is connected with the greatly lower prevalence of contraception in the Negroes as compared with the whites.

The unexpected, and it must be confessed somewhat surprising, results regarding differential fertility by educational classes are extremely puzzling, and suggest the need for further study of the problem. The low fertility of the Illiterate group (in the whites) presents the most serious difficulty of interpretation. Since contraception is but little attempted in this group (as will presently appear) and the effectiveness of the efforts made is relatively low, the suggestion plainly is that this group in this material really has a relatively low innate biological fertility apart from external and adventitious factors. A detailed study of the much more refined statistical analysis presented in Table XX of Appendix I only emphasizes, but does not clarify, the difficulty. The numbers of primiparae in this group are plainly too small to have any significance. The numbers of Illiterate multiparae are small too, but not so small as to be dismissed off-hand on that ground. A possible suggestion, but not more than that, might conceivably be that perhaps the low fertility of this Illiterate group reflects real and serious under-nutrition or malnutrition. Such a supposition would carry with it the not altogether improbable assumption that the Illiterates are a small selected group representing the most underprivileged—and therefore in so far as bad environment has influenced physiological processes the most biologically inadequate at the moment—elements in the Very Poor group on the economic classification. In any case the matter plainly demands further examination with larger material.

TABLE 41

Percentages of contraceptive effort by educational groups and age periods. Derived from Table XX

Age period	Illiterate	Elementary	High School	College	Illiterate	Elementary	High School	College
	A. *White Primiparae*				C. *Negro Primiparae*			
10–14	..	11·6	14·3	..	..	5·3	0·0	..
15–19	9·1	24·8	35·2	55·2	0	9·8	14·8	25·0
20–24	20·0	34·4	51·9	72·1	0	14·0	14·5	18·2
25–29	46·2	34·6	60·5	71·4	0	16·7	17·2	50·0
30–34	28·6	27·4	59·3	66·3	0	6·7	42·9	100
35–39	..	18·8	50·0	55·0	..	..	0·0	..
	B. *White Multiparae*				D. *Negro Multiparae*			
10–14	20·0	34·9	42·9	..	0·0	22·5	33·3	..
15–19	35·9	43·2	58·7	81·4	1·3	21·0	25·2	63·6
20–24	38·4	47·1	63·5	76·5	5·9	23·5	26·5	46·7
25–29	39·8	49·1	66·2	75·7	5·7	23·5	31·6	47·4
30–34	37·1	48·1	62·9	75·2	0·0	25·7	33·9	28·6
35–39	34·6	43·3	61·2	73·4	0·0	27·1	34·6	100

Table 41 gives the relative measures of contraceptive effort by educational categories, the figures being derived from Table XX, and denoting the percentages of all women in the several groups who made some contraceptive effort. Similarly Table 42 gives the relative measures of contraceptive effectiveness as practised, the measure as before being the percentage amount by which the contraceptor mean pregnancy rate per 100 computed ovulations is lower than the corresponding mean rate for the equivalent non-contraceptor group.

For the white women, in the four quinquennial age periods from 15 to 34 years inclusive, the data of Tables 41 and 42 have been plotted together in the diagram shown here as Fig. 35. These are the most important age periods from the reproductive standpoint, and give a simple and intelligible general view of the essentials of the whole somewhat complicated numerical picture.

TABLE 42

Percentages of contraceptive effectiveness by educational groups and age periods

	A. *White Primiparae*				C. *Negro Primiparae*			
Age period	*Illiterate*	*Elementary*	*High School*	*College*	*Illiterate*	*Elementary*	*High School*	*College*
10–14	..	80·2	..	..	..	..	..	..
15–19	..	55·5	56·9	55·2	..	23·2	15·9	..
20–24	−2·3	59·1	58·4	53·5	..	34·0	19·6	52·6
25–29	84·7	47·1	50·7	59·4	..	75·8	57·9	66·1
30–34	..	48·9	38·8	30·3	..	..	−462·0	..
35–39	..	72·1	−10·2	39·0	..	..	..	..

	B. *White Multiparae*				D. *Negro Multiparae*			
10–14	..	−108·6	..	..	..	−70·4	−132·9	..
15–19	−11·0	16·2	31·4	74·9	..	14·0	6·7	−136·6
20–24	15·3	28·6	33·8	32·6	34·0	1·3	24·1	−18·6
25–29	19·5	24·9	23·5	25·4	−73·4	−21·4	15·1	−154·1
30–34	36·3	4·4	21·1	24·2	..	−8·0	−1·4	..
35–39	29·2	18·6	−8·2	36·4	..	5·5	−91·8	..

The tables and diagrams tell an interesting tale, albeit one that illustrates once more the sad disparity so often observed in human affairs between intention and accomplishment. Generally speaking, and with exceptions probably due only to the vagaries of sampling, it appears that the more formal education these women had been exposed to, the more of them proportionately there were who attempted birth control, by one method or another. The effort percentages depicted by the solid black bars tend with few exceptions to rise steadily from low values in the Illiterate group to high ones in the College educated group, three-quarters or more of whom as multiparae tried to limit artificially the overt expression of their natural fertility. Their relative success in this enterprise, however, as compared with the performance of their comparable contemporaries who took no trouble at all about the matter, was at best only fair. The Illiterate primiparae for the most part had no success at all. But amongst the other classes of primiparae, and in the multiparae generally, there was no definite, regular, or marked statistical association between educational status and the relative effectiveness in lowering pregnancy rates of

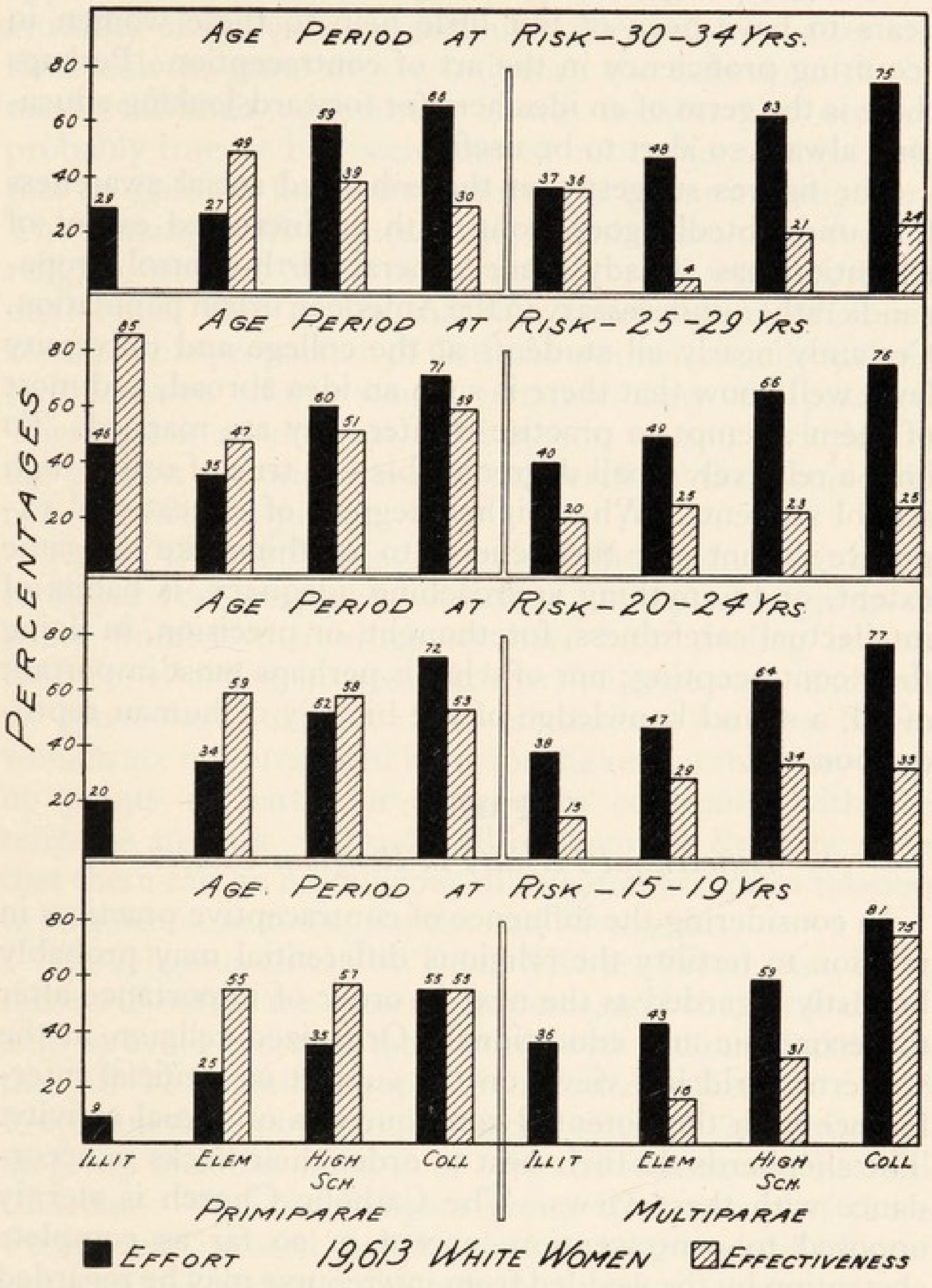


FIG. 35. Percentages of contraceptive effort and contraceptive effectiveness of the efforts actually made (as defined in the text) by white women. The figures at the tops of the bars are the actual percentages to the nearest whole numbers.

the contracepting actually done. Their school training appears to have been of but little help to these women in acquiring proficiency in the art of contraception. Perhaps there is the germ of an idea here for forward-looking educators, always so alert to be useful.

The figures suggest that the enhanced social awareness that undoubtedly goes along with an increased extent of education has already made general birth-control propaganda rather unnecessary in the American urban population. Certainly nearly all students at the college and university level well know that there is such an idea abroad, and most of them attempt to practise it after they are married. To only a relatively small degree is this less true of urban high school students. What higher degrees of educational exposure do not give their clients to anything like the same extent, or to anything approaching adequacy, is habits of intellectual carefulness, forethought, or precision, in doing their contracepting; nor of what is perhaps most important of all, a sound knowledge of the biology of human reproduction.

PART C

Differential Fertility in Religious Classes

In considering the influence of contraceptive practices in relation to fertility the religious differential may probably be justly regarded as the next in order of importance after the economic and educational. Organized religion in the western world has views on the subject of artificial interference with the potential consequences of sexual activity. The shepherds do their best to order their flocks in accordance with these views. The Catholic Church is sternly opposed to contraception, except in so far as complete abstention by the wedded from intercourse may be regarded as a birth-control measure—which it is, being in fact the surest of all contraceptive techniques now known to biology, or ever likely to be. The orthodox Jewish faith is also officially opposed to contraception. The various Protestant sects have taken differing views, which in general may be said to have ranged all the way from complete opposition to approval, tacit or expressed. The official or quasi-official attitudes of the various religious bodies on this matter undoubtedly in some degree influence the behaviour of the masses of their adherents. It was because this seemed probably true, as has been pointed out earlier in this book, that no Catholic hospital was included in our investigation. The nursing staffs of most such hospitals are composed of religious sisters. Many of the medical staff are Catholic in their faith. Our advice was that *under these conditions* a considerable proportion of Catholic women actually making contraceptive efforts would certainly deny the practice. Therefore it results that the Catholic women included in the present material were all delivered of their babies in non-Catholic hospitals.

Table XXI of Appendix I gives the mean pregnancy-rates per 100 computed ovulations for the same group of white women with which we have been dealing in this chapter: all living in wedlock, married once only, and free of gynecologic disease. The tabulations for the Negro women are not presented here, for the reason that they have no points of particular interest in connexion with the religious analysis. Virtually all of them are Protestants so that there can be no religious differential except in relation to two denominations, Baptist and Methodist.

The religious classes of Table XXI are broad ones, since these will suffice for present purposes, and since it is desirable to avoid blurring the picture with tedious detail. In the All Protestant group are included adherents of all Protestant denominations and sects; similarly the All Catholic group includes affiliates of both the Roman and Eastern Churches. The No Religion group is made up of those women who insisted that they had no religious affiliation of any sort and wished to be recorded in that sense.

Before examining the results set forth in Table XXI it will be well to consider certain other pertinent facts about the material when classified in religious groups. To this end Tables 43 and 44 are presented. Table 43 gives the mean ages at observation (delivery of latest product of conception) and at marriage.

TABLE 43

Mean ages of white women by religions

Group	A. *At observation* (*years*)	B. *At marriage* (*years*)
(*a*) All women in sample	26·60 ± 0·03	21·13 ± 0·02
1. Primiparae. All Protestants. Non-contraceptors	22·71 ± 0·07	21·07 ± 0·06
2. Primiparae. All Protestants. Contraceptors	25·08 ± 0·08	22·44 ± 0·07
3. Primiparae. Catholics. Non-contraceptors	22·82 ± 0·06	21·17 ± 0·06
4. Primiparae. Catholics. Contraceptors	23·56 ± 0·10	21·10 ± 0·09
5. Primiparae. Jews. Non-contraceptors	23·36 ± 0·16	21·93 ± 0·15
6. Primiparae. Jews. Contraceptors	24·47 ± 0·09	22·03 ± 0·08
7. Primiparae. No Religion. Non-contraceptors	22·39 ± 0·69	20·11 ± 0·40
8. Primiparae. No Religion. Contraceptors	24·30 ± 0·57	20·90 ± 0·45
(*b*) All primiparae	23·45 ± 0·04	21·46 ± 0·03
9. Multiparae. All Protestants. Non-contraceptors	27·60 ± 0·08	20·39 ± 0·05
10. Multiparae. All Protestants. Contraceptors	29·04 ± 0·07	21·23 ± 0·05
11. Multiparae. All Catholics. Non-contraceptors	28·68 ± 0·08	21·08 ± 0·05
12. Multiparae. All Catholics. Contraceptors	28·33 ± 0·08	20·67 ± 0·05
13. Multiparae. Jews. Non-contraceptors	29·49 ± 0·25	21·73 ± 0·15
14. Multiparae. Jews. Contraceptors	29·51 ± 0·09	21·51 ± 0·06
15. Multiparae. No Religion. Non-contraceptors	25·41 ± 0·47	19·14 ± 0·28
16. Multiparae. No Religion. Contraceptors	26·25 ± 0·43	20·18 ± 0·34
(*c*) All multiparae	28·54 ± 0·04	20·92 ± 0·02
(*d*) All Protestants	26·45 ± 0·04	21·14 ± 0·03
(*e*) All Catholics	26·57 ± 0·05	21·00 ± 0·03
(*f*) All Jews	27·41 ± 0·07	21·73 ± 0·04
(*g*) All No Religion	24·75 ± 0·28	19·95 ± 0·18

From Table 43 it appears that there is no very striking or important difference between the Protestant and the Catholic groups in respect of mean age, either at observation or at marriage, or as concerns either primiparae or multiparae. The Jewish group tends, on the whole, to exhibit a little higher mean ages than either the Protestant or Catholic. The small No Religion group trends rather the other way, towards younger mean ages. But, in general, there are no very important age differentials among the religious groups. The usual differences in mean ages between primiparae and multiparae, and between contraceptors and non-contraceptors, appear here in the religious analysis, just as in other breakdowns.

The data of Table 44 demand some discussion because they bring out points of considerable significance to the student of the natural history of population. In the first place we see that these women had produced in their reproductive lives up to the time of observation 42·6 living births for each 100 woman-years of wedded life, or 0·4 of a live birth per year married. This is a high live-birth rate. If

TABLE 44

Live-birth rates per 100 years of married life; total reproductive wastage rate per 100 pregnancies experienced; criminal abortion rate per 100 pregnancies experienced, and percentage of total reproductive wastage due to criminal abortion; in white women by religions

Group	Live births produced per 100 years of married life	Total reproductive wastage per 100 pregnancies	Criminal abortions per 100 pregnancies	Percentage of total reproductive wastage due to criminal abortion
(a) All women in sample	42·6	10·81	1·39	12·9
1. Primiparae. All Protestants. Non-contraceptors	59·3	2·02	0·18	8·9
2. Primiparae. All Protestants. Contraceptors	37·4	1·76	0·07	4·0
3. Primiparae. All Catholics. Non-contraceptors	65·7	2·89	0·15	5·2
4. Primiparae. All Catholics. Contraceptors	42·5	1·82	0·0	0·0
5. Primiparae. Jews. Non-contraceptors	62·6	2·54	0·32	12·5
6. Primiparae. Jews. Contraceptors	40·4	1·44	0·16	11·1
7. Primiparae. No Religion. Non-contraceptors	47·4	2·17	0·0	0·0
8. Primiparae. No Religion. Contraceptors	37·5	0·0	0·0	0·0
(b) All primiparae	50·7	2·19	0·13	6·1
9. Multiparae. All Protestants. Non-contraceptors	44·6	11·75	0·81	6·9
10. Multiparae. All Protestants. Contraceptors	37·8	12·87	2·42	18·8
11. Multiparae. All Catholics. Non-contraceptors	47·3	11·62	0·64	5·5
12. Multiparae. All Catholics. Contraceptors	40·4	12·37	2·35	19·0
13. Multiparae. Jews. Non-contraceptors	37·6	15·16	2·00	13·2
14. Multiparae. Jews. Contraceptors	32·2	13·94	3·32	23·8
15. Multiparae. No Religion. Non-contraceptors	49·1	10·89	0·0	0·0
16. Multiparae. No Religion. Contraceptors	42·3	13·07	3·98	30·4
(c) All multiparae	41·4	12·30	1·62	13·1
(d) All Protestants	42·0	10·63	1·39	13·1
(e) All Catholics	45·9	10·72	1·13	10·5
(f) All Jews	35·1	12·08	2·56	21·2
(g) All No Religion	45·3	10·24	1·56	15·2

continued steadily throughout the 31·2 years' average duration of the female reproductive span it would mean that each woman would produce, on the average, a total of 13·3 live births. But these are relatively young women with an average age of only 26·6 years as a whole group, who have produced live births at the rate indicated in Table 44. There is no justification for extending this rate throughout the reproductive span, because if these identical women were each to be followed through to the menopause it would be found that this reproductivity rate of early married life would drop off rapidly and markedly, for two reasons—increasing contraceptive effort with advancing age and increasing sterility (childlessness) as they grew older. The earlier part of the reproductive span is characterized by relatively high birth-rates. It is a general characteristic of human behaviour in this matter that people tend to have the bulk of what children they are ever going to have relatively early in married life.

Considered as wholes the three principal religious groups stand in the order Catholics, Protestants, and Jews, in respect of live-birth rates per hundred person-years of married life experienced. This agrees with the results of Methorst (27) and Gargas (31) regarding religious class differential fertility in Holland; of Grämiger (21) in Germany (for Catholics and Protestants); of Grotjahn (27)—on the basis of data from Krose and from Lenz—in Germany for all three groups; of Holmes (24, 26) for families of University of California students; of Russell (28) in Ireland (Catholics and Protestants); of Grebenshtshikoff (04) and Nowosselsky (15) in Russia; of Hanauer (28) in Germany; of Notestein and Kiser (35) in American urban populations (Catholics and Protestants); of Oppenheim (19) in genealogical records of Frankfurt families (Jews and Christians); of Michaykoff (36) in Bulgaria; of Marcuse (13) in Germany; and of many other authors who might be cited.

The highest live-birth rates in the table are those for the Catholic primiparae non-contraceptors and the No Religion multiparae non-contraceptors. Among the primiparae the Catholic and Jewish non-contraceptors are outstanding in their live-birth rates. Considering only non-contraceptor multiparae there is no great difference between Protestants and Catholics in live-birth rates though the latter have a little the higher rate.

The effectiveness of the contraceptive efforts made, as judged by reduction of live-birth rates, was substantially the same in the Protestant and Catholic groups. There was among the Protestant primiparae an average reduction of 21·9 live births per 100 years of married life associated with contraception as against a reduction of 23·2 live births among the Catholic primiparae. Among the multiparae the corresponding reductions in average number of live births per 100 years of married life were 6·8 for Protestants and 6·9 for Catholics. The figure was also 6·8 for the No Religion multiparae. The contraception of the No Religion primiparae and of the Jewish multiparae was less efficient.

Total reproductive wastage per 100 pregnancies experienced was highest in the Jews as a whole group, amounting to just over 12 per cent., and stood at approximately the same lower level for the other three groups. The total reproductive wastage is here, as usual, much lower in the primiparae than in the multiparae, on the basis of pregnancies experienced. The contraceptor primiparae exhibit lower total wastage rates than the non-contraceptor primiparae. Except for the Jews, this relationship is reversed among the multiparae. This is because of the high induced (criminal) abortion rate among the multiparae contraceptors.

The last two columns of Table 44 present the facts about this matter of deliberately induced abortions. These may be induced by the woman herself or by some one else. In either case they are criminal abortions, and for simplicity's sake the columns have been so headed. It is to be remembered that the figures are based on the women's own *admissions*, and probably understate the true incidence. As can be seen from the percentages in the last column, and graphically from Fig. 36, there are marked differences between the religious groups in the extent to which they resort to induced abortion (self and criminal).

The Jews stand at the top of the list in the proportion of total reproductive wastage caused by resort to criminal abortion. Next in order comes the No Religion group, and next below that the Protestants. The Catholics as a group resort least often to this dubious practice. These results suggest that the sanctions of the Catholic Church still have some statistically demonstrable effect upon the everyday behaviour of even its more sophisticated communicants.

The picture that these results give of the working partnership between criminal abortion and birth control, regardless of religion, is not exactly a pleasant one. Taking the whole material together it is seen that, in this large sample of respectable white married women already shown to be fairly representative of the general population from which it came, those who practise contraception as a part of their sex life, by their own admission resort to criminally induced abortions about *three times* as often proportionately as do their comparable non-contraceptor contemporaries. It re-

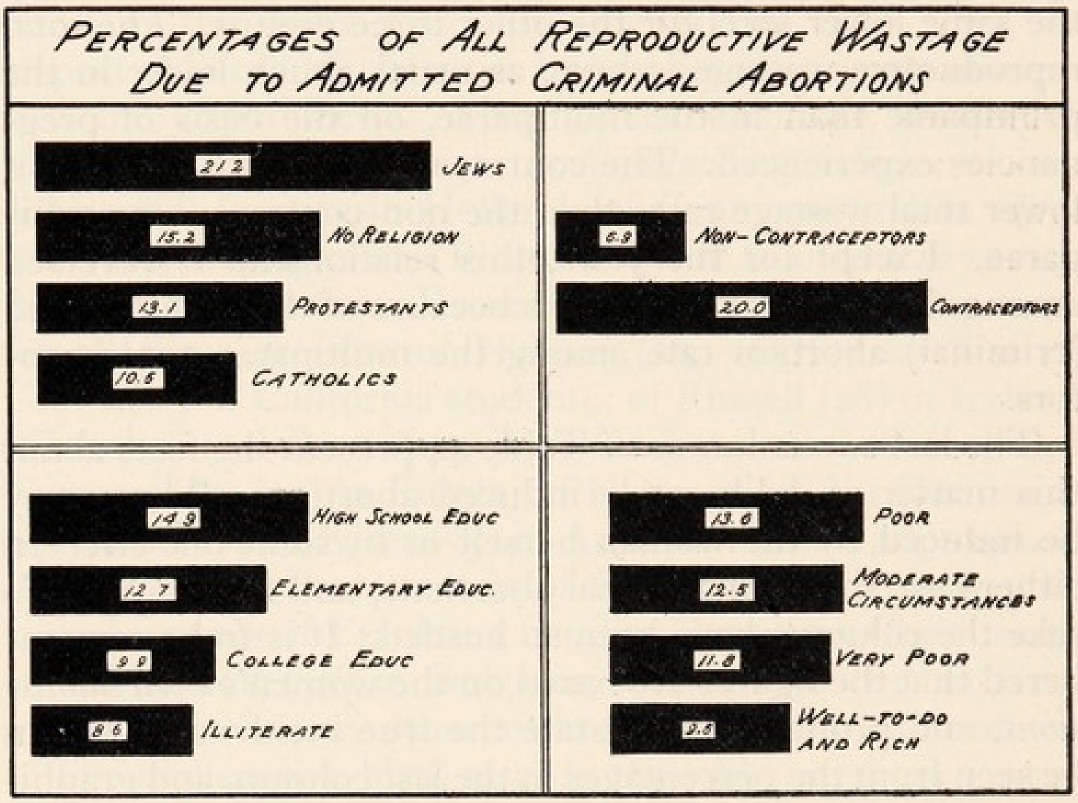


FIG. 36. Percentages of total reproductive wastage due to criminal abortions, in various groups.

quires no elaborate analysis or documentation to know why this is so. It is because criminal abortion is the last desperate remedy to correct the failures of contraceptive techniques. A cynic might suggest that the best evidence of real improvement in contraceptive methodology will be afforded if and when the proportionate part of total reproductive wastage due to criminal abortion begins to decline among the contraceptor moiety of the population. In the meantime, a not unreasonable deduction from the results set forth in Table 44 would be that for something like three-quarters of that part of the professional abortionist's business that derives from urban American married women he can thank the birth controllers and the current imperfections in the technique of their art.

For the sake of comparison there have been added to Fig. 36 diagrams showing the differentials relative to criminal abortion as a factor in total reproductive wastage, on the basis of educational and economic status. The group differences in both these categories are obviously smaller than those relative to religion and contraception. Relative to economic status they are of little practical concern except in the case of the Well-to-do and Rich. It has already been suggested that the most probable explanation of their proportionately infrequent resort to criminal abortion is to be found in the relatively high efficiency of their contraceptive efforts. The criminal abortion differentials relative to education do not seem amenable to any simple general explanation. The fact of the matter probably is that the extreme complexity of the correlational nexus between education, other social factors, and relative intensity and efficiency of contraception obscures the picture here.

From the data of Table XXI of Appendix I are derived the percentages of contraceptive effort made by the women in the several religious groups shown in Table 45, with the age period 40 and over years omitted, for reasons already stated. The figures in Table 45, as before, mean in each case the percentage of all the women in the sub-groups who practised contraception in some form or other.

TABLE 45

Percentages of contraceptive effort by religious groups and age periods

	A. *White Primiparae*				B. *White Multiparae*			
Age period	*All Protestants*	*All Catholics*	*Jews*	*No Religion*	*All Protestants*	*All Catholics*	*Jews*	*No Religion*
10–14	12·5	8·3	33·3	0·0	35·2	35·2	55·6	25·0
15–19	27·7	25·4	57·7	28·6	46·1	41·7	80·3	47·2
20–24	47·3	31·6	73·6	48·6	54·2	42·4	82·5	48·1
25–29	58·1	29·6	71·6	54·5	58·4	41·5	83·5	58·0
30–34	51·4	31·1	64·3	16·7	58·9	37·3	80·8	58·8
35–39	39·2	37·9	57·1	0·0	56·3	32·8	71·4	20·0

Table 46 presents the information as to relative efficiency of contraception as practised in the different religious groups. The figures are the percentages by which the contraceptor mean pregnancy rates are below the corresponding non-contraceptor mean rates.

TABLE 46

Percentages of contraceptive effectiveness by religious groups and age periods

	A. *White Primiparae*				B. *White Multiparae*			
Age period	*All Protestants*	*All Catholics*	*Jews*	*No Religion*	*All Protestants*	*All Catholics*	*Jews*	*No Religion*
10–14	−224·0	..	..	..	−126·5	−100·7	..	..
15–19	51·8	57·3	66·7	92·3	18·2	16·0	31·4	16·2
20–24	57·7	56·4	58·5	75·0	27·2	24·7	35·5	19·2
25–29	46·8	52·5	59·9	44·4	21·0	19·2	18·3	33·3
30–34	31·0	57·4	47·3	..	9·6	12·0	−17·6	4·6
35–39	−0·1	65·7	−94·2	..	6·1	13·8	34·7	..

The relative degrees of contraceptive effort and effectiveness are shown graphically in Fig. 37.

The most striking and significant result that emerges from the data shown in Fig. 37 and its supporting tables is the much higher proportion of contraceptive effort among the Jews than among the women of any other religious class. In all of the four important age periods, and in both primiparae and multiparae the Jewish women far outranked all other classes in the proportion of contraceptors to all women. Next below the Jews in this respect came the Protestants, generally speaking, though the small No Religion group showed slightly higher percentages of contraceptive effort in some age periods. The Catholics stood lowest in the proportion of contraception in the whole group, in all sub-groups, and in all age periods. Max von Gruber (14) stated that this was also true in Germany.

Percentage lowering of mean pregnancy rates (contraceptive effectiveness) were generally about equal in Protestant and Catholic groups. The Jews were not greatly different in this respect, except that in the two early age periods (15–24 years inclusive) they showed somewhat greater contraceptive efficiency.

On the whole it appears, in so far as the present material may be regarded as representative, that urban American

Jews constitute the most ardent birth-controlling group in the population. Regardless of economic or educational

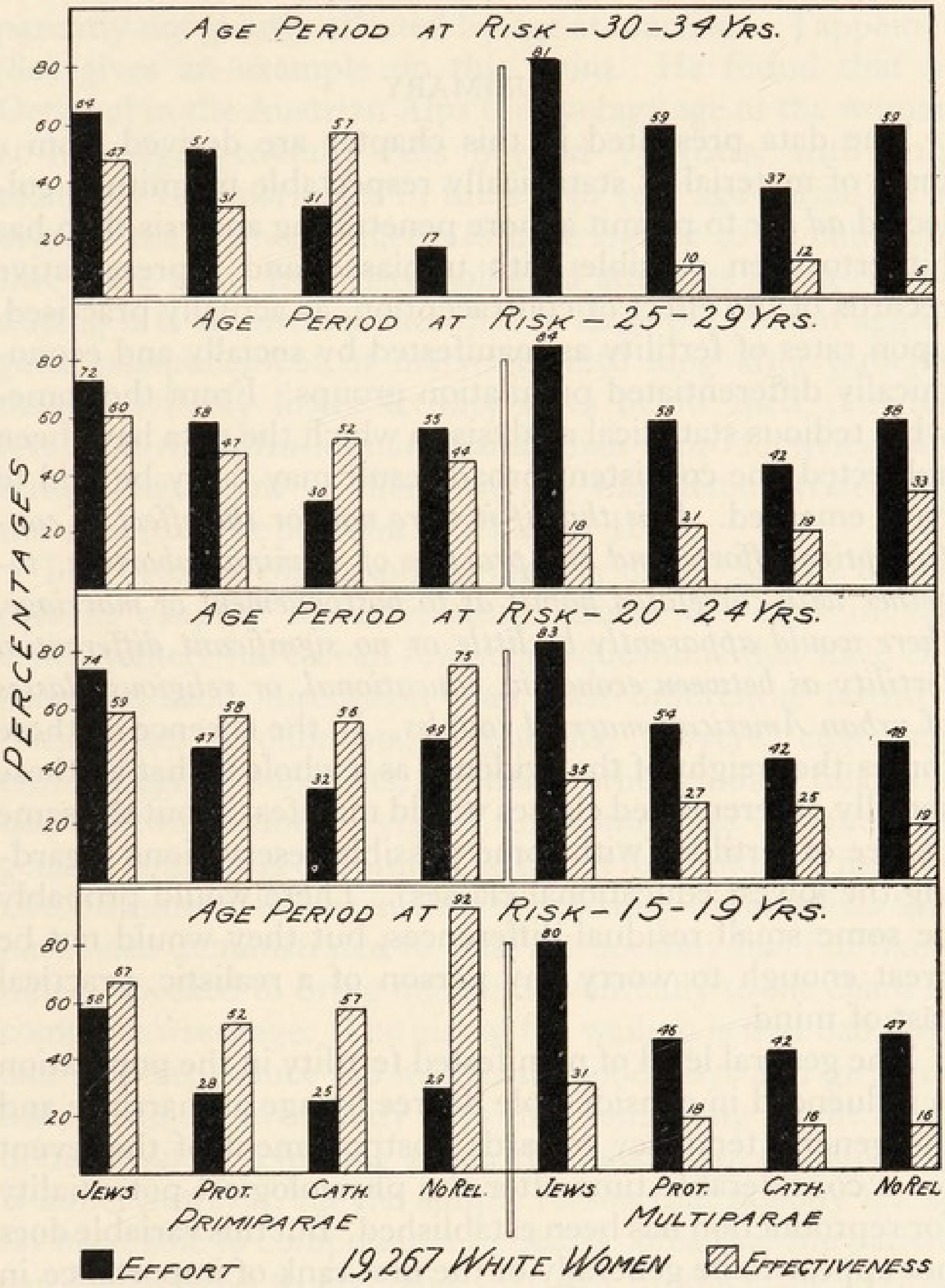


FIG. 37. Percentages of contraceptive effort and effectiveness by religious classes.[41]

status the Jews seem overwhelmingly to be of the opinion that contraception is the thing. Their efficiency at it appears, however, objectively not to be sufficiently greater than that of other groups to warrant any boasting. But they plainly are in earnest about trying.

SUMMARY

The data presented in this chapter are derived from a mass of material of statistically respectable magnitude collected *ad hoc* to permit a more penetrating analysis than has hitherto been possible with unbiased and representative records of the effect of contraception, as actually practised, upon rates of fertility as manifested by socially and economically differentiated population groups. From the somewhat tedious statistical analysis to which the data have been subjected one consistent broad result may fairly be said to have emerged. *It is that if it were not for the effect of contraceptive efforts and the practice of criminal abortion, together with correlated habits as to postponement of marriage, there would apparently be little or no significant differential fertility as between economic, educational, or religious classes of urban American married couples.* In the absence of these forces the weight of the evidence as a whole is that all these socially differentiated classes would manifest about the same degree of fertility (with some possible reservations regarding the lowest educational classes). There would probably be some small residual differences, but they would not be great enough to worry any person of a realistic, practical cast of mind.

The general level of manifested fertility in the population is influenced in considerable degree by age at marriage and the general tendency towards postponement of this event for a considerable time after the physiological potentiality for reproduction has been established. But this variable does not appear to be generally of the first rank of importance in producing social class differential fertility. Its quantitative effect is greatest differentially in respect of economic status, but even there the contraception and criminal abortion differentials probably outweigh it. One reason for this is that age at marriage is to a considerable degree a matter of the general *mores*, and the different social classes imitate each other in this regard to no small degree. Furthermore, the psychological attitudes about having children are apparently not greatly affected by age at marriage. Tappeiner (80) gives an example on this point. He found that in Oetzthal in the Austrian Alps the average age of the women at marriage generally falls beyond 35 years, with only relatively few marriages in the 25–30 year age period. Yet even so the women sometimes have from 5 to 10 children. But quite apart from psychological attitudes about reproducing it is an obvious fact that in large population aggregates postponement of marriage until long after puberty must inevitably lower fertility rates below their possible levels on the infra-human mammalian reproductivity pattern. The extent of this lowering was demonstrated for the American population in Chapter III.

The broader philosophical aspects of the results of the present chapter are interesting. Since the turn of the century there have been few social questions that have engendered more discussion than class differential fertility. Sociologists, economists, physicians, lawyers, eugenists, criminologists, biologists, and many other kinds of folk have had at it with emotion, vigour, and sometimes venom. The general consensus of opinion, with but few mild and ineffective dissenters, has been that the fertility differentials that have been demonstrated to exist are not only bad but likely unless checked to bring mankind eventually to the chaos of complete wreckage. The gist of the wailing is that bad boys and girls reproduce too much and good boys and girls too little. Almost everybody says that something ought to be done about it. Nothing much that is statistically effective is done, however, for the simple reason that nobody has so far been able to compound a remedial bolus that the patient can be induced to take and that will produce the desired purge.

The writer has upon several occasions ventured (see, for example, Pearl, 27, 28, 30) to suggest that a dispassionate and realistic examination, so far as possible uninfluenced by overt or hidden racial and social prejudices, be made of the question as to whether a relative excess reproduction on the part of underprivileged classes of whatever origin was inherently and necessarily ruinous to civilization and mankind. The suggestion was not well received. It produced only disparagement, ranging all the way from bitter denunciation and invective to kindly commiseration for a temporary lapse in perspicacity. The reception of the idea was, however, a matter of no concern, being more an emotional than an intellectual reaction. The significant point is that the suggested sort of examination of the problem is now being made in various quarters, and increasing and more penetrating study of it is going to be made as time goes on. Large-scale political and social experiments are being made to-day all over the world that will in time furnish something analogous to laboratory data to aid in the appraisal of the suggestion of a decade ago.

But leaving wholly aside, for possible discussion at some future time, the question of whether the existence of socio-economic class fertility differentials is in itself a bane or a boon, the results of this chapter would seem to have rather direct implications for the problem of doing something about it. The evidence presented indicates that in one population at least the existing fertility differentials do not rest upon deeply rooted, innate biological differences. Instead, the responsibility for them appears to rest primarily, overwhelmingly, and directly upon that body of doctrine and practice popularly called birth control. Up to the limit of its present technical potentialities birth control produces differential fertility between classes, and corrects the consequences of its technical defects so far as may be by induced abortion. This situation should arouse no moral indignation or judgements of any sort, for an obvious reason. Contraception is a wholly voluntary activity, free of all compulsions except the negative ones that may arise indirectly through ignorance. This single exception is at the present time being rapidly diminished in force, so far as concerns the population of America and western Europe. Thanks to the diligent and unremitting efforts of the leaders in the birth-control movement the ignorance factor in the situation is on the road to disappearance.[42] As has been said, except for this factor, the situation now is that classes of people have different fertility rates because, of their own volition and intent, they want to have them.

This being so, we are furnished with a sharply outlined definition of the task facing those persons and that body of public opinion desiring to alter the existing fertility differentials. Those favouring a change have got to make all the rest of the people really want the same thing that they themselves want. This plainly is a difficult task, because it takes in a lot of emotional and intellectual territory. It involves *convincing* great masses of people that the suggested new programme is so intrinsically good and worthy that they, the people, out of their own conviction of its righteousness and desirability, will alter their sex and reproductive behaviour away from what they have hitherto been accustomed to, and in the direction of something new and strange. To the extent that they have consciously thought about their old habits and modes of behaviour at all, they have, on the whole, regarded them as conducive to the enhancement of their enjoyment of life, and to the promotion of their own self-interest, or at least not sufficiently detrimental to it to make them change. To alter this situation would seem to be a really super-colossal job to undertake. And if it be suggested that it can be facilitated by resort to the authoritarian and dictatorial techniques temporarily so well thought of in the methodology of social amelioration instead of by the democratic procedure of intellectual conviction that has been outlined, I would remind you softly that the congress of the sexes is, and is likely long to remain, a somewhat private and personal matter inherently difficult to regiment.

It has been alleged that if legal and religious restrictions to the free and universal dissemination of contraceptive information were wholly removed, so that presently there would be no ignorance about the matter at all, then the existing class fertility differentials would largely if not wholly disappear, and the world would amble contentedly along with merely a horizontally lowered general fertility level. Perhaps this would be the result. One ventures to doubt that any existing evidence permits a positive or categorical conclusion on the point, however. There appear to be too many complex human variables involved to permit any dogmatic pronouncement at the moment.

But a query insistently obtrudes at this point. Is the obliteration of existing fertility differentials what those who people the earth want? Or is a new pattern of fertility differentials, planned by the eugenists in their wisdom, what those who people the earth want, or merely what the eugenists want? Those who people the earth, and they alone, will in their own good time decide. As far back as history goes men have never been lacking to allege that they knew what was best for humanity. But steadily and surely, if very slowly, the mass of humanity—those who people the earth—have themselves decided, ever more and more, what they themselves thought they wanted, and have proceeded in ever-increasing degree to get it. Their desires have often been foolish and sometimes plainly harmful, even to the extent of threatening the survival of the whole enterprise of human living. But such errors of judgement have not altered the dominant characteristic of human social evolution—the awkward, terribly slow and stupid, muddling, but steady progress of mankind in the mass towards the control of its own affairs. When fertility differentials change their patterns, as they may in the future, just as they have in the past, it will most likely be because the breeders—those who people the earth—decide that it will be to their personal advantage and self-interest to alter their breeding habits, and not for any other reason.

VI

WORLD POPULATION—PAST, PRESENT, AND FUTURE

1. *Bringing the Threads Together*

Up to this point this book has been devoted to an analysis in some detail of the more directly biological factors and forces involved in the natural history of population. A population is a group composed of single living individuals. What we have tried to do is to bring together data that would make it a little clearer than before how the biological mechanisms of reproduction work in individuals, and the effects they produce in making populations what they are observed to be, in size and in composition. The analysis has been far from complete. The fragmentary nature of what it has been possible to discuss has been due to two causes: first, the enormous range and extent of the lack of knowledge that still exists about the biology of reproduction, and that urgently demands steady and continued research; second, the limitations of time and space that have compelled the curtailment of the discussion to only a part of what we already do know. To bring together in one co-ordinated account all the available material that is truly relevant and important to the natural history of population would require a much larger book than this.

But the material gathered together in this book may perhaps fairly be said to have made certain general relations clear. At least to the writer it seems evident that:

1. The major problems of population are primarily and fundamentally biological in nature, because the size and other characteristics of populations rest upon the operation of the fundamental biological principles of individual survival, reproduction, variability, and their mutual interactions and integrations with the environment.

2. The state of any particular population at any particular moment depends primarily upon and is determined by the manner in which the specific biological elements that

influence fertility have been, and are, acting in the direction either of its promotion or its restriction.

3. There is great variation among individuals and groups in the biological elements that influence fertility, both as to time and as to space.

4. The basic biological pattern of human reproductivity is inherently and intrinsically different in a number of important respects from that of other animals lower in the evolutionary scale, and has been made still more widely divergent by artificial alterations that man has consciously and deliberately made in his own intrinsic pattern of reproductivity.

5. In the population of the United States, at least, the fertility differentials relative to race (Negro versus white) and to the three most important social class differentiations (economic, educational, and religious) are due primarily to differences in the relative prevalence and effectiveness of the efforts made to prevent conception, correlatively aided by relative frequency and postponement of marriage and the practice of criminal abortion, and to practically nothing else.

6. But in this same United States population it appears in high degree probable that the general level of fertility, and particularly the steady decline of total fertility that is now going on and has been in the recent past, both in the population as a whole and in differentiated classes within it, cannot be justly regarded as due solely, or possibly even primarily, to the operation of the forces enumerated in the preceding paragraph. Other and more obscure factors are involved, about which literally almost nothing of a precise and definite character is now known. In this chapter there will be some discussion of what some of these factors may be, but no one recognizes more clearly than the writer the highly speculative character of any or all such discussions.

While the evidence that has been offered here in support of the six general points that have been made above has come largely from one population only, that of the United States, it seems plain that the same principles and forces are operating in all populations, in widely different and varying degrees and extents, to be sure, but always and everywhere in some degree. If this be granted, as seems reasonable, it then follows that in the population of the world as a whole we are presented with the objective record, at any particular time, of the net integrated effect of the operation of all the complexly interrelated factors and forces concerned. So then let us now turn to an examination of the population of the world.[43]

2. *The Present Population of the World*

It should be emphasized that it is as impossible now as it has always been in the past, and will be for a long time in the future, to know exactly how many human beings are or were living on the face of the earth at any stated moment. The primary difficulty arises from the fact that the process of census counting has never included all the people or areas of the globe; and a secondary one from the fact that in different countries censuses are taken on different dates. But the situation grows steadily more encouraging. At the present time it can be said that something of the order of 75 per cent. of the population of the world is either regularly counted in recurring censuses, or has been counted at some time in the past, or at least an attempt has been made at a count. Of the wholly uncounted residue, for which there have never been any figures except estimates as a base, China constitutes by far the major portion. According to what seems to be the most reliable estimate, China's population at the present time constitutes something of the order of 22 per cent. of the world total. When China takes a real census, if she ever does, the study of world population will then rest upon a basis of sufficient statistical security to justify a very substantial degree of confidence in results and inferences. All the purely estimated (never really counted) populations of the earth at the present time, including China's, amount to approximately 25 per cent. of the world's population, as nearly as it is possible to estimate.

In the meantime—and it may be a long one since China's political affairs, internal and external, are in a fermenting state—the problems presented by the growth of world population are so intriguing and intrinsically important that it would seem a graver error of judgement to wait placidly for an indefinitely postponed approach to statistical perfection than to tackle the problem with what material is now available, it being clearly understood that there is bound to be error and uncertainty, one way or the other, in any results reached. On the basis of all the evidence, however, it appears that the error inherent in present-day discussions of total world population cannot be very great relatively. It is unlikely to be as much as 10 per cent. plus or minus. It might possibly be nearer 5 per cent. if the truth could be known. Dogmatism about either figure would be unwise, however.

It is the practice of the writer's laboratory to make from time to time, usually annually, revisions of the figures for world population. The plan used is to assemble separately on work sheets the latest available data regarding population, area, and time (date of count or estimate) for each of the smallest areal and political divisions of the earth for which data are available, and then combine them into larger divisions by summation, checking the figures at each stage in every way possible. The reasons for taking as units of the revisions the smallest areal divisions for which separate data are available are two. In the first place by this procedure we come nearer to the actual base data, with the attendant probability of greater accuracy. In the second place one of of the principal problems in which we are interested is the geographic distribution of different degrees of population density over the earth's surface, and obviously the finer the areal subdivision of the material the better will be the situation for studying the problem.[44]

The data of three recent revisions are given in Table 47.

TABLE 47

World Population

	1934 revision	*1935 revision*	*1937 revision*
Area (sq. miles)	52,139,677	51,742,763	51,422,465
Total population (in millions) .	2,050·4	2,073·3	2,104·8
Density (persons per sq. mile) .	39·3	40·1	40·9
Mean date to which figures apply.	1930·1	1931·5	1934·7

The steady decline in the area figures between the successive revisions appears at first glance completely paradoxical, not to say verging slightly on the idiotic. The earth's surface is plainly not shrinking at any such rate. The land area of the globe apparently shrivelled, according to Table 47, some 717,212 square miles between average dates of 1930·1 and 1934·7. All that this means is that two things have happened. The first is that more accurate surveys of outlying parts of the world are being made available each year. These have led in recent years to official revisions of area particularly in French West Africa, Venezuela, Iraq, Nicaragua, Tanganyika, and South-west Africa. The results of these surveys, as they become available, we incorporate in our annual revisions. In the second place we are increasingly able to make each year corrective deductions for the areas included in inland waters (lakes, broad rivers, &c.), which formerly were counted as land area. For the end of 1935 the *League of Nations Yearbook* gives the land area of the globe as 132,460,000 sq. km. [= 51,143,000 sq. miles]. The discrepancy of 996,677 square miles between this and our figure as of mean date 1934·7 is apparently chiefly accounted for by the fact that we include some subdivisions (and peoples) that the League statisticians omit. Our area figures, however, diverge from theirs by only about 1·9 per cent.

Our figure for total world population of 2,104·8 millions is a little greater than the latest League of Nations figure, which is 2,095·0 millions. We have included estimates of uncounted native populations wherever stated figures seemed fairly reasonable; whereas the League statisticians frequently omit them. But obviously the two world estimates are in substantial agreement, the difference being only 0·47 per cent. of the mean of the two estimates. A discrepancy of less than a half of 1 per cent. in two independent estimates of world population, made at approximately the same time, is surely nothing to grieve over. Both estimates are probably somewhat below what the real population of the world was at the indicated time—the end of 1935—because the over-counts and over-estimates in the record probably do not balance the uncounted, unestimated, and therefore unrecorded folk who were, however, living.

The mean density of world population between 1930·1 and 1934·7 appears to have been almost exactly identical with that of continental United States at the 1930 census. This is a thought-provoking figure when really grasped—about 40 persons on the average for each 640 acres of the earth's land surface.

The *apparent* mean annual growth-rate per cent. of the world's population between the dates 1930·1 and 1934·7 is 0·58 per cent., that is six-tenths of a person added in each year net to the living population for each hundred living at the beginning of the year.

On the basis of the data given, the rate of world population growth seems to be rather rapidly slowing, as is indicated by the following figures:

	Apparent world population mean annual growth-rate
During the 6·5 years between mean dates 1920·6 and 1927·1	1·38 per cent.
During the 4·4 years between the mean dates 1927·1 and 1931·5	1·09 per cent.
During the 3·2 years between mean dates 1931·5 and 1934·7	0·47 per cent.

It is, however, uncertain as to how much significance should be attached to these apparent growth-rates, because of the fact that they include at all stages purely estimated population figures, as well as counts and legitimate short intercensual extrapolations from counts. If we deal only with those countries (or other political subdivisions) for each of which there are available data[45] from which a *separate* individual growth-rate can be computed—134 'items' at the 1934 revision, 140 'items' at the 1935 revision, and 158 'items' at the 1937 revision, each 'item' being a country or political subdivision—the results shown in Table 48 are obtained.

It is evident from the second and fourth lines of Table 48 that the areas and populations included here are substantial percentages of the world totals. Furthermore, the figures include none of the doubtful data (particularly those for China) necessarily embodied in Table 47. On these two grounds of large proportionate size of sample and relatively greater reliability of the data, it is reasonably to be expected that the growth-rates of Table 48 probably represent more accurately the general situation than those derived from the figures of Table 47. In general, it would be expected statistically that relatively accurate data for a sample comprising about 75 per cent. of the universe of discourse would be likely to give a fairly reliable picture of the real conditions in the whole universe—probably, indeed, a more reliable one than the data for the whole universe in a case like this where it is known that the figures, for the part of the universe not included in the sample, are dubious.

TABLE 48

Recent world population growth-rates for those countries only for which the necessary data are separately available

Information	*1934 revision*	*1935 revision*	*1936 revision*	*1937 revision*
Area (sq. miles)	38,095,193	38,369,596	40,478,875	42,502,783
Percentage of total world area	73.1	74.2	78.5	82.7
Latest population (in thousands)	1,421,293.2	1,465,646.5	1,524,340.3	1,577,307.8
Percentage of total world population	69.3	70.7	73.9	74.9
Mean date for latest population	1930.42	1931.89	1932.95	1934.87
Earlier population (in thousands)	1,276,299.5	1,326,170.8	1,393,842.3	1,465,280.3
Mean date for earlier population	1920.45	1924.06	1925.39	1928.01
Mean annual growth-rate per cent.	1.14	1.34	1.24	1.11
Length of period (years) on which rate is computed	9.97	7.83	7.56	6.86

In the light of the data presented it may be tentatively suggested that the population of the world, as a whole, has been growing in the recent past at a rate of something of the order of 1 per cent. per annum—perhaps a little more, perhaps a little less, but at about that figure. This would mean, if continued without change, a doubling[46] of the present world population in 69.7 years. There is, however, no reason to suppose that a growth-rate of 1 per cent. per annum will continue unchanged for even any considerable part of 70 years. Nor does it appear, as will be shown in the next section, that the total population of the world will ever, in its present cycle of growth at least, be double what it is at the present time.

It seems reasonable to conclude, from the data already presented, that the mean annual growth-rate per cent. for the world population is steadily decreasing at the present time, and during the recent past. In other words, the decline of fertility that has been noted and discussed in an earlier chapter appears not to be exclusively confined to highly 'civilized' countries, where the populations are most sophisticated and eager and adept at birth-controlling. It seems rather to be a world-embracing phenomenon—something affecting man as a species. But, as will appear clearly in the next section, it is a phenomenon of historically very recent appearance, in comparison with man's total span of existence on the earth as a distinct species. The world-wide decline in fertility is certainly a much more recent thing than the making of efforts at contraception, as is clearly indicated in general by the historical information about contraceptive practices ably assembled and analysed by Himes (36). Specific examples may be given. On the evidence it appears likely that the slowing up of the growth-rate of world population per unit of time did not begin until about the beginning of the present century, or in the preceding decade. But seventy years ago Storer and Heard (68) said, regarding the American people, that they 'were sorry to be obliged to state that the knowledge above referred to [such "knowledge, physiological or mechanical, or in practice, as in most cases to regulate impregnation at will"] is rapidly becoming universal'. Short (1767), a century earlier, in his entertaining treatise on the population of England—perhaps history's most venomous diatribe against the establishment of hospitals and homes for foundlings, usually considered an innocent form of altruistic behaviour—has repeated references to the prevalence of contraceptive practices. As an example he deplores (p. 28) the fact that in 'Cities and great Towns . . . the wicked Arts of preventing Conception are more generally known and used' than in rural habitats. These examples sufficiently indicate that long before the world population began to slow down in its growth-rate, enough contraceptive effort was being made in the western world, at least, to worry some students of the matter.

3. *The History of World Population*

In 1924 Pearl published (24, pp. 631–74) a logistic curve fitted to the data assembled by Knibbs (17) to indicate the growth of population of the world, from the estimate of Riccioli in 1660 up to and including that of Knibbs himself as of 1914. Regarding the curve the following was said at the time:

'The fit is obviously nothing to excite admiration. The most that can be said for it is that it strikes fairly through a flock of highly irregular points, some of which are obviously poor guesses at world population (judged to be poor not because of their divergence from the curve, but from comparison with nearby estimates in point of time). The marvel is not that the fit is bad, but that it is as good as it is, considering how world population estimates have been made.'

It became apparent some time ago that this original world logistic needed revision badly, because by 1930 the population of the world had already exceeded the upper asymptotic limit set by the curve. Consequently Pearl and Gould (36) recently brought the old curve up to date, adding five more estimates of world population since 1914, the latest being their own of mean date 1931·5. The new logistic curve is shown in Fig. 38.

In deriving the equation of the present world logistic, the standard procedure of fitting, by the method of least squares, a straight line to $\log \frac{k-y'}{y'}$ was followed. The final equation is

$$y = 445{\cdot}5 + \frac{2200}{1 + 8{\cdot}7349e^{-{\cdot}2273x}}$$

where y is world population in millions, and x is time in 10-year intervals, from the year 1800 as origin.

Regarding the fit of the present logistic curve as a whole nothing more or very different can be said than was about the first. The nature of figures that have to be used in lieu of 'observations', which even at the present date represent only about 75 per cent. of complete actual observation, precludes the possibility of ever getting anything like a really smooth fit with a four-constant curve. But taking the material for what it is, with all its inherent disabilities, a number of interesting points are presented for discussion.

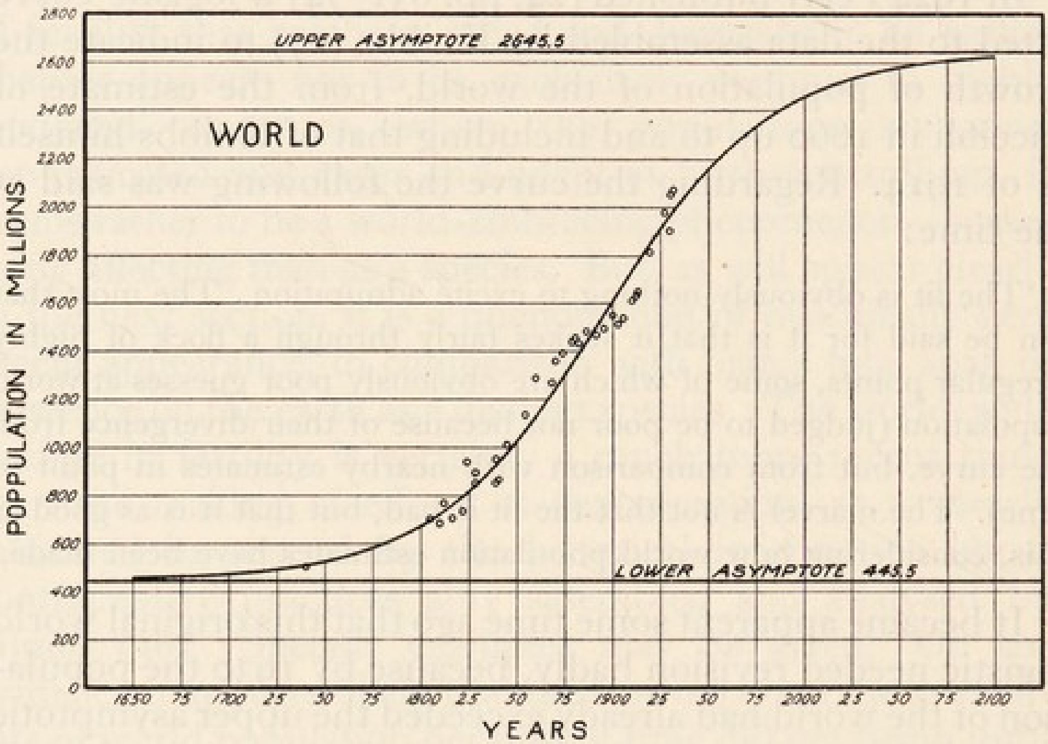


FIG. 38. The population growth of the world from the seventeenth century to 1931–2. The circles give the observations, and the smooth line gives the graph of the logistic equation.

In the first place the asymptotic limit of the current cycle of growth is raised by about 31 per cent. of the former figure, to a new value of 2,645·5 millions. According to the curve this colossal total will be closely approached around A.D. 2100, provided nothing happens in the meantime to alter seriously the present trends of reproductivity. No formal prediction is made, however, that this will represent the ultimate size of the world's human population. It is only an extrapolation from the available evidence as to what the past history of world population growth has been up to the present time. No other interpretation than this should be put upon it. It is a figure that future events and trends now wholly unpredictable may alter, just as proved to be the case with the former extrapolation. If not so altered, a total world population of 2,645·5 millions would indicate an average population density over the whole land area of the earth of about 51 persons per square mile, instead of the present 40. This seems like no great increase. But world population is now at a point on its logistic curve such that, unless new and unpredictable forces operate to alter its course, a slowing rate of growth will make itself increasingly manifest with the passage of time. Furthermore, there is evidence that the average density of world population is already approaching the point of producing uncomfortable results, under present conditions of living. But, in any case, we wish to emphasize again that we have had no inside information or revelation from divine sources as to whether the upper asymptote depicted in Fig. 38 will reasonably accord with reality in the year 2100, and are not to be understood as advocating its absolute validity or significance.

Fig. 38 suggests that in the period of 30 years, between 1890 and 1920, the growth of world population either actually slowed below its expected trend as indicated by the fitted curve, or that the estimates of world population consistently and systematically erred in defect of the real facts in that period. With only the estimates at hand when our first logistic was graduated, the resulting fit was reasonable, and the extrapolated portion of the curve what, in general, might fairly enough be supposed likely to happen. But actually the extrapolation turned out to be grossly in error. It can now be seen that what led the curve astray was the dip of the 'observations' below their real long-time trend in the period of roughly 1890 to 1920. The case demonstrates with great clarity the necessity for frequent revision of human population logistics as new data become available, a point upon which the writer has always insisted since his first work with these curves.

The present logistic cycle of world population growth got discernibly under way at about the middle of the seventeenth century—say 300 years ago in round figures—and started from a lower asymptotic value of about 445 millions. This is, of course, only an estimate, but cannot be far away from what was the actual fact. Indeed, all competent students of population agree on a value of about this general magnitude for the time stated. Since then the world's population has increased to about 2,105 millions, again in round figures, as of an average date of 1934·7. In other words there has been in roughly 300 years a 4·7-fold multiplication of human beings on the face of the earth, and this present cycle of growth appears to be only about two-thirds completed. A nearly fivefold net multiplication of the population of a species with such relatively poor reproductivity as man displays, in a time period of only about 300 years, is certainly a notable phenomenon worthy of the most serious consideration.

But man, as a distinct and differentiated species, had been on the earth an extremely long time prior to the seventeenth century. Few, if any, anthropologists nowadays question that he had become differentiated and was making flint tools of the pre-Chellean type early in the Quaternary, certainly somewhere in the first interglacial period. Nor is it doubted that from at least that time he has continued on the earth in an unbroken succession of generations: through the long second and third inter-glacial periods and the glaciations that separated them. The artefacts indicative of his ever-improving culture, through Chellean, Acheulian, Mousterian, Aurignacian, Magdalenian, and Azilian-Tardenoisian stages, make his continuous habitation certain. Geologists, anthropologists, and archaeologists seem, however, not to have been able, up to very recent times, to agree as to the number of calendar years it took man to climb this long evolutionary ladder. It is not necessary for the present purpose to review all the widely varying judgements. Whitnall (24), synthesizing data from Penck, Osborn, Boule, and Obermaier, put Heidelberg man and pre-Chellean culture 475,000 years back, an estimate that now seems very reasonable. On the other hand, Kroeber (30) tentatively allows only 100,000 years from the beginning of the lower palaeolithic to recent times. Lately, however, Zeuner (35) has synthesized all the evidence in a masterly way, with results that warrant, and appear to be receiving, general acceptance, so that it may be hoped that the timing of prehistory may be at last regarded as reasonably settled. Zeuner's conclusions seem to be as nearly definitive as it is humanly possible to reach. Using the Miklankowitch 'radiation curve', together with other evidence from geology, palaeontology, and prehistoric archaeology, he reaches the conclusion that *Homo heidelbergensis* from the Mauer sands (the oldest find in Central Europe) has a probable date on the absolute time-scale of about 500,000 years. Other cultures are found to date approximately as follows: Acheulian 183,000 years; Mousterian Neanderthal man 140,000 to 105,000; Aurignacian 95,000 to 69,000; Solutréan 67,000; Magdalenian 65,000 to 18,000; Mesolithic 15,000 to 7,500; Neolithic 7,500 to 4,000, all the figures being reckoned as years before A.D. 1800.

So then the following situation is presented for the consideration of the student of population. In the 500,000-odd years from the time that man got under way as a distinct zoological entity, to about 1630–50 say, he had certainly increased in numbers in the normal biological way of things. He may be presumed to have multiplied during these years as rapidly, on the whole, as his inherent biological equipment and the circumstances of his natural environment would permit. Yet the total world population in 1630 was only 445 millions, with a density of a little over 8 persons per square mile as against the present 40.[47]

This being so, at least three possible alternative inferences present themselves. The first of these is that the human population of this globe more or less steadily *grew* for 500,000 years, but at an extremely slow time rate as compared with the growth performance of any but a very few populations now existing. On this hypothesis it may be regarded as probable that growth of world population was not entirely steady and continuous along a smooth curve, logistic or other, but instead was irregular, fluctuating up and down about the ever-rising time-trend line. These fluctuations, consequent upon wars, famines, pestilences, and climatic changes, may have been relatively large at times, but absolutely well within the limit set by the 445 millions asymptote finally achieved.

A second possible alternative is that for a long time—thousands of years—prior to the seventeenth century, the population of the world *stood stable* at between roughly four and five hundred million, or oscillated in waves of relatively small amplitude about some such figure. On such a view this value would represent a relatively stable upper asymptotic level achieved in a cycle of population growth that was consummated long before, and at a relatively early stage of man's evolution.

Finally, a third possible alternative is that during some period or periods in this vast span of 500,000 odd years of man's life on the earth, the *world population was much higher* than 445 millions, and subsequently lessened, for reasons wholly unknown, to reach that final figure at the time when reasonably reliable population history begins.

Which of these three alternatives is true? No one can say with any authority. But the combined evidence from palaeontology, from the geographical distribution of plants and animals, from ecology and particularly plant ecology, from archaeology, from prehistory, and from history, masses such weight against the third alternative as to be practically conclusive. In short, all the relevant evidence seems to indicate that there were as many (or more) human beings living on the face of the earth in 1630 as there ever had been at any prior time since man set up in business for himself. Most particularly to be counted against the third alternative is the fact that until recent times man's culture was not of the sort to make possible the existence of large populations on the earth. Hunting, pastoral, and primitive agricultural cultures are not compatible with large total populations, as we know them nowadays, because high densities cannot be supported at these cultural levels or stages.

The case is not quite so conclusive relative to the second alternative, but still, on the balance, the evidence seems to be against it. It appears probable that if the population of the world had been generally stabilized for even 2,000 years before the seventeenth century we should almost certainly have heard something about it in historical writings. Instead, the references and inferences about population that can be drawn from ancient history seem to indicate it as fluctuating in consequence of wars, famines, pestilences, &c., but on the whole tending always to grow, even though slowly and irregularly.

So then we are left with the first alternative, a very slow and irregular time rate of growth of world population over a very long time prior to the Middle Ages, let us say, followed by a relatively tremendous spurt of growth not yet ended.

The implications of the three alternative hypotheses will be made plainer by the diagram shown in Fig. 39. For reasons of practical convenience in drawing and reproduction, Fig. 39 is scaled as though the total period of man's life on the earth, prior to the seventeenth century, was a span of 100,000 years instead of the 500,000 that seems undoubtedly much nearer the truth.

How is this sharp spurt of population growth after 1630 to be explained? The primary cause behind the new cycle of logistic growth of world population that started in the seventeenth century seems clearly to have been that mankind first became aware, at about that time, that its effective universe was expanding. The earth was not growing physically bigger to be sure; there were no new acres of land being really added to the planet. But many were being discovered, uncovered, and put to use, and, in general, man's *effective* universe for purposes of living certainly was expanding, and at an accelerating rate. This was being brought about by new discoveries and new ideas that made it possible for man to exploit, far more effectively than he had known how to before, the natural resources for human living inherent in the earth on which he lived. One of the most important and obvious aspects of the expansive changes in man's effective universe that have appeared in the last 300 years was the ever increasing facility of communication and transportation, with its consequent broadening of the base and acceleration of the *tempo* of trade. Indeed, it was the development of railroads that had a large part in making the

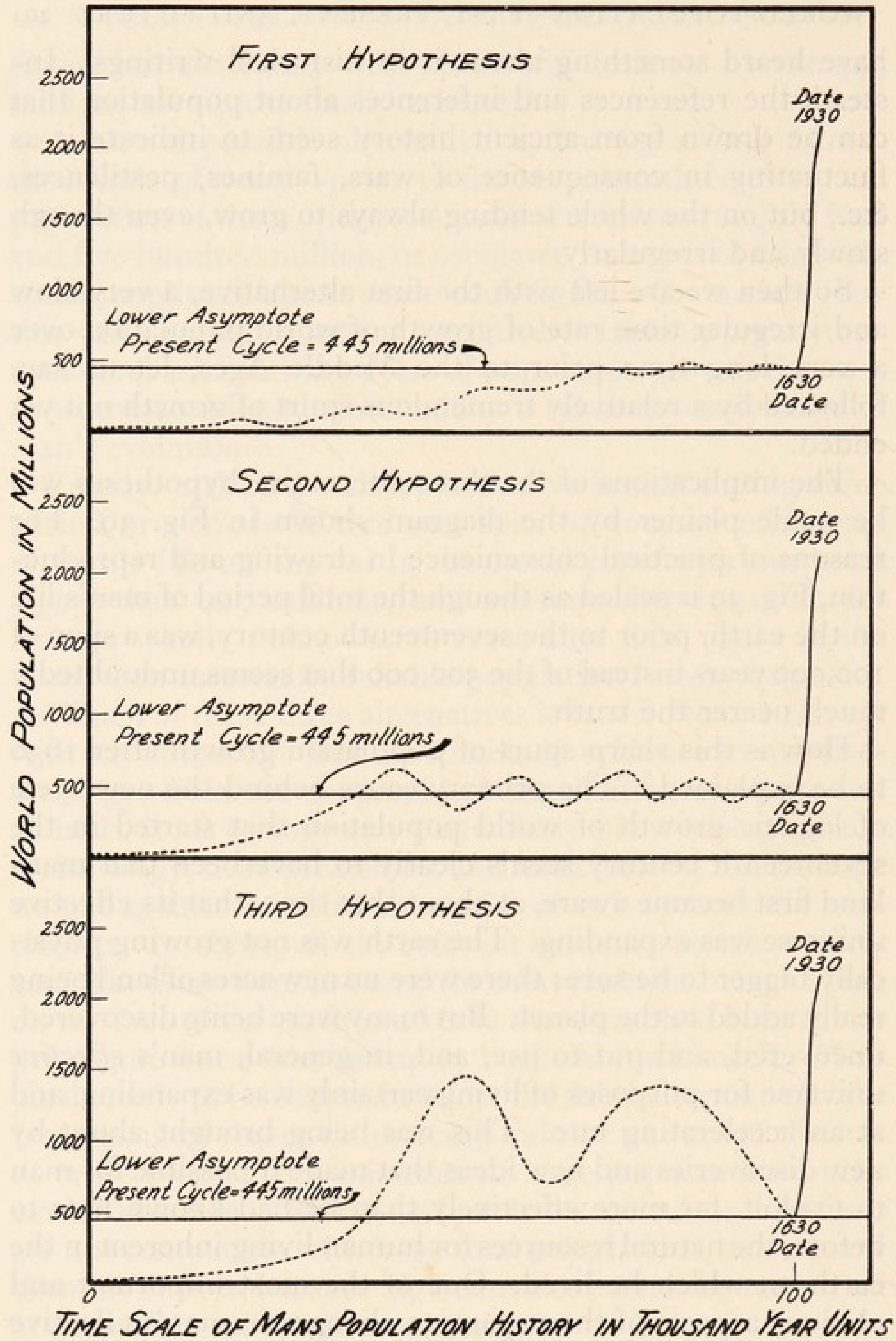


FIG. 39. Diagram to illustrate alternative hypotheses as to the history of the human population of the earth. The portions of the curve drawn in broken lines are purely hypothetical, except as to the total time scale. The portions of the curves depicted by a continuous solid line (1630–1930) represent the known facts as to world population growth, and are plotted to the same time scale as the earlier portion.

gloomy prophecies of Malthus about the future of mankind, at the end of the eighteenth century, seem comically absurd soon after he made them. Another change of similar sort was the development of relatively cheap and highly effective power, associated in the first instance with the discovery and rapid improvement of practical steam engines. In generalized terms, what expanded man's effective universe and made possible a great spurt of population growth, was scientific discovery and the application of its results, in the broadest sense including exploration as well as technology, to man's basic problem of how best to cope with and exploit his natural environment.

There is much evidence to support this view as an explanation of what is known of the whole history of human population on the earth. It would take a sizable book to review it. Only one striking general feature of this mass of evidence can be mentioned briefly here. It is that, to this day, peoples who because of geographical location, climatic conditions, general stupidity, and other causes, have been unable to participate in any real sense in the consequences of an expanding effective universe, are still growing in population very slowly if at all. The conditions of living, and particularly the difficulties of getting a living, in the more primitive stages of culture where the individual wrings his living out of a raw and untempered environment by his own direct efforts, do not permit rapid population growth any more now than they ever did.

4. *Consequences*

The most obvious direct and objective consequence of the great spurt of world population growth that has occurred in the last 300-odd years is the increase in average density of population that it has entailed. It will be well to examine the facts about this in some detail.

The population of the earth is distributed with great unevenness over its land surface. This is shown in Table 49. This table is arranged in order of ascending density classes (persons per square mile). It is based upon 906 separate political or administrative units for which separate data are available as to area and population. By 'political unit' is meant either a country (as the Dominican Republic), or a state (as Arizona), or a department (as Côtes-du-Nord), or a canton (as Fribourg), or a colony, protectorate, or territory, or in a few cases a city (as Oslo) having separate administrative status equivalent legally and politically to that of a state. Each such separate political unit was put in its appropriate density class, and the areas and populations summed for the class. These absolute figures were then reduced to the percentages shown in Table 49.

TABLE 49

Percentage of total land area of the earth and of total world population, by population density classes, as of average date 1930

Density classes (persons per square mile)	*Percentage of total land area occupied*	*Percentage of total population in area*	*Average density for class*	*Number of political units in class*	*Percentage of total political units in class*
0–9	56·989	4·517	3·1	147	16·2
10–39	24·433	13·731	22·1	176	19·4
40–99	9·040	13·359	58·1	187	20·6
100–199	4·291	15·910	145·8	187	20·6
200–299	1·720	10·418	238·3	65	7·2
300–399	1·745	15·650	352·8	46	5·1
400–499	0·876	9·921	445·7	25	2·8
500–599	0·176	2·310	517·7	8	0·9
600–699	0·401	6·391	626·6	15	1·7
700–1,299	0·316	6·610	823·5	23	2·5
1,300–1,899	0·008	0·305	1,509·9	8	0·9
1,900–3,099	0·003	0·150	2,063·5	5	0·6
3,100 and over	0·002	0·728	11,994·8	14	1·5
Totals and Averages	100·000	100·000	39·3	906	100·0

It should be clearly understood that the 'political units' upon which Table 49 is based are in some degree arbitrary and artificial, in the sense that they are not precisely equivalent to each other geographically, anthropologically, or demographically. But for the present purpose they have a certain usefulness. They validly represent 906 divisions of the land surface of the earth, for each of which the area and population are known either exactly or approximately. Therefore for each of them it is possible to compute density of population. When all similar densities so computed are grouped together (as in the density classes of Table 49) and their several areas added, they represent large parts of the earth's surface alike in at least the respect of equal density of population, within the limits set by the class range. Thus the first density class 0–9 persons per square mile includes 147 'political units' whose aggregate area is over 29 million square miles. Even the highest density class (3,100 and over persons per square mile) with only 14 'political units' has an aggregate area of over 1,200 square miles.

The first and most striking general fact that is evident from Table 49 is the extreme skewness of the distribution of population density over the earth's surface. Taking the mean densities of the several classes as a conservative basis for estimating the range of intensity of human crowding upon the earth it is seen that 35·6 per cent. of political units cover only 0·3 per cent. of the whole range of population densities; and even 76·8 per cent. of the political units cover only 1·7 per cent. of the total range of densities. Even though the political units are not equivalent to each other, as has been said, nevertheless there can be no question as to the skewness of population density distribution. This skewness has come about initially through the self-interested *desire*, and eventually the social and economic *necessity*, for large numbers of people to live together in cities. This process of urbanization down through the ages has led to the formation of the great metropolitan centres, or 'conurbations' as Fawcett (32) calls them (following in this usage, as he says, Professor Patrick Geddes) in which so large a proportion of present-day men live out their allotted spans. They represent one of the many quaint ways in which mankind is coming to resemble more and more clearly the termites in modes of life and social philosophy.

The matter may be looked at statistically in other ways that do not involve consideration of the separate political units. Well over a half (57 per cent.) of the total land area of the earth is occupied by only four and a half per cent. of the total population of the world. And about 81 per cent. of the earth's total land area contains only 18¼ per cent. of the world's population. Only a little over 5 per cent. of the land area of the earth (densities of 200 and above) contains 52·5 per cent. of its population.

Fig. 40 emphasizes graphically certain broad facts of the distribution of world population over the land surface of the earth. The area of the whole square is taken as that of the land area of the globe. The lower unshaded rectangle—the 'great open spaces' comprising roughly 81 per cent. of the whole area—has an average density of population of only about 9 persons per square mile. The cross-hatched rectangle at the upper left corner comprises just over 13 per cent. of the whole land area, and contains a little over a quarter of the total world population living at the not too unreasonable average degree of crowding of about 86 persons per square mile. Finally, the little black rectangle in the upper right corner comprises only just over 5 per cent. of the total land area, but contains over one-half of the whole world population. This moiety of poor humanity lives at an average density of 394 persons to the square mile. All told we have in Fig. 40 a gaudy picture of the net biological result that human civilization had wrought by its efforts up to the year of grace 1930.

The average density of world population as a whole is nearly 41 persons per square mile, as we have seen. Yet the populations on over 81 per cent. of the total land area are living at densities under 40. About 14 per cent. of the population of the world—roughly one person in seven—is living at densities of 600 or above, that is with one acre or less per person, on an even personal distribution of area. Now as a rough and round figure it is estimated by Brown (36), a competent and conservative authority, that 2·5 acres are needed to support a human being. Obviously this implies good land, and all of it intensively cultivated. But neglect these latter points for a moment, so as to put the best case possible. The data of Table 49 indicate, if we take the 2·5 acre figure at its face value and with the obviously too optimistic assumption that all land functions at that scale, that in order to get the means of subsistence to something

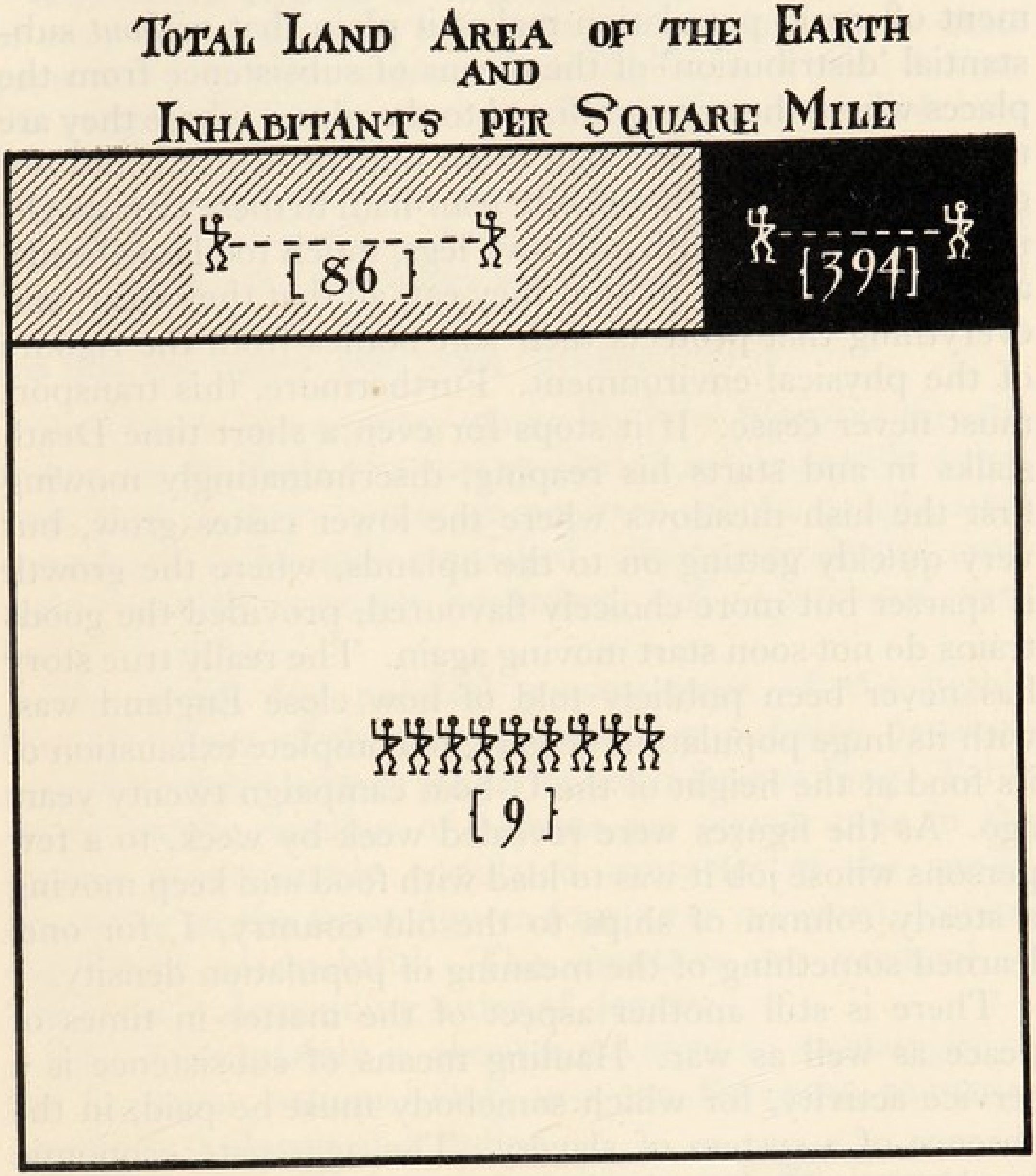


FIG. 40. Land area of the earth and population density. For further explanation see text.

over a half of the world's population to-day will involve a significant problem of transportation and distribution. Here one of the principal villains of the socio-economic melodrama enters the scene. It is one of the commonest of assertions that the faults and troubles connected with the 'distribution' of goods are chiefly to blame for the world's woes, with the implication that if these faults could be eliminated the world's economic troubles would largely disappear.

But, faults or no faults, the present geographical arrangement of world population makes it plain that *without* substantial 'distribution' of the means of subsistence from the places where they are produced to the places where they are used, something over a half of all human beings could not go on living at all. Somebody *must* haul to these city-dwelling near-termites with only two legs, much too large heads, and no exoskeleton, all that they eat, all that they wear, and everything that protects their soft bodies from the rigours of the physical environment. Furthermore, this transport must never cease. If it stops for even a short time Death stalks in and starts his reaping, discriminatingly mowing first the lush meadows where the lower castes grow, but very quickly getting on to the uplands, where the growth is sparser but more choicely flavoured, provided the goods trains do not soon start moving again. The really true story has never been publicly told of how close England was, with its huge population density, to complete exhaustion of its food at the height of the U-boat campaign twenty years ago. As the figures were revealed week by week, to a few persons whose job it was to load with food and keep moving a steady column of ships to the old country, I, for one, learned something of the meaning of population density.

There is still another aspect of the matter in times of peace as well as war. Hauling means of subsistence is a service activity, for which somebody must be paid, in the absence of a system of slavery. The aggregate economic burden so added to the business of human living on the earth, however skilfully and intelligently it may be done, is an extremely large one. It seems bound in principle to become still greater if the tendency to unevenness of population distribution over the earth's land area—of which one aspect is, in more usual phraseology, urbanization—continues to increase.

But urbanization, though the principal, is not the only factor involved. Another significant one is the disinclination of human beings, on the whole, to move far from where they are born. For example Wattal (35) points out (p. 123) that in India, a country of relatively high population density:

'The stay-at-homeness of the people of this country is the theme of every census report. In 1901 only 9·27 per cent. of the whole population were enumerated outside of the district of birth. In 1911 this proportion fell to 8·7 per cent. Even of these, two-thirds were born in a contiguous district and the movement, perhaps, from one village to another contiguous one which happened to be in another district has no connection with the pressure of economic causes. For the census of 1931 the figures are much the same. Of the total population of India enumerated by birth place, 350½ million odd, less than one million were living elsewhere.'

And this is in a country where Sir John Megaw (36) estimates, on the basis of a survey carried out under his direction, that (p. 61): 'under 40 per cent. of the people were considered to be well nourished, while over 40 per cent. were regarded as poorly nourished, and 20 per cent. very badly nourished.'

The social and political consequences of the highly skewed nature of the distribution of population densities over the earth's surface are serious and far-reaching. Table 50 shows the number of persons per square mile in the twenty most densely populated countries of the world, according to the latest figures (our 1937 revision), leaving out China as doubtful. The countries are arranged in Table 50 in descending order of density.

This table plainly is about equivalent to a catalogue of the European nations. Only two non-European countries appear in it (Japan and India).

Taking a world view, it is evident that the increase of urbanization has by no means reached its end. On the contrary, it is still going on, and, on the whole, at an ever accelerating pace. In a broad sense the most striking thing that has taken place in regard to agriculture during the last fifty years, not only in the United States or Canada or Argentina but in some degree more or less all over the world, is that the progressive development of new knowledge, improved technique, and fuller application of power and machinery have made it possible for fewer human beings to produce more of everything than was formerly the case. This means that agricultural areas—and for the same sort of reason mining areas too—need less dense populations in their own regions and in their own businesses, and can comfortably support only such less dense aggregates. Young people no longer needed in agriculture, mining, and similar sorts of productive enterprises have inevitably slipped away to other occupations, where there is greater opportunity.

TABLE 50

Twenty most densely populated countries

Country	*Persons per sq. mile*	*Country*	*Persons per sq. mile*
Belgium	704·9	Denmark	224·6
England and Wales	700·0	Austria	208·8
Netherlands (excluding water area)	674·2	Portugal	205·7
Japan (proper)	469·2	India	204·8
Germany	369·3	France	197·1
Italy	355·2	Jugoslavia	158·8
Czechoslovakia	280·0	Bulgaria	157·0
Switzerland	261·2	Rumania	153·7
Hungary	250·6	Greece	136·0
Poland	228·1	Spain	126·4

From the point of view of population density such movements lead to an odd sort of paradox. Social and economic forces and modes of thought that are fundamentally identical—namely, applications of new discoveries, improved machinery, better transport and communication, to the business of getting a better living—work in opposite directions when applied to agriculture and to the manufacturing type of industry so far as concerns the trend towards human crowding. On the one hand, the movement is towards a still lower density of population in agricultural regions, already the most sparsely peopled portions of the earth's surface capable of supporting any substantial population at all. On the other hand, there is the trend towards an even higher density—still greater crowding—in urban industrial centres, already most densely populated. What makes the paradox is that identically the same set of forces, at bottom, is producing these diverse results.

The same principle applies to a considerable extent as between mother countries and their colonies or other dependencies. Densely populated countries with small areas, like those of Europe, and Japan, are highly industrialized and commercialized. They cry for more land so that their people may spread out. But their nationals, by and large, refuse to leave the homeland in any considerable numbers to settle in the fair but sparsely populated regions available to them. Italy, for example, had succeeded up to the time of the World War in placing only about 8,000 of her people in all her African colonies together. Again, the colonial empire that was Germany's on July 1, 1914, had, all told, but a meagre 24,000 or so German inhabitants.

Why this sort of thing comes about—and many other examples might be cited—is that the advance of science and technology at one and the same time brings about increasing opportunities for what individuals themselves regard—whether rightly or wrongly does not matter—as a relatively pleasant existence in the homeland, and diminishing opportunities for a similarly pleasant existence in colonies exploited for wealth production.

National as well as individual psychology is involved. Nations have their pride as well as individuals. But they are not blind about the difficulties of getting their nationals to spread out into colonies. What they really want colonies for is to produce wealth. As they look about the world they perceive an unequal distribution of the richer lands. This is indicated in Table 51 which is concerned with nine political aggregations here called 'empires' because in each case all the lands and peoples are under the direct political control, wholly or partly, of a single country, called here for convenience the 'home country'. The figures in this table are based on our 1935 revision (average date 1930·1) and are consequently a little out of date now, but in principle and relatively the situation is now essentially as depicted in the table. It just has become a little 'more so' in the meantime.[48]

TABLE 51

PART A. *Area, population, and population density of nine 'empires'*

'Empire'	*Area (sq. miles)*	*Percent. of world's land area*	*Population*	*Percent. of world's population*	*World 'Empire' density (persons per sq. mile)*
British	13,042,896	25·21	496,344,556	23·94	38·1
Russian	8,241,921	15·93	165,778,400	8·00	20·1
French	4,649,407	8·99	105,444,795	5·09	22·7
American (U.S.A.)	3,738,437	7·23	137,904,330	6·65	36·9
Italian	992,944	1·92	45,105,638	2·17	45·4
Belgian	929,775	1·80	17,733,041	0·85	19·1
Portuguese	848,066	1·64	15,738,954	0·76	18·5
Dutch	800,569	1·55	69,260,628	3·34	86·5
Japanese*	723,292	1·40	129,783,555	6·26	179·4
'Empire' totals	33,967,307	65·67	1,183,093,897	57·06	34·83
World exclusive of empires	17,775,456	34·33	890,250,321	42·94	50·08
World total	51,742,763	100·00	2,073,344,218	100·00	40·07

* Includes Manchukuo.

PART B. *Area, population, and density of home countries controlling nine 'empires'*

Controlling country of 'empire'	*Area (sq. miles)*	*Percent. of world's area*	*Population*	*Percent. of world's population*	*Density*
Belgium	11,775	0·023	8,247,950	0·40	700·5
Netherlands	12,579	0·024	8,290,389	0·40	659·1
England, Wales, and Scotland	88,745	0·17	44,888,377	2·17	505·8
Japan	147,592	0·29	68,194,900	3·29	462·1
Italy	119,713	0·23	42,621,000	2·05	356·0
France	212,659	0·41	41,834,923	2·02	196·8
Portugal	35,490	0·069	6,825,883	0·33	192·3
United States	3,026,789	5·85	122,775,046	5·92	40·6
European U.S.S.R.	3,513,728	6·79	133,769,700	6·45	38·1
Total	7,169,070	13·86	477,448,168	23·03	66·6

Figures like those of Table 51 breed wars. Doubtless they ought not to, because war is dreadful. But they do. With nine nations having 23 per cent. of the world's population, themselves living on only 14 per cent. of its total land area, controlling 66 per cent. of all the land in the world and, in greater or less degree, the political life of 57 per cent. of all human beings, emotions do get stirred. If Russia and the United States be regarded apart from the others—for which Americans and Russians, at least, think there is some justification—the remaining seven nations, with just under 11 per cent. of the people in the world living on less than 1¼ per cent. of its land area, control approximately 42 per cent. of all the lands and all the people on the globe.

The contrast between the first four 'empires' of Part A of Table 51 and the other five is striking. Each of these four has still a larger share of the earth's lands than of its peoples. Together these four control over 57 per cent. of the land surface of the world. Taking a soberly scientific and detached view of the matter, based upon what is known about human psychology and behaviour, is it any wonder that Japan, Germany, and Italy are restless and discontented or that the appeal to 'do something about it' can easily be made to stir the hearts of their respective peoples? And who is to say that in so behaving they are inhuman monsters of greed? If there is one single nation on the earth that can come into court to-day with entirely clean hands on the question of lands and peoples, history has most unfortunately failed to record its case. Might has never made right, but it has certainly made empires and nations. This being so the problems generated by the huge growth of population during the last three centuries are surely not going to be solved by the simple device of groups of men calling each other names. Nor are they going to be solved by war, whether of the old-fashioned kind, or that latest brilliant discovery of the diplomatic mind—'undeclared' war.

For suppose the too densely crowded folk go to war in the hope of eventually seizing some of the fairer parts of the good earth. Is the problem going to be solved? It is not. If crowded country A goes to war with Empire B, beats her into submission and takes away her rich and sparsely populated colonies, obviously country A will thereupon find herself an empire and otherwise in much the position that B was in before the trouble began, and vice versa. Pot A and kettle B will merely have changed places.

The *world* problem of population and area, however, will remain unaltered. But, practically, the situation will have been made worse because of the extravagantly wasteful destruction of real wealth that war always causes. The problem that is really serious is how can forty-one persons be maintained, not in peace, and comfort, and happiness, but just maintained at all, for every square mile of land surface of this globe—good, bad, and indifferent land together? This problem cannot be solved by war. War cannot enlarge the land surface that must support mankind; it has never diminished the total number of people who want to live on it except by a tiny fraction for a quite brief period. There is no way out of the dilemma by the pathway of war.

Another aspect of the matter will bear attention. Nations make wars, but individuals by their breeding activities make populations grow. We have seen in Table 50 the twenty most densely populated countries in the world. What are the most rapidly growing at the present time? The twenty-five with highest recent growth rates are shown in Table 52, again arranged in descending order of the rates. The table includes only countries (political units) in which the population is over one million, and also those only for which definite data are available and the figures can be regarded as reasonably reliable. The data are taken from our 1937 revision of world population.

TABLE 52

Twenty-five most rapidly growing populations

Country	*Mean annual growth rate per cent.*	*Country*	*Mean annual growth rate per cent.*
Palestine	5·81[49]	Siam	2·27
Syria and Lebanon	4·70	Salvador	2·25
Dominican Republic	4·35	U.S.S.R. (Soviet Russia)	2·17
Uruguay	3·32	Algeria	2·08
Argentina	2·73	Ecuador	1·92
Bolivia	2·53	Jugoslavia	1·78
Haiti	2·52	Albania	1·73
Union of South Africa	2·50	Chile	1·68
Peru	2·35	Philippine Islands	1·68
Turkey	2·34	Tunis	1·64
Puerto Rico	2·33	Japan	1·62[50]
Mexico	2·31	Unfederated Malay States	1·53
Dutch East Indies	2·31		

With but two exceptions (Jugoslavia and Japan) this is an entirely different set of countries from the most densely populated ones listed in Table 50. More than half of the countries in Table 52 are tropical or subtropical in their geographical situation. Also, in more than half Catholicism, of either the Roman or Eastern variety, is the prevailing religion; in some cases it is the official religion of the state, in others not officially recognized but including the vast majority of the inhabitants. Perhaps this reflects the official opposition of the Catholic Church to birth control, but probably the matter is not so simple. It is also worthy of note that there are several preponderantly Moslem countries in the list of those with the fastest rate of recent increase in population. Eleven of the most rapidly growing countries are in Central or South America. Ten of the twenty-five countries have population densities for the whole country below the world average of 41.

In general, it is obvious that with the single exception of Japan no one of these most rapidly growing countries is, or has ever been, in any way remarkable for its industrial development. Soviet Russia is struggling to make headway in this direction, but as yet has not attained a really prominent position. In the other countries in the list the vast majority of the people live at the simpler cultural levels of the agricultural type of pursuits and at generally low population densities. They benefit in relative ease of getting their livings, as compared with earlier populations at correspondingly primitive cultural levels, and are consequently able to grow faster by virtue of the much wider markets that are made available at the present time by the ease and speed of communication and transportation. In general, it is plain that Tables 50 and 52 put side by side exemplify on a large scale the same sort of socio-economic differential fertility that is seen within any single population. The higher the degree of industrialization, urbanization, and consequent population density that characterizes a whole population, the lower is that population's fertility and growth rate, and vice versa; this, on the whole, and with but few apparent exceptions.

5. *The Future*

The greatest problem[51] that confronts every single soul that makes one of the units that add up to these colossal human aggregates we have been considering is: 'How shall I get a living?' For the science of biology is quite dogmatically sure about one thing. Every living organism must get its living or perish. Life is a dynamic process. It requires energy and matter to keep going. Through every living organism there must be kept up a rather constant flow of these two categories of things, or else it stops living.

The logical consequences of this purely natural law are obvious, in a broad sense. Each living organism, including each man, woman, and child, either must get its own living, or an arrangement must be made such that somebody else gets the living for it. We, and a good many other organisms, arrange to get the livings for our babies—embryos and still undeveloped young—until they are biologically able to fend for themselves. Mankind, to an enormously greater extent than any other species, makes similar arrangements for the continued living of other categories of individuals—notably the aged, infirm, defective, and degenerate—incapable on their own resources of keeping their vital fires alight. The fact that man does this is probably the chief reason why he regards his species as a noble one, a view in which it is doubtful whether the true termites would concur. But never mind about termitodoxic moral judgements for the moment. The important thing is that a very considerable number of persons now on this earth who are neither babies, nor aged, infirm, or defective, find themselves, or think themselves, completely unable to get their livings by their own efforts. Strangely enough, the total number of these 'unemployed' persons in the world, on the best estimate possible to get, seems to be at the present time of about the same order of magnitude as the number of new human beings that are being added to the world each year.

What is going to be done about it? Some say one thing, some another. The view that, on the whole, seems to be most generally favoured in the United States at the present time is that those who are getting a living for themselves shall support those who are not. This is a biologically possible temporary solution, there as elsewhere, chiefly because the extravagantly lush bounty of this good earth of ours, the true 'unearned increment', has not yet been entirely exhausted. And until it is, there is plainly no reason why we should not average up the pleasures of human living, if it pleases us so to do—reducing them for some to the end that they may be increased for others.

But such a process can in the nature of the case be at best only temporary, because before any considerable period of time has elapsed the business of averaging will probably have encountered serious if not wholly insurmountable difficulties from deeply rooted traits of human nature. In the first place, the instinct and habit of thrift are fundamental. They appeared in organic evolution long before man was ever dreamed of. When a plant stores food reserves in bulbs, or when a squirrel lays by a store of nuts, each is doing something about equivalent in its lowly biological philosophy to what we do when we set up an account in a sound savings bank. Each is doing its best to ensure survival. Thrift, wherever and whenever practised, makes for a due and proportionate measure of biological security and happiness. The roots of the institution of capitalism are biological in this important matter of thrift.

In the second place, in spite of the enormous development of the sentiment of altruism in the human race in the most recent part of its evolutionary history, this sentiment appears to have definite biological limitations. The instinct for personal individual survival, as we have already seen, is the most fundamental, deeply rooted, and persistent of all urges implanted in living things, and it is in the nature of the case biologically selfish in character. Incidentally because it is so, the whole purpose and *raison d'être* of human social organization is, and always has been, to curb and check the baser and more vicious manifestations of this primal instinct. But it needs no elaborate argument to recall to any intelligent person's mind, if he has forgotten it, that the checks to bad behaviour afforded by social organization are extremely feeble and ineffective things when groups of men are, or think they are, threatened with biological elimination, or even with the discomfort of a definitely lowered standard of living. Recent events in Asia and Africa leave no doubt on this point. 'Live and let live' is a fine and noble maxim, but it works pragmatically only so long as there is enough 'living'—that is, desired good things that make living pleasant—to go round. Men as individuals and as groups will beg, steal, fight, murder, and otherwise demean themselves to the level of other beasts not yet 'civilized', in order, hopefully, to ensure the continued survival of themselves, their own flesh and blood, and their kind, if they feel that survival is threatened.

Some persons find it difficult to understand or to admit such a view of the ultimate human behaviour pattern. They see most people not only living peaceably, most of the time, but also at considerable expense of time and money keeping alive ever-growing numbers of biologically unfit persons. The physically and mentally defective and degenerate, as well as the very young and very old, are taken care of in a manner unparalleled in any other form of life except man's. In the course of history, this process has become largely socialized, first through religious organizations, then through private groups of laymen, until, finally, more and more of the burden has been spread over the whole fit population as a recognized function of government.

This has bearing, and most important bearing, upon the plan, so popular just now, of alleviating the world's woes by averaging the world's goods. This plan seems in the long run likely to be steadily resisted by all those human beings who are, or think they are, inherently smarter and abler than some other human beings, whom incidentally they would be willing to name for you, if urged. For they would justly argue two things: first, that they have an inalienable right, which there are sound biological reasons for regarding as derived from and an integral part of the very protoplasm that is their being, to have and to hold what they are able honestly and fairly to get by their own efforts, and, taking everything into account, want to get;

second, that any process of averaging stands, on the whole and in the long run, to diminish what they will be able to get and have. In the transition period of a change to the averaging system, as in Russia to-day, this argument will not be heard much, for the reason that a great many of the older people, who realistically viewed never were terribly smart, find that, on the whole, they are better off than under the old system. Furthermore, under present political conditions, they are not able to do much about the situation whether they like it or not. In this respect, and the words are carefully chosen, they are dreadfully like worker caste termites. The youngsters in Russia are being conditioned mentally to the philosophy of Dr. Pangloss that theirs is the best of all possible worlds. But these conditions are likely to be only temporary, for the reason that in Russia as elsewhere some men are inherently smarter and abler than others, and the consequences of this biological fact will eventually make themselves felt.

They will make themselves felt for the reason that in a last analysis the living of every human being must come out of the earth—directly, as matter or energy useful for the manifold aspects of human living and the various activities associated with it; or indirectly, from the living things, plant and animal, that spring from and are nourished by the earth. The only exceptions here are, broadly speaking, what we are able to get from the atmosphere and the water that covers so large a part of the earth's surface. These contributions are, however, relatively unimportant as compared with those from the earth (in the sense of the lithosphere). Now, as has already been shown, each individual man, woman, and child now living has available for its living and all the activities associated with and derivative from human living, only about sixteen acres of land counting all the land, good, bad, and indifferent together, and probably nearer half of this number of acres of land really good for anything, in the literal sense of the words. This is a meaningless and fantastic average if it is thought of in the sense of forcibly attaching each individual human being to a particular sixteen acres of the earth's surface. But it is an average fraught with the deepest meaning in a world view, when it is remembered that all the means of human living, whether by the agricultural, industrial, commercial, or any other method, are derived, directly or indirectly, from the inexpansible earth and the energy from the sun's rays.

In the meantime, the world's population keeps on growing. This growth, at the present time, is at a gradually slowing rate for the world as a whole, as has been shown above. But the twenty-five countries included in Table 52, which together have a population of nearly 470 millions constituting 22·3 per cent. of the total population of the world, are not growing slowly at all, but are adding in every case to their total populations upwards of one and a half living persons net each year for every hundred alive at the beginning of the year. Two-thirds of the twenty-five countries are growing at rates of over 2 per cent. per annum. In a few of these countries the observed present high rate of growth is partly due to immigration, but for the most part the rates represent true natural increase.

The earth on and from which man must live is not an inexhaustible source of the means of living. Jacob G. Lipman, a recognized authority on the biology and chemistry of soils, has recently pointed out (35) that whereas, on the average, the four elements oxygen, silicon, aluminium, and iron make up about 87 per cent. of all known terrestrial matter (including lithosphere, hydrosphere, and atmosphere) these elements, with the exception of oxygen, constitute only an insignificant fraction of organic matter, the matter of living things. The solid matter of a man reduced to ash and analysed, contains about 0·0001 per cent. of aluminium, 0·03 per cent. of iron, and 0·005 per cent. of silicon. On the other hand, 54 per cent. of the dry matter of man—merely reduced to complete dryness but not burned to ashes—is carbon. This element all living organisms get, directly or indirectly, from the atmosphere or the lithosphere, or both, each in its own way; and by their vital processes all build it into their living structure, of which it is the keystone of the arch. But of the total known terrestrial matter, again including lithosphere, hydrosphere, and atmosphere, carbon constitutes, on the average, only 0·08 per cent. And of this, only about one two-hundred-and-fiftieth part is in such form as to be directly usable by plants, animals, and men for the purpose of their living. The great bulk of it is in insoluble forms such as coal and oil, where it was laid down by the living beings of past geological eras after they had finished with it. For the carbon cycle is, in considerable part, a degradatory one from the standpoint of living things. The total store of carbon that is directly usable by and absolutely necessary to organisms for their growth and living tends constantly to diminish by being transferred to insoluble forms.

The whole position regarding carbon will be clarified by the following quotation from Lipman:

> 'Under the head of debits, we may note the assimilation annually of more than 16 billion tons of carbon by vegetation. There is the fixing of large amounts of carbon in the weathering of rocks and in the formation of insoluble carbonates. An equivalent of 5 billion tons of carbon is fixed annually through the life processes of sea organisms. Altogether, it appears that the carbon dioxide withdrawn from the atmosphere by plants is balanced by that added to the air by micro-organic and other processes in the soil. By way of further clarification, we should note that the carbon given off by the soil comes partly from the destruction of organic matter and partly from root respiration. According to the investigations of J. W. Shive, the root respiration of a corn crop amounts to about 35 per cent. of the quantity of carbon fixed as organic matter by this same corn crop. If this ratio is extended to the entire plant world, it would mean that about 7,000 of the 19,000 million tons of the carbon addition diffusing from soils can be credited to root respiration, leaving 12,000 million tons due to the destruction of organic matter. If we add the 7,000 million tons of carbon transpired by roots to the 16,300 million tons of the carbon assimilated by plants, we obtain a total of 23,300 million tons of carbon utilized annually by vegetation. The release through soil respiration is but 19,000 million tons.'

While carbon is the keystone it is not the whole organic arch. The story of annual net loss of the stuffs of life is similar for other essential chemical elements. Lipman estimates that the soils of the United States suffer the following annual net losses: of nitrogen 2·7 million tons; of phosphorus 1·2 million tons; of potassium 30·7 million tons; of calcium 43·2 million tons; of magnesium 14·2 million tons; of sulphur 1·1 million tons; and of organic matter generally 222 million tons.

Let it not be supposed that the problem concerns food alone, or that mankind is scheduled to perish miserably by starvation in the next fortnight. The problem of adequate food production for the present or an even larger world population is not the most serious aspect of the matter. The industrial and commercial modes of life are using up their basic resources at an even faster rate than that of soil exhaustion. To support a world increase of population of about two and a half times between 1800 and 1918, coal and pig-iron production had to be increased about a hundred-fold.

So then we are confronted with the picture of a world presenting the following salient characteristics. First, it is a world becoming steadily depleted of the ultimate chemical resources upon which all life depends including that of human beings, and depends in an obligate fashion. Second, it is a world in which one large portion of the total population is reproducing at such slow rates that, if these rates are continued, these populations will shortly decline in size instead of growing. Third, in this same world another large part of the total population is reproducing so rapidly that if their present rates were to continue these populations would double in from 12 to 46 years. The rest of the world's population falls in between these two extremes in reproductive habits and efficiency.

The populations in the first category, apparently on the road to extinction for want of breeding activity, are the more highly 'civilized', and those in the second category less so, as measured by current standards of opinion about social values. But the differences between the categories in this respect tend to get smaller all the time, for two reasons. The first depends on the fact that certainly since the beginning of recorded history the more socially advanced peoples have felt it their duty, for reasons that it is perhaps best not to inquire too closely into, to 'civilize' their less advanced brothers. The effects of this activity upon the clients are various, but always have one common result. This is the invariable tendency to make the hitherto 'uncivilized' behave more and more like the 'civilized' in all ways, but particularly in the more obnoxious ways. But we may let that pass. The main objective and achievement is the efficient mediocrity that so strikingly characterizes the termitarium. The second reason that humanity becomes more uniform depends on the simian trait of imitativeness so deeply rooted in human nature, which makes men try to be like those whom they regard, however unwisely, as deserving to be aped.

So, if everything went along for a long time as it is going now, it might be reasonably expected that eventually our second category of folk would get as 'civilized' as the first category is now, and be as little fertile as they are. But, in the meantime, the first category would have disappeared. So, also, would the second category a short time thereafter, for the same reason. Perhaps something like all this is going to happen. Perhaps not. There is another possibility.

There seems to the biologist some reason to believe that mankind is at the present time engaged in the process of biologically adjusting or adapting itself to the situation that has developed as the combined result of the growth of scientific knowledge and the tremendously accelerated growth of population that that increase in knowledge has fostered in the last 300 years. This adaptation appears to be going on in what must be regarded as the normal biological way, namely by processes that are not, for the most part, the resultants of conscious group effort or planning, and may therefore be designated as natural, in so far at least. Birth rates over a large part of the world are generally falling, and have been falling for a considerable time past. This decline in human reproduction is nowhere a consequence as yet of a type of behaviour deliberately planned by the State for the whole mass of its people and deliberately forced upon them; nor, on the best evidence, is it anywhere wholly due to individual planning to reduce reproduction by birth control. It has occurred and is now occurring among peoples where effective birth control is but very little practised, if at all. Rather, what is going on appears to be a much more complex biological adjustment or adaptation involving many factors, both immediate and evident as well as remote and obscure. Among these factors an important one is conscious individual contraception, but probably nowhere the only important one.

Full comprehension of the implications of the present situation of the world's population, as depicted in Fig. 39 *supra*, makes it seem to the biologist that the adaptive regulatory processes demanded will probably be the greatest and most far-reaching that the human species has ever, so far, had to undertake in its evolutionary history. Those required during the glaciation of the greater portion of the northern hemisphere seem insignificant by comparison. For, in truth, as was so ably shown by Prof. H. L. Hawkins in his brilliant address as Chairman of the Section on Geology at the 1936 meeting of the British Association for the Advancement of Science, the position of man as a species presents to-day an extraordinary similarity to that displayed by many others in the palaeontological record just prior to their disappearance from the cosmic scheme of things. The case cannot be better presented than in his own words:

'It would be wearisome to reiterate the various features wherein the history of human affairs corresponds with the course of evolution in other groups. Whether we consider individual lives, dynasties or empires, the same depressing story applies. Some races, once dominant in their particular sphere, have disappeared entirely; others, fallen from high estate, linger in inglorious decay. But all of those brave civilizations and empires of which we have records seem to have shown a succession of similar histories. They have risen from obscurity through possession of successful attributes, and have reached the peak of their power only to pass it. Some have rotted away quietly, others have fallen before the onset of less rotten stock or perhaps of extra-human disaster. Many of the early empires were on so small a scale that their rise and fall had merely local effect; others have been more comprehensive, and their dissolution has spread havoc over wide areas of the world.

'Until comparatively recently, there has been a persistent proportion of "backward" types, unaffected by the civilizing influence of the progressive powers. These have remained to provide a new upstart when the current one had crashed. To-day there are few races of this kind left; almost all of mankind has encountered civilization and either perished or been transmuted. The fatal complexity of civilization grips the whole species, crushing it into unity.

'The specific causes of the collapse of once dominant races are doubtless varied; but there is general agreement that one universal factor in disintegration is complexity, an aspect of over-specialization. The units of an empire, be they individuals or factions, tend to work together in harmony during the period of upward struggle; but when a position of dominance is won, they continue to struggle. When there are no new worlds to conquer they begin to fight among themselves. Selfish aims replace patriotic ones, and the community becomes discordant.

'The correspondence between this state of affairs and the morphogenetic trends in other races of animals is so close that it needs no elaboration. Those who deny that human institutions are subject to the laws of organic evolution know either no history or no Palaeontology. Many proverbs give epigrammatic statements of the principles of evolution in imaginative terms.

Ill fares the land, to hastening ills a prey,
Where wealth accumulates and men decay.

'The history of extinct empires, which should be studied as a cautionary tale, is commonly regarded as providing an example to be followed. Human nature has a curious trait of gambling against the laws of cause and effect. We always hope that the fate that befell our predecessors will pass us by. Babylon, Egypt, Rome, Spain, all traversed the same track; and to-day we follow in their footsteps hoping to reach some different goal.

'Our peculiar quality of superior mentality seems but a suicidal acquisition, hastening and intensifying the imminent doom. But the human mind is more than a fabricator of evanescent institutions. It can transcend utilitarianism (wherein it but exaggerates animal qualities) and can form idealistic conceptions.

'Ideas of chivalry, honour and self-sacrifice have no place in the struggle for existence; but they are inherent in all but hypersophisticated minds. Among ordinary folk, conceptions such as these are stronger incentives to action than animal impulses, as even the most rascally demagogue knows. Learning, philosophy, and art are realities to which men will devote their lives, creating rather than copying, with no ulterior or mercenary aim. The arts and virtues bring a new and incalculable feature into the story of evolution.

Some, at least, of their achievements outlive kingdoms and empires, seeming immortal.

'Men are, for the most part, enthusiastic admirers of virtue, even to the extent of devising laws to ensure its maintenance. Very many of them are actual exponents of virtue in their personal relations; but in public affairs and in the mass they are often content to behave as animals rather than as men. "Manners makyth man" is perhaps the most concise specific diagnosis ever published. But there is only one law of evolution, common to individuals and races alike. If mankind as a whole neglects its "manners", it abandons any claim it may have to qualitative difference from other animals. There is no doubt of man's ability to become the most successful type of animal that has ever existed; but the reward of success in that direction is death.'

This cogent statement of the case by a palaeontologist distils to three essentials, in the view of the human biologist: (*a*) excessive specialization, to the end of (*b*) altering enormously the balance of nature in directions and ways thought by man to be to his immediate advantage, which in turn (*c*) has permitted and encouraged an enormous growth of population, entirely disproportionate in magnitude and rapidity.[52] On the existing record, as Hawkins points out, no species has ever yet been able, in the long history of life on the earth, to adapt itself swiftly and skilfully enough to survive this combination of circumstances. Whether mankind will or not lies in the lap of the future. The problem presented is of a sort that statesmen, for the most part, are, by their own natures and aptitudes, by their training, and in truth by the very nature of their business, quite unable to envisage or understand, and still less able to do anything effective about. Some philosophers and men of science understand the problem well enough, but lack the power of a Caesar or the persuasiveness of a Pied Piper to lead mankind to a solution, even if they knew just the road to take to a practical solution. So, on the whole, man's only chance of coming successfully through the ghastly mess he is plainly in for would seem to lie, for what it may prove to be worth when put to the supreme test, in the fact that he has shown himself in the past to possess somewhat greater innate powers of adaptability than any other organism ever known.

NOTES

[1] The following discussion is based upon and follows rather closely an earlier paper of the writer entitled, 'Biology and Human Trends' (Pearl, 35), originally published in the *Journal of the Washington Academy of Sciences*, and subsequently reprinted in the *Annual Report of the Smithsonian Institution* for 1935.

[2] The statements in this paragraph are intended merely as an expression of opinion as to the real situation, and with no desire to stir the wrath of birth-control propagandists, who do seem occasionally to lose touch with reality. Once at a dinner party an ardent birth controller became so carried away by argumentative zeal as to defend, as her climactic thesis, the proposition that only ignorance prevented cats from practising contraception! Obviously this was unanswerable, but the company of sober-sided biologists concluded that, odd as it seemed, she must never have seen a pair of cats in an amative mood.

[3] In the case of Ireland the comparison is not absolutely exact, because in 1900 the rate was for the whole country, while the figure for 1933 is for the Irish Free State only. The error so made is not serious, because the birth-rates for the two portions of Ireland are at the present time nearly the same.

[4] It is, of course, to be noted that, long before Doubleday, Adam Smith had pronounced the dictum that poverty is favourable to generation. But this is not the place to enter on a systematic historical discussion of ideas about fertility. The only purpose here is to illustrate points pertinent to the present discussion.

[5] Presumably married women, though no definite and unequivocal statement on the point is to be found in the original.

[6] An apparently real exception to this general rule is found in the original report of Man (82) on the aboriginal inhabitants of the Andaman Islands. He observed these people before they had experienced any significant contact with civilization. He found that 'three or four is the average number of children born of the same parents. The largest family known consists of six, three only of whom attained maturity.' Twins were found to be rare, and triplets unknown. 'The limited fecundity of the women may in some measure be due to the circumstance that they never wean their babies so long as they are able to suckle them.'

[7] While in recent times it is Rivers's book that is usually referred to by students of population, it should be remembered that, long before he became interested in the matter, others had discussed depopulation in the South Seas with great acuteness and penetration. In particular Robert Louis Stevenson (18), a third of a century earlier, had

contributed pertinently, and from first-hand observation, to the subject. The following passages bear significantly on the points made in the present connexion. Discussing conditions in the Marquesas he says (p. 29):

'Thus, in the half-year ending July 1888 there were twelve deaths and but one birth in the district of Hatiheu. Seven or eight more deaths were to be looked for in the ordinary course; and M. Aussel, the observant gendarme, knew of but one likely birth. At this rate it is no matter of surprise if the population in that part should have declined in forty years from six thousand to less than four hundred; which are, once more on the authority of M. Aussel, the estimated figures. And the rate of decline must have even accelerated towards the end.'

More generally regarding all Polynesia he says (pp. 37–8):

'Over the whole extent of the South Seas, from one tropic to another, we find traces of a bygone state of over-population, when the resources of even a tropical soil were taxed, and even the improvident Polynesian trembled for the future. We may accept some of the ideas of Mr. Darwin's theory of coral islands, and suppose a rise of the sea, or the subsidence of some former continental area, to have driven into the tops of the mountains multitudes of refugees. Or we may suppose, more soberly, a people of sea-rovers, emigrants from a crowded country, to strike upon and settle island after island, and as time went on to multiply exceedingly in their new seats. In either case the end must be the same; soon or late it must grow apparent that the crew are too numerous, and that famine is at hand. The Polynesians met this emergent danger with various expedients of activity and prevention. A way was found to preserve breadfruit by packing it in artificial pits; pits forty feet in depth and of proportionate bore are still to be seen, I am told, in the Marquesas; and yet even these were insufficient for the teeming people, and the annals of the past were gloomy with famine and cannibalism. Among the Hawaiians—a hardier people, in a more exacting climate—agriculture was carried far; the land was irrigated with canals; and the fish-ponds of Molokai prove the number and diligence of the old inhabitants. Meanwhile, over all the island world, abortion and infanticide prevailed. On coral atolls, where the danger was most plainly obvious, these were enforced by law and sanctioned by punishment. On Vaitupu, in the Ellices, only two children were allowed to a couple; on Nukufetau, but one. On the latter the punishment was by fine; and it is related that the fine was sometimes paid, and the child spared.'

By way of interpretation the following points are made (pp. 40–1):

'Here, then, we have one side of the case. Man-eating among kindly men, child-murder among child-lovers, industry in a race the most idle, invention in a race the least progressive, this grim, pagan salvation army of the brotherhood of Oro, the report of early voyagers, the wide-spread vestiges of former habitation, and the universal tradition of the islands, all point to the same fact of former crowding and alarm. And to-day we are face to face with the reverse. To-day in the Marquesas, in the Eight Islands of Hawaii, in Mangareva, in Easter Island, we find the same race perishing like flies. Why this change? Or, grant that the coming of the whites, the change of habits, and the introduction of new maladies and vices, fully explain the depopulation, why is that depopulation not universal? The population of Tahiti, after a period of alarming decrease, has again become stationary. I hear of a similar result among some Maori tribes; in many of the Paumotus a slight increase is to be observed; and the Samoans are to-day as healthy and at least as fruitful as before the change. Grant that the Tahitians, the Maoris, and the Paumotuans have become inured to the new conditions; and what are we to make of the Samoans, who have never suffered?

'Those who are acquainted only with a single group are apt to be ready with solutions. Thus I have heard the mortality of the Maoris attributed to their change of residence—from fortified hill-tops to the low, marshy vicinity of their plantations. How plausible! And yet the Marquesans are dying out in the same houses where their fathers multiplied. Or take opium. The Marquesas and Hawaii are the two groups the most infected with this vice; the population of the one is the most civilized, that of the other by far the most barbarous, of Polynesians; and they are two of those that perish the most rapidly. Here is a strong case against opium. But let us take unchastity, and we shall find the Marquesas and Hawaii figuring again upon another count. Thus, Samoans are the most chaste of Polynesians, and they are to this day entirely fertile; Marquesans are the most debauched; we have seen how they are perishing; Hawaiians are notoriously lax, and they begin to be dotted among deserts. So here is a case stronger still against unchastity; and here also we have a correction to apply. Whatever the virtues of the Tahitian, neither friend nor enemy dares call him chaste; and yet he seems to have outlived the time of danger. One last example: syphilis has been plausibly credited with much of the sterility. But the Samoans are, by all accounts, as fruitful as at first; by some accounts more so; and it is not seriously to be argued that the Samoans have escaped syphilis.'

Stevenson sums up his discussion in the following manner (p. 43): 'Upon the whole, the problem seems to me to stand thus:—Where there have been fewest changes, important or unimportant, salutary or hurtful, there the race survives. Where there have been most, important or unimportant, salutary or hurtful, there it perishes. Each change, however small, augments the sum of new conditions to which the race has become inured. There may seem, *a priori*, no comparison between the change from "sour toddy" to bad gin, and that from the island kilt to a pair of European trousers. Yet I am far from persuaded that the one is any more hurtful than the other; and the unaccustomed race will sometimes die of pin-pricks.'

[8] This conclusion accords with that of Hjort (34), who states (p. 5) as a general law that: 'Any given historical equilibrium will remain as such or in an incipient state of change, unless the action of forces in the environment alters this condition of things.'

[9] The precise meaning and mode of derivation of these pregnancy rates are described later (cf. note 20).

[10] The procedures used were those described in detail in Pearl (30). The chief difficulty the biometrician encounters in menarche statistics is relative to the statement of ages. Most authors who put their observations in the form of frequency distributions, as all should, give the observed frequencies against single years of age stated as integers (as, for example 9 years, 10 years, 11 years, &c.), and fail to state whether these ages are intended to indicate age at *last* birthday (9–9·9 years, 10–10·9 years, &c.) or age at *nearest* birthday (8·5–9·4 years, 9·5–10·4 years, &c.). Naturally there is no way by which any subsequent worker can surely tell which of these alternatives was meant. Of course, what any properly trained statistician, or untrained person with a sound innate statistical sense always does, is to state precisely the limits of his age classes. But, in the absence of such information in many of the distributions dealt with in Table II of Appendix I, we have made it a uniform rule, in computing the biometric constants of age at menarche where in the original the ages are given only in integer years, to assume that the recorded observations were based upon *age at last birthday*. This decision was made primarily upon the belief that most people state their ages that way when asked. It seems unlikely, on the whole, that any woman says that she was 14 when a certain event occurred unless she had passed her 14th birthday at that time and had not yet reached her 15th. However, this is an assumption, and is recognized to be such. In Table II an asterisk against the name of the source of the original distribution indicates that the limits of the age classes were precisely stated by the author. For all other distributions the reader may subtract 0·5 years from the means and medians as given in the table, if he is of the opinion that it is more probable the original informants gave their ages at first menstruation in terms of nearest birthday rather than in terms of last birthday. But at least one desirable consequence of the procedure we have adopted is that all the means and medians of Table II as they stand are comparable *inter se*. The relative differences between them are valid.

[11] In a discussion of married fertility in England and Wales based upon the 1921 Census, Fehlinger (28) states that children of fathers under 20 and over 45 form 7·9 per cent. of the total number of children, a figure agreeing closely with the U.S.A. experience of 1934. He goes on to say that the corresponding figure for mothers is only 2·6 per cent. of the total. This latter figure seems plainly an error.

[12] Other similar cases of pregnancy and birth, at extremely early

ages, that appear trustworthy have lately been recorded by Vaughn (33) [a Mohammedan child in Kashmir 8 years old] and Keane (33) [unmarried Mohammedan girl aged 7]. Less well authenticated cases from the older literature will be found discussed at length in Gould and Pyle (97). Dittrick (27) reviewed the literature on precocious pregnancy a decade ago and reported a case of his own [Croatian immigrant to the U.S.A., delivered at the age of 11 years, 10 months, and 22 days]. Klumov (26) reviewed the literature of sexual precocity, discussing the matter from the endocrine point of view, and stated that up to 1926, the date of his paper, about 400 such cases had been described.

13 A. R. Simpson (84), in his valedictory address to the Edinburgh Obstetrical Society, spoke of a case recorded by W. J. Kennedy of a woman pregnant at the age of 62, and quoted from the *Account of the Islands of Orkney*, by Jos. Wallace, M.D., the case of Marjory Bimbester, 'in the parish of Erie, [who] was in the year 1683 brought to bed of a male child in the sixty-third year of her age'.

14 There seems to be growing a tendency among medical men to ascribe priority to Hellin for the discovery of the rule associated with Zeleny's name. One sees casual references to the 'Hellin ratio', when what is meant is the Zeleny relation between twin and triplet frequencies. Actually, an examination of Hellin's (95) interesting treatise on multiple births and their causation fails to reveal the slightest sign that he was aware, or had ever even thought, of the now well-known rule. In fact the only 'ratios' of multiple to single births that Hellin gives are some that he copied from Puech (74), giving the numbers of twin to single births in France between the years 1843 and 1858, which range from 1/83 to 1/75.

15 Some present-day examples of sexual athletes who make Casanova, the traditional star, seem a somewhat puny performer, have been given the writer (*in litt.*) by a thoroughly trained and experienced American sociologist working in Paris. She says: 'I thought you might be interested in some cases of—as it seems to me—prodigious sexual athleticism. Of course the evidence is purely anecdotal and it is a question just how much credence it merits from a scientific point of view. The women who report it assure me of its utmost accuracy, but in a city that places as much emphasis on sex as Paris, there seems to be a sort of professional pride in one's sexual prowess, even among women, and this may invalidate their evidence. The three women, one a widow, the other two divorcées, are, I should judge, of about 90–95 I Q., with the equivalent of, say, a sixth- or eighth-grade education. The widow, who is concierge in a hotel, claims that when her husband was alive they had sexual intercourse, complete, four times a day regularly —in the morning, at noon, in the afternoon, and at night. They raised and sold horses and were hard at work all day. She was surprised that any one might think this at all unusual. One of the divorcées, now 32,

claims that complete sexual intercourse nine times a night is not at all unusual for her. Further, immediately following menstruation she is on edge all day long waiting for night, which apparently is spent in continuous coitus. The other divorcée, a Hungarian woman, also 32, states that when she was living with her husband sexual relations fifteen times a night were common, especially when her husband had been drinking. She admits this was too much, but that her husband demanded it. Fifteen or twenty minutes after orgasm he was once more erect. In other respects apparently normal. The women are (from the point of view of an American) astonishingly candid. They make no effort to conceal the fact that the one and only thing they live for is sexual gratification, and yet they are by no means the disorganized or degenerate prostitute type, but, so far as an outsider can judge, thoroughly normal, well integrated, and organized. Nor are they promiscuous; they seem to have a certain attachment for their "friends". They are not, however, monogamic.'

Subsequent inquiry developed the further interesting report that the concierge had been only twice pregnant, and had used as a contraceptive only plain water douches; the French divorcée had also been pregnant only twice, and had relied on soapy water douches as a contraceptive; the Hungarian divorcée used as contraceptive a 'chapeau', that is a rubber occlusive pessary of the diaphragm type.

The case of the concierge can be exactly paralleled by a working man's family in Baltimore known to the writer, where the same routine of intercourse four times a day was the established habit. So fixed was this routine that the man voluntarily gave up a job because it did not permit him to go home at noon and enjoy his postprandial indulgence.

[16] As a matter of fact the writer has for a long time had in his possession a few such diary records, and hopes sometime to publish an analysis of them. He would like to get more, and will be greatly obliged if any person under whose eyes these lines may fall, who has such a diary record, will let him have a copy of it for study and analysis, with, of course, the most complete and binding assurance that anonymity will be strictly and permanently safeguarded. In order for the record to have any critical value, however, the writer must himself know who is responsible for it, and what the guarantees of its authenticity are.

[17] The meaning and scope of these occupational classes is made clear by the following account quoted from Pearl (33, p. 493):

I. Owners, managers, officials, and professional men.
II. Skilled and semi-professional workers.
III. Labourers—unskilled and semi-skilled.

'The underlying idea is to contrast *primarily* two groups of persons, namely those (I) who, on the whole, are situated at or near the top of things in the existing social organization, and those (III) who, by and large, find themselves at or near the bottom in the same social organization. This leaves a third class (II): persons who are, on the whole, neither very near the top nor the bottom, and who, if they are sometimes thought and sometimes think themselves to be worse off than those in class I, are plainly and admittedly better off, on the whole, than those in class III.

'The distinction between classes I and III is a real and fundamental one. By and large—that is to say in a statistical sense and with some admitted exceptions—the individuals falling in class I have much higher incomes and standards of living than those in class III; incomes in fact high enough—again with individual exceptions—so that they have definite marginal resources which not only give them a feeling of relative security as regards biological survival, but also make possible education for themselves and their children and indulgence in various luxuries and pleasures. . . .'

'On the other hand, the individuals of class III—and again by and large in a statistical sense—have low incomes and standards of living: so low, generally speaking, as never to be much above the minimum necessary for biological survival. Sometimes they drop temporarily below this minimum. They have few or no marginal resources individually and are therefore correspondingly restricted in such matters as education, luxuries, and pleasures. . . .'

'The individuals falling in class II are generally intermediate in their circumstances and attitudes between the other two, some tending more towards one, others more towards the other.'

[18] Normally, and as the usual thing with most married couples, the regular habits of sexual intercourse as to frequency are not altered greatly by the wife's pregnancy until near the time of delivery. The positions assumed in coitus are often changed because of the somatic changes in the woman resulting from pregnancy, especially in the later months, but the evidence indicates that no very significant change takes place in the usual rate as to frequency. This has been particularly discussed by Ballin (29) who could find no evidence that coitus, during the first 5 months of pregnancy, led to any harmful results whatever, although in the last 4 months there was some indication that it might increase the chances of abortion or still-birth. Büben (24) interviewed 5,000 women in the Woman's Clinic of the Royal Hungarian University in Budapest as to the time of their last coitus before delivery, and found that it was only 'several hours' before in 0·7 per cent. of both primiparae and multiparae, and only one day or less before delivery in 3·6 per cent. of the primiparae, and in 4·0 per cent. of the multiparae; while 23·4 per cent. of the primiparae, and 34·6 per cent. of the multiparae indulged within *a week or less* time before delivery. Liubimowa (26) reported similar findings from 775 obstetrical clinic cases in Leningrad. So also did Ponomareff (29) on the basis of data for 212 women. He could find no clear evidence that coitus at a fortnight before delivery produced any harmful effects. Some of his cases indulged up to 12 hours before parturition.

[19] In making the computations relating to frequency of coitus the following procedures were followed:

From the gross time spent in wedlock during an age period was deducted 0·79 year for each live or still-birth; 0·29 year for each miscarriage; and 0·415 year for each therapeutic or criminal abortion (to allow for pregnancy and puerperium except where more definite information as to duration is given in the history). Where necessary deductions were also made for chronic or disabling illness of either husband or wife and for temporary separation of the couple. The remainder was multiplied by 0·82 to allow for non-intercourse during menstruation, and the product was then multiplied by the number of copulations per year from the data, to give total net potentially effective copulations in the age period.

The same procedure was followed for gross copulation figures, except that no deductions were made for time spent in the pregnant and puerperal states.

[20] The statistical form and method of computing the pregnancy rate may be described as follows:

Let $M =$ the total period (in years) during which a woman engages in copulation, between puberty and the menopause (for practical purposes the duration of marriage within the same limits—that is, between puberty and the menopause); and

$P_1 =$ duration of time (in years) she spends in the pregnant state, and regardless of the manner of its termination (by term birth, or abortion, &c.); and

$T =$ number of times she becomes pregnant during the time-period M; and

$P_2 =$ duration of time (in years) she spends in the puerperal state (taken to a rough approximation as $0{\cdot}04T$ or $0{\cdot}04(T-1)$ when, as is the case in our records, the period of observation and record ends with the date of termination of a pregnancy).

Then $M-P_1-P_2 =$ duration (in years) of time spent free from pregnancy (and puerperium), and $\dfrac{100T}{13(M-P_1-P_2)+T} = R_p =$ pregnancy rate per 100 computed ovulations.

This pregnancy rate may take any value between the limits of zero and 100. For the completely sterile mating ($T = 0$) it will be $R_p = 0$. The more fertile the woman the higher will be the rate. That some women may closely approach the upper limit of 100 per cent. performance over considerable periods of time is shown by the following example from our records:

This woman had been married 5·5 years, and in that period had been pregnant 17 times. Two of these pregnancies terminated in live births at term; 15 of them ended in self-induced abortions. Assuming, as a rough approximation, that each of these abortions occurred at the completion of two months of pregnancy, we then have the following values:

$M = 5{\cdot}5$ yrs.; $P_1 = 4{\cdot}83$ yrs.; $P_2 = 0{\cdot}64$ yrs.; $(M - P_1 - P_2) = 0{\cdot}03$ yr.

Then $R_p = \dfrac{1700}{17{\cdot}39} = 97{\cdot}8$ pregnancies per 100 computed ovulations.

This woman, in short, during the first five and a half years of her married life, became pregnant just under 98 per cent. of the times she presumably ovulated.

[21] As many a woman has learned by experience it is not always easy to induce an abortion, even by extremely drastic methods. As was pointed out in the preceding section it is sometimes difficult to get a pregnancy under way, but once the new individual is started it often proves extremely tenacious of its hold on life in its snug uterine *nidus*. To illustrate this tenacity the following experiences may be quoted from the practice of a distinguished gynecologist and obstetrician, Dr. J. P. Maxwell (29):

[*Case I.*] 'On December 10th, 1926, an old patient of mine, an American . . . came to the Peking Union Medical College Hospital feeling very wretched. She had had two children, the last one in Dec. 1923, and after the last confinement she got an acute streptococcic inflammation of the right and left breasts. The right one had to be removed, the left recovered after multiple incisions, but was left scarred and useless. In April 1926 she was admitted for acute rheumatic fever with mitral stenosis, and recovered with a damaged heart.

'She was now pregnant and the last monthly period had begun on October 8th, 1926.

'After consultation it was decided that it was very inadvisable that the pregnancy should continue, and I was asked to terminate it by a curettage. She was placed under gas and oxygen, the canal dilated to No. 10 Hegar and the cavity systematically scraped and then packed for 12 hours. She recovered at once, lost her nausea, and thought no more about the matter till four months later when, on her way home to the States, she consulted a doctor because her abdomen was enlarging, and he found a pregnancy corresponding to the proper date. She went to term and had a normal child without difficulty on July 12, 1927.

[*Case* 2.] 'The patient was a Chinese lady . . . a multipara with four children, sent to me because of incipient active tuberculosis of one apex with a request from her physician that the pregnancy should be terminated. The last monthly period had been on November 24th, 1927 and she was admitted to the Peking Union Medical College Hospital on February 8th, 1928.

'Here I dilated the uterine canal to No. 14 Hegar and after removal of part of the conception with forceps, scraped out very thoroughly with a sharp flushing curette, and packed the uterus with gauze for 24 hours. Nausea at once stopped but being only able to find the decidua in the sections, I kept her under strict observation. On April

14th, 1928, or roughly 4¾ months from the last monthly period, it was clear that the pregnancy was progressing, so I again dilated to 24 Hegar and delivered a normal conception from below, having some little difficulty with the head of the foetus. The foetus appeared to be about 2½ months old, so that the pregnancy at the time of the first curettage must have been about six weeks old. In the first case the pregnancy was probably about the same age.

[*Case* 3.] 'It is generally believed . . . that extensive operations on the cervix are apt not merely to terminate a pregnancy but to predispose to abortion. This is not always the case.

'A Korean woman, aet. 32 . . . was admitted to the Peking Union Medical College Hospital on December 17th, 1924 for profuse, intractable leucorrhoea of ten months duration. She spoke Chinese very poorly and had had four full term deliveries. The last monthly period had been on or about November 21st, 1924. She had a hypertrophied nodular cervix with much endocervicitis. On December 27th, 1924 a Sturmdorf operation was done by Dr. N. J. Eastman, the cervix dilated to No. 19 Hegar, a Hegar dilator No. 5 being passed into the uterus at the close of the operation, and a uterine probe passed during the post operative examination on January 12th, 1925. On August 28th, 1925 she came to hospital in labour with a full term pregnancy. The cervix dilated badly and as the lower uterine segment was thinning out, the husband was sent for in order to get permission for a Caesarean section. Less than an hour later she suddenly ruptured her uterus. Coeliotomy was done, followed by a supravaginal hysterectomy and she made a good recovery. So that in this case passing a No. 5 Hegar and a uterine probe into the uterus, combined with the Sturmdorf operation, failed to arrest a pregnancy which must have been about three weeks old at the time of operation.'

[22] This discussion is, to a considerable extent, based upon two recent studies (Pearl, 36, 37).

[23] The practical breeder, as well as the laboratory worker, is familiar with this fact. Sterility occurs commonly in forms where the usual lushness of multiplication does not suggest the occurrence of sterility. Thus, to take only two examples by way of illustration, Sure and Beach (30), in a particular series of experiments with rats, found 9 sterile out of 88 females, or 10 per cent., under the conditions of experimentation. In some experiments of the writer with the fruit fly *Drosophila melanogaster* there were, among 2,045 pairs of flies used as breeders in 100 consecutive generations, 496 completely sterile pairs, or 24·3 per cent. Yet even so there were produced in the hundred generations 217,221 offspring flies. Similar data for a genetically different group, in which there were 2,221 breeding pairs in total, show 263 sterile pairs, or 11·8 per cent. and a total production in 100 consecutive generations of 191,296 offspring flies. Under the conditions of experimentation the first group, because of its high innate fertility, and in spite of its also high

percentage of sterility, produced an average of 157·9 offspring flies per day for the 1,237 days included in the 100 generations, while the second group, with less than half the percentage of sterility, but also a lower innate fertility, produced only 139·0 offspring flies per day of elapsed time, on the average.

[24] Computed from data given on pp. 183 and 237 of *Abstract of the Fifteenth Census of the United States*. Washington (Gov't. Printing Office), 1933. Pp. viii+968.

[25] Besides the testimony of each annual report on birth statistics to this fact the literature contains many casuistic accounts of extraordinary fertility steadily continued through the reproductive life span. Ansell (74) describes a case where the father and mother were married when they were respectively 23 and 21 years of age; they produced 25 children, all of whom grew up to be adults. The child-bearing period lasted 27 years from marriage (menopause at 48 years). Berger (14) gives a detailed account of a woman who had 30 pregnancies in 25 years and bore 36 children of whom 20 were alive at birth. Her menarche was at age 10, and her marriage at 19 (last birthday). She experienced 4 twin and 1 triplet pregnancies. Eustache (96) reports three sisters (French) one of whom gave birth to twins at the age of 48 from her 24th pregnancy; another had 24 pregnancies between the ages of 17 and 49; the third had 22 pregnancies in total. Laurentie (22) describes the reproductive history of a Syrian woman who married at 13 years of age. Three months later she became pregnant. By age 50 she had had 36 pregnancies, 12 of which ended in abortions at various periods and from indeterminate causes. The other pregnancies ended at term. At the time of observation (1922) she was 85 years old. Her mother had 23 children. Raymondaud (17) reported (*Paris Médical*, Dec. 16, 1916) the case of Marie Dehen, born in 1847. She bore her first child at the age of 18, and her last at age 49. The sum of her contribution to the population of France was 32, 18 boys and 14 girls. Eight of the former and seven of the latter were living at the time of record. She ceased menstruating at the age of 60, and so might have borne still more children than she did if it had not been for the death of her second husband while she was, at age 49, still reproducing. For the interests of France and of science it can only be regarded as a calamity that this man died when he did, and the greatest of pities that Madame Dehen did not take still another husband promptly after that sad event. One of her daughters, who married at the age of 25 years, had produced 10 children by the time she was 35, and was cheerfully awaiting an eleventh blessed event at the time of record.

[26] Computed from data given in Tables 4 and 13 of *Birth, Still-birth, and Infant Mortality Statistics for the Birth Registration Area of the United States, 1930*. Washington (Govt. Printing Office), 1934. Pp. iv+400.

[27] Derived by adding to the 2,256,913 births known to fall within

the maternal age limits the number of births, living and still together, born to mothers of unrecorded age reduced by 42 births, this being the number out of 30,325 expected to be produced by mothers under 15, and 50 and over, in age, if the same ratio held in this group of births as holds for all births to mothers of known age.

[28] In 1930 the recorded still-births were 3·8 per cent. of all births (living and still). Pearl (33) reported 1,006 abortions in 6,441 pregnancies, or 15·6 per cent. There is good reason to believe that in this series no significant number of abortions were unreported. Hence an *addition* of four times the already recorded still-births seems a reasonably liberal average. Green-Armytage (36) states that in England '15 per cent. of all pregnancies terminate in miscarriage', a figure in close agreement with that from the Baltimore experience just cited.

[29] There are two minor technical points that must be mentioned in connexion with the construction of Table 18. Owing to the different practice, already mentioned, of the census and registration officials relative to race (colour) classification, coloured live births in Table 18 are expressed as percentages of Negro and 'Other Races' women combined. Thus the 7·26 per cent. of Table 18, expressing percentage of coloured live births to women 30–34 years of age, is derived from 3,293,200/(414,652+38,726). It seems probable that the net residual error embodied in Table 18 from this source cannot be great enough to be of any practical importance. There are two reasons why this seems likely. In the first place it is certain that the great majority of the coloured births are Negro births, because the aggregate number of 'Other Races' women in the portion of the population under discussion is only about 8 per cent. of the number of Negro women. In the second place it seems probable that a considerable, though unascertainable, fraction of the births to 'Other Races' mothers were in fact entered on the birth certificates as 'coloured'.

The other point concerns the small group of 'Whites of unrecorded nativity'. This group affected in no way the computation of Table 18 except in respect of the right-hand marginal mean percentages. There the births in the unrecorded nativity class were subtracted from the marginal totals. Thus for age 15–19, $4{\cdot}89 = (267{,}078-202)\times 100/5{,}454{,}533$. This is not an exact procedure, because mothers of unrecorded nativity are still concealed amongst the women, even though their births have been deleted. However, the numbers involved are so small relatively that the resulting error is insignificant.

[30] Not all the differences are statistically significant, but some are.

[31] Taken from table on p. 281 of Pearl (36).

[32] The discussion of parity that follows is based upon the officially recorded reproductive experience in 1930 of women in the U.S. Birth Registration Area, which in that year included all the states in the country except Texas and South Dakota. All the data used are derived

from the annual volume of birth statistics for 1930 except as otherwise noted. (Bureau of the Census. *Birth, Still-birth, and Infant Mortality Statistics . . . 1930*. Washington (Govt. Printing Office), 1934. Pp. iv +400.) The official records are unfortunately not uniformly tabulated for the whole Registration Area, and therefore their usefulness is diminished in a manner presently to be explained in detail.

General Table 6 of the 1930 birth report cited gives 'births (exclusive of still-births)', that is *live births*, by number of child and age of mother in single years, but 'exclusive of Colorado, Maine, Massachusetts, New Hampshire, and Rhode Island' (p. 232). Table 14 gives corresponding information for still-births 'exclusive of Massachusetts, Rhode Island and New York', but in quinquennial instead of single year age groups. Obviously it is possible to compile the data in each of these tables the other way about, so that instead of having, as in the original report, the frequency of mother's ages for specified numerical order, we shall have frequencies of ordinal birth numbers for mothers of specified ages. This transformation was the first step of the investigation. Unfortunately, because of the 'exclusions' noted above, that do not tally geographically, it is impossible to combine the two resulting live and still-birth distributions into one total distribution. Therefore it is impossible to discuss even approximately the parity age distribution of *pregnancies*. Instead, we are necessarily confined to the treatment separately of the parity-age distribution of live births and of still-births, with, in each case, only the material available for the class by itself.

The total material discussed includes 2,058,277 live births and 70,574 still-births, or 2,128,851 births in total. This latter number is smaller than the total births of the year, by reason of the omission of births for which the mother's age, parity, nativity, or some combination of these failed of record, and also because of the exclusion of states in the tabulations as already noted.

While the initial discussion is confined to the statistics of a single year (1930) it should be understood that any other nearby year would show substantially the same results. Indeed, so nearly identical would all the *relative* figures be as to make it certain that no conclusion would be different in even the smallest degree.

[33] Pomerat (36), in a study of 987 married couples over a 15-year period, found 19·35 per cent. sterile (in the sense of childless). This agrees closely with the writer's estimate in the text.

[34] This plan was adopted deliberately to avoid the inevitable ambiguity that would ensue in the records if the patients had been asked simply to state their own or their consort's age. Different people have different habits about stating age at a given moment. Some give it as at the last preceding birthday; others as at the next birthday; still others as at the nearest birthday. The mere statement of a number of years on a record blank completely fails to differentiate between

these categories for the information of the subsequent student of the record. Recording actual dates of birth and marriage gets around this difficulty, though it involves much subsequent computation.

[35] A facsimile of this form is reproduced herewith.

CONTRACEPTION—COMPUTATIONS

PAT'S. AGE AT 1ST PREG. = L = S = M = T = O = No.
TOTAL PREG. AGE PERIODS IN PATIENT'S LIFE

	10–14	15–19	20–24	25–29	30–34	35–39	40+	TOTAL
1. L×·75								
2. S×·75								
3. M×·25								
4. T×·375								
5. O×·375								
6. (Tot. Preg.—1)×·04 = P_2								
7. Sum Items 1 to 6 Incl.								
8. Duration of Marriage								
9. (Item 8)−(Item 7)								
10. (Item 9)×13								
11. (Item 10)+(Total Preg.)								
12. 100 (Total Preg.)÷(Item 11)								
13. 100 L÷(Item 11)								
14. PREG. RATE—CODE NOS.								
15. BIRTH RATE—CODE NOS.								

In twin pregs. count pair of twins as ONE in computing Items 1 to 12 incl., but in computing Item 13 count a pair of twins as 2L.
CODE XX if patient is not exposed in age period.
CODE OO if patient is exposed but not pregnant in age period.
If either Rate (Item 12 or 13) is <1 but >0 CODE X and first decimal figure.

[36] This was carried out by the following members of the laboratory staff: Dr. John R. Miner, Mrs. Augusta K. Hibbitts, Dr. Antonio Ciocco, Miss Sophia A. Gould, Dr. T. I. Edwards, Dr. Marjorie E. Gooch, Mrs. Ruth Pearl Jencks, and Dr. Ralph G. Schott, each devoting a certain amount of time each day to this unexciting routine task. I cannot speak in terms of too high praise and gratitude for the loyal and willing spirit in which these workers interrupted their own investigations to help in the general laboratory enterprise.

[37] A West Indian mulatto, whose white ancestry was Jewish, and in that faith she alleges she worships.

[38] Robishaw (36), for example, puts the percentage as 'at least 85'.

[39] Seventy-eight per cent. of Robishaw's 4,000 cases had been pregnant two or more times at admittance. The experience of the Bureau for Contraceptive Advice in Baltimore showed 92 per cent. of this status.

[40] The difficulty arises from the fact that the time of observation and record for each woman in the material was the date of delivery of

her latest product of conception. In the terminal class, 40 and over years, this means that the period of opportunity of becoming pregnant is curtailed, and the pregnancy rates per 100 computed ovulations are consequently artificially raised. In principle the same consideration applies to women having their latest pregnancy at the time of observation in any other quinquennial age period. But statistically the effect upon the biometric constants is not serious except in the 40 and over age class. This is because in the earlier classes there are enough women in the material who go on into later age classes to reduce the error (arising from the curtailed opportunity of those who stop in a particular class) to practical insignificance. But very few women in the material had more than one pregnancy in the 40 and over age period, and that one is for the most part early in the period, so there is produced a maximum effect of the curtation of opportunity.

41 The total number of women included in Fig. 37 is less than the grand total of 19,613 white women living in wedlock, married once only, and free of gynecologic disease, by reason of the omission throughout the discussion of religious class differential fertility of the 346 women in the statistically unimportant class 'Christian'. These were women who stated that they had no affiliation of any sort, sympathetic or otherwise, with any organized religious body or sect, but wished it to be understood that they were neither Jews nor atheists.

42 As a matter of fact, realistically considered, about the only thing that prevents any one who wants to in the United States to-day from getting information about contraceptive methods of some sort or other is his or her own stupidity. The legal and other restrictions on the dissemination of such information are much more formal than compulsory. Any population that devised so many and so effective schemes for getting alcohol to drink during the era of national prohibition can reasonably be counted on to get contraceptive information and appliances if, as, and when they want them.

43 In connexion with this discussion, see Pearl and Gould (36) and Pearl (36*b*, and *c*, 37*a*, *c*, and *d*).

44 When available library facilities do not permit going first-hand to original statistical sources, five well-established and generally reliable secondary sources have been used in making revisions of world population figures. These are:

(*a*) *Aperçu de la démographie des divers pays du monde, publié par l'Office Permanent de l'Institut International de Statistique*. La Haye. [Last volume issued in 1932. A new one is expected to appear shortly.]

(*b*) *Statistical Year-Book of the League of Nations*. Geneva. [This extremely useful volume is compiled, so far as concerns population data, on a plan in some respects similar to the one independently employed in the writer's laboratory.]

(*c*) *The Statesman's Year-Book*. [An extremely useful compilation.

but of perhaps not quite the high standard of accuracy of the two preceding sources.]

(*d*) *Epidemiological Report of the Health Section of the Secretariat of the League of Nations*. Geneva. [A quarterly that usually carries in each number a page of the latest available population data for selected countries.]

(*e*) *Revue de l'Institut International de Statistique*. La Haye.

The working tables carry the following items of information in order:

1. Name of country or subdivision.
2. Area in square miles.
3. Total population at last recorded census or estimate.
4. Year to which population figure (Item 3) applies.
5. Density of population (persons per square mile).
6. Population at census or estimate preceding last recorded.
7. Year to which population recorded as Item 6 applies.
8. Recent annual growth rate per cent. (derived from the difference between Items 3 and 6 taken as percentages of Item 6, and reduced to an annual rate on the basis of the difference between Items 4 and 7).

[45] The omitted countries (in the sense of subdivisions of the earth's area) for which only pure estimates of population have been available up to the present time, include:

Abyssinia .	7,600,000	Sokotra Is. .	12,000	Sarawak (British Borneo) .	600,000
Afghanistan	12,000,000	Kuria Muria Is. . .	2,200	Southwest Africa .	360,000
Arabia .	10,000,000	Bahrain Is. .	120,000	New Guinea	756,000
Bhutan .	300,000	Transjordan	300,000	New Hebrides	52,000
Iran .	15,000,000	British Somaliland	344,700		
Liberia .	1,500,000	Anglo-Egyptian Sudan .	5,768,000	Rio de Oro, Ifni, Spanish Guinea .	181,000
Nepal .	5,600,000	Spanish Morocco and Tangier	855,000	Chinese Republic	457,835,000
				Total .	519,185,900

The figure used for China was furnished us by the Chinese Government authorities (*in litt.*), and checked and elucidated by the Chinese Embassy in Washington. For these courtesies we are very grateful.

The estimation of China's population has always been a sort of thorn in the flesh of statisticians. Many eminent non-Chinese statisticians have attempted to crack the nut, with much display of pedantry. In this laboratory we have finally reached the working position that (*a*) the Chinese should, and in all likelihood do, know the probable population of their own country as well as or better than any foreigner; and (*b*) that in any case the Chinese should, in common statistical decency, be accorded the same right that is unquestioningly accorded to every other nation in the world, namely the right to state officially what they think the population of their country is. Our position may be unwise, but after struggling with the matter for some years we have made up our minds to grasp firmly this horn of the dilemma, and hang to it until something like a real count shakes us loose. The logic of the situation, at least, seems clearly on our side.

[46] It may be useful to set down here, in condensed form, the equation from which may be computed the time required for a population to double its size at a given constant growth rate per annum. This is

$$T_{2P} = \frac{\log 2}{\log(1+r)} = \frac{0{\cdot}3010300}{\log(1+r)} \qquad \text{(i)}$$

where T_{2P} = time in years required for population to double itself,
r = constant rate of growth per annum expressed per unit (not per hundred units).

In the present case (i) becomes

$$T_{2P} = \frac{0{\cdot}3010300}{\log(1+0{\cdot}01)} = \frac{0{\cdot}3010300}{0{\cdot}0043214} = 69{\cdot}7 \text{ years.}$$

Equation (i) is a simple derivation from the law of compound interest

$$s = p(1+r)^t, \qquad \text{(ii)}$$

whence

$$t = \frac{\log s - \log p}{\log(1+r)} \qquad \text{(iii)}$$

In the special case of time required to double the principal, $s = 2p$, and equation (iii) reduces to equation (i).

[47] Regarding medieval and earlier populations in Europe Russell (37) says (p. 504):

'From this evidence, Beloch (86, 99, 00) made an estimate of the general trend of medieval population. At the height of the greatest ancient population, that is about 200 A.D., the number probably reached a peak of about 40 millions in Europe. Then it sank, reaching its lowest about 700 A.D. Beloch did not estimate this number. By 1000 A.D. the increase in population was rapid, probably to 35 millions about 1000–1050, and to 59 millions just before the Black Death of 1348. This plague set the population back by at least 10 millions. Although recovery was apparently rapid it was not complete until in the fifteenth century.'

[48] As can be seen by comparing the densities of population in the

last column of Part B of Table 51 with those of the same countries in Table 50.

[49] The recent valuable paper by Friedenwald (37) on the growth of the population of Palestine should be consulted.

[50] These figures are for the Empire of Japan and include Korea, Formosa, and Karafuto, in addition to Japan proper.

[51] This discussion of the biological implications of unemployment follows an earlier paper of the writer (Pearl, 36*c*).

[52] The writer has elsewhere (37*a* and 37*e*) developed the biological aspects of this matter more fully than can be done here.

APPENDIX I

TABLES

THE purpose of this Appendix is to assemble together, and by so doing free the text of their burden, the longer original statistical tables upon which the discussions in the body of the book are based. In general no tables are presented here that have already been published elsewhere. While it might in some cases indubitably conduce to the reader's convenience to have reprinted here for reference some of the tables the writer has published in earlier fertility studies, the present costs of printing prohibit this.

TABLE I

Changes in median pregnancy and live-birth rates (per 100 computed ovulations) with advancing age. White multiparae, married once only, living in wedlock, and free of gynecologic disease, married in age group 15–19 and thereafter continuously exposed to risk of conception through age period when observed. None made any contraceptive effort at any time

A. MEDIAN RATES

Group	N	*Median rates in indicated age periods*				
		15–19	*20–24*	*25–29*	*30–34*	*35–39*
40 years old and over at observation:						
Pregnancy rates	63	2·25 ± 0·59	6·83 ± 0·37	4·78 ± 0·37	4·43 ± 0·44	4·17 ± 0·56
Live-birth rates	63	2·08 ± 0·57	4·90 ± 0·37	4·56 ± 0·30	4·31 ± 0·37	4·03 ± 0·46
35–39 years old at observation:						
Pregnancy rates	169	2·54 ± 0·41	4·88 ± 0·29	4·49 ± 0·29	4·21 ± 0·27	..
Live-birth rates	169	2·27 ± 0·41	4·74 ± 0·25	4·38 ± 0·25	4·03 ± 0·26	..
30–34 years old at observation:						
Pregnancy rates	242	2·75 ± 0·40	4·68 ± 0·23	4·42 ± 0·21	..	..
Live-birth rates	242	2·33 ± 0·39	4·54 ± 0·23	4·20 ± 0·21	..	..
25–29 years old at observation:						
Pregnancy rates	482	3·12 ± 0·40	4·61 ± 0·17	..	..	..
Live-birth rates	482	2·50 ± 0·36	4·42 ± 0·16	..	..	..
Weighted average, all ages at observation:						
Pregnancy rates	956	2·87	4·82	4·49	4·27	4·17
Live-birth rates	956	2·39	4·54	4·31	4·09	4·03

TABLE I—*continued*

B. Standard Deviations of Rates

Group	N	Standard deviations in rates at indicated ages				
		15–19	20–24	25–29	30–34	35–39
40 years old and over at observation:						
Pregnancy rates	63	5·56 ± 0·33	3·47 ± 0·21	3·47 ± 0·21	4·13 ± 0·25	5·28 ± 0·32
Live-birth rates	63	5·39 ± 0·32	3·48 ± 0·21	2·79 ± 0·16	3·45 ± 0·21	4·30 ± 0·26
35–39 years old at observation:						
Pregnancy rates	169	6·33 ± 0·23	4·39 ± 0·16	4·51 ± 0·17	4·19 ± 0·15	..
Live-birth rates	169	6·24 ± 0·23	3·77 ± 0·14	3·88 ± 0·14	3·94 ± 0·14	..
30–34 years old at observation:						
Pregnancy rates	242	7·38 ± 0·23	4·32 ± 0·13	3·86 ± 0·12	..	..
Live-birth rates	242	7·25 ± 0·22	4·18 ± 0·13	3·80 ± 0·12	..	..
25–29 years old at observation:						
Pregnancy rates	482	10·31 ± 0·22	4·33 ± 0·09	..	..	..
Live-birth rates	482	9·46 ± 0·21	4·13 ± 0·09	..	..	..
Weighted average, all ages at observation:						
Pregnancy rates	956	8·55	4·28	4·04	4·17	5·28
Live-birth rates	956	8·06	4·04	3·69	3·81	4·30

C. Mean and Median Ages at Marriage and at Observation of the Four Cohorts of Women dealt with above

Cohort	Age at marriage		Age at observation	
	Mean	Median	Mean	Median
First cohort. Observed at 40 and over	18·21 ± 0·10	18·43 ± 0·13	42·48 ± 0·14	41·98 ± 0·17
Second cohort. Observed at 35–39	17·92 ± 0·07	18·04 ± 0·08	37·67 ± 0·06	37·68 ± 0·08
Third cohort. Observed at 30–34	18·15 ± 0·05	18·37 ± 0·07	32·75 ± 0·05	32·70 ± 0·07
Fourth cohort. Observed at 25–29	18·15 ± 0·04	18·39 ± 0·05	27·74 ± 0·04	27·70 ± 0·05

TABLE II

Biometric constants for age at menarche. Computed in Department of Biology, School of Hygiene, Johns Hopkins University, from frequency distributions given in indicated sources. All ages stated in original distributions in single years (as 13, for example) assumed to be age at last birthday, unless specifically noted to be otherwise. (See note 10)

Group	*N*	*Mean (years)*	*Median (years)*	*Standard deviation (years)*	*Coefficient of variation (per cent.)*	*Source*
India (Native East Indians)	1,752	13·17 ± 0·02	13·02 ± 0·02	1·17 ± 0·01	8·88 ± 0·10	Joubert* (95)
Spanish (Valencia)	300	13·33 ± 0·04	13·23 ± 0·05	1·12 ± 0·03	8·42 ± 0·23	Campá* (82)
American (New Orleans daughters)	196	13·47 ± 0·07	13·37 ± 0·09	1·42 ± 0·05	10·57 ± 0·36	Gould and Gould* (32)
American (Newcomb College daughters)	363	13·48 ± 0·05	13·43 ± 0·06	1·41 ± 0·04	10·48 ± 0·27	Gould and Gould* (32)
Jewish (Holland)	165	13·55 ± 0·08	13·40 ± 0·10	1·53 ± 0·06	11·32 ± 0·43	Bolk (26)
Chinese (Shanghai and Wuchung)	309	13·56 ± 0·06	13·60 ± 0·07	1·35 ± 0·04	9·99 ± 0·27	Westbrook* *et al.* (34)
American (Louisiana daughters)	451	13·60 ± 0·04	13·55 ± 0·05	1·32 ± 0·03	9·70 ± 0·22	Gould and Gould* (32)
American (all daughters)	680	13·61 ± 0·03	13·57 ± 0·04	1·31 ± 0·02	9·65 ± 0·18	Gould and Gould* (32)
American (Southern daughters)	577	13·62 ± 0·04	13·57 ± 0·05	1·30 ± 0·03	9·55 ± 0·19	Gould and Gould* (32)
Egyptian (Cairo)	81	13·71 ± 0·05	13·65 ± 0·06	0·69 ± 0·04	5·04 ± 0·27	Elgood* (09)
French (Marseilles and Bouches du Rhône. Well-to-do classes)	52	13·73 ± 0·18	13·73 ± 0·23	1·95 ± 0·13	14·17 ± 0·96	Queirel and Rouvier* (79)
American (Total women in study)	1,037	13·74 ± 0·03	13·68 ± 0·04	1·39 ± 0·02	10·14 ± 0·15	Gould and Gould* (32)
American (Louisiana State University daughters)	317	13·76 ± 0·04	13·72 ± 0·06	1·71 ± 0·03	8·51 ± 0·23	Gould and Gould* (32)
India (Eurasians)	797	13·79 ± 0·03	13·66 ± 0·04	1·35 ± 0·02	9·82 ± 0·17	Joubert* (95)

* The distributions having an asterisk over the author's name are those in which the limits of the age intervals in the original distribution were either stated precisely, or otherwise made evident.

Group	N	Mean (years)	Median (years)	Standard deviation (years)	Coefficient of variation (per cent.)	Source
Dutch (Holland. Nordic type blondes)	1,130	13·86 ± 0·03	13·74 ± 0·04	1·63 ± 0·02	11·79 ± 0·17	Bolk (26)
India (East Indians)	134	13·86 ± 0·08	13·88 ± 0·10	1·34 ± 0·06	9·69 ± 0·40	Leicester* (10)
American (Newcomb College mothers)	209	13·97 ± 0·08	13·93 ± 0·10	1·63 ± 0·05	11·64 ± 0·39	Gould and Gould* (32)
Russian (Kharkow. High school education)	330	13·98 ± 0·06	13·83 ± 0·08	1·71 ± 0·04	12·24 ± 0·33	Gurewitsch and Grosser* (29)
American (All mothers)	357	13·99 ± 0·05	13·94 ± 0·07	1·50 ± 0·04	10·74 ± 0·27	Gould and Gould* (32)
American (Louisiana State University mothers)	148	13·99 ± 0·08	13·96 ± 0·09	1·36 ± 0·05	9·70 ± 0·38	Gould and Gould* (32)
Korean	424	14·01 ± 0·04	14·04 ± 0·04	1·15 ± 0·03	8·24 ± 0·19	Lee* (30)
Brazilian (All races. Northern climatic zone)	425	14·01 ± 0·05	13·82 ± 0·07	1·65 ± 0·04	11·80 ± 0·28	Ribeiro de Castro (12)
American (Southern mothers)	295	14·01 ± 0·06	13·97 ± 0·07	1·43 ± 0·04	10·21 ± 0·29	Gould and Gould* (32)
American (Louisiana mothers)	224	14·05 ± 0·07	14·06 ± 0·08	1·47 ± 0·05	10·47 ± 0·34	Gould and Gould* (32)
Dutch (Holland. Blondes and brunettes)	1,800	14·06 ± 0·03	13·93 ± 0·03	1·67 ± 0·02	11·85 ± 0·14	Bolk (26)
Chinese (Shanghai, Soochow, Nanking)	2,924	14·07 ± 0·02	13·93 ± 0·03	1·73 ± 0·02	12·26 ± 0·11	Yang and Gear* (34)
American (New Orleans mothers)	113	14·08 ± 0·10	14·08 ± 0·12	1·51 ± 0·07	10·69 ± 0·49	Gould and Gould* (32)
Brazilian (Rio Janeiro. Negroes)	537	14·12 ± 0·05	13·94 ± 0·06	1·66 ± 0·03	11·76 ± 0·25	Araujo (29)
Jewish (India)	73	14·13 ± 0·08	14·10 ± 0·10	1·05 ± 0·06	7·45 ± 0·42	Joubert* (95)
India (Eurasians)	253	14·15 ± 0·07	14·07 ± 0·08	1·59 ± 0·05	11·21 ± 0·34	Leicester* (10)
French (Paris. Old nobility, financier and merchant classes)	53	14·16 ± 0·18	14·21 ± 0·22	1·90 ± 0·12	13·42 ± 0·90	Brierre de Boismont (42)
Brazilian (Rio Janeiro. Mulattos)	764	14·16 ± 0·04	14·02 ± 0·05	1·58 ± 0·03	11·15 ± 0·19	Araujo (29)

American (Bikur Cholem Hospital, Brooklyn. Born in towns 5,000–25,000)	105	14·17±0·09	13·18±0·11	1·37±0·06	9·69±0·46	Lintz and Markow (23)
Brazilian (Negro women)	2,023	14·18±0·03	13·97±0·03	1·72±0·02	12·14±0·13	Ribeiro de Castro (12)
Brazilian (All women together)	6,657	14·20±0·01	13·99±0·02	1·68±0·01	11·86±0·07	Ribeiro de Castro (12)
Brazilian (All races. Middle climatic zone)	5,249	14·20±0·02	14·00±0·02	1·67±0·01	11·78±0·08	Ribeiro de Castro (12)
Brazilian (Rio Janeiro, native-born white)	1,406	14·21±0·03	14·03±0·04	1·64±0·02	11·57±0·15	Araujo (29)
Brazilian (White women)	1,637	14·21±0·03	13·99±0·03	1·65±0·02	11·63±0·14	Ribeiro de Castro (12)
Brazilian ('Mestiça')	2,063	14·23±0·02	14·05±0·03	1·66±0·02	11·67±0·12	Ribeiro de Castro (12)
Japanese (Osaka Medical School)	373	14·25±0·04	14·24±0·05	1·23±0·03	8·64±0·21	Kosakaé *et al.* (33)
India (European women, born and bred in India, and resident there)	103	14·25±0·09	14·33±0·11	1·36±0·06	9·55±0·45	Leicester* (10)
French (Marseilles and Bouches du Rhône. Peasants living in country)	41	14·26±0·17	13·95±0·21	1·58±0·12	11·07±0·83	Queirel and Rouvier* (79)
Brazilian (All races. Southern climatic zone)	521	14·27±0·05	14·06±0·07	1·82±0·04	12·79±0·27	Ribeiro de Castro (12)
India (European-born women in India)	179	14·29±0·09	14·20±0·11	1·72±0·06	12·05±0·44	Joubert* (95)
Brazilian (Rio Janeiro. All women in study)	3,309	14·30±0·02	14·14±0·02	1·68±0·01	11·77±0·10	Araujo (29)
India (All European women resident in India)	221	14·32±0·07	14·36±0·08	1·47±0·05	10·26±0·33	Leicester* (10)
Brazilian (São Paulo, born in Brazil)	5,043	14·39±0·02	14·32±0·02	1·65±0·01	11·47±0·08	Mattos (34)
Dutch (Holland. Alpine type brunettes)	670	14·39±0·04	14·27±0·05	1·67±0·03	11·58±0·22	Bolk (26)
India (European women, *not* born and bred in India, but resident there)	118	14·39±0·10	14·39±0·12	1·55±0·07	10·81±0·48	Leicester* (10)

Group	N	Mean (years)	Median (years)	Standard deviation (years)	Coefficient of variation (per cent.)	Source
French (Marseilles and Bouches du Rhône. Total sample) . .	257	14·41 ± 0·09	14·12 ± 0·12	2·21 ± 0·07	15·35 ± 0·47	Queirel and Rouvier* (79)
American (Bikur Cholem Hospital, Brooklyn. Born on farms, hamlets, and towns up to 4,000) .	387	14·42 ± 0·04	13·13 ± 0·05	1·15 ± 0·03	7·99 ± 0·20	Lintz and Markow (23)
India (European women born in India and always resident there) .	387	14·45 ± 0·05	14·36 ± 0·06	1·49 ± 0·04	10·29 ± 0·25	Joubert* (95)
German (Berlin primiparae under 20)	1,426	14·46 ± 0·02	14·46 ± 0·03	1·31 ± 0·02	9·06 ± 0·12	Mikulicz-Radecki and Kausch (35)
American (Bikur Cholem Hospital, Brooklyn. Born in cities 50,000 or over)	308	14·52 ± 0·05	13·23 ± 0·06	1·35 ± 0·04	9·28 ± 0·25	Lintz and Markow (23)
American (Urban, regular type) .	2,280	14·53 ± 0·02	14·38 ± 0·03	1·65 ± 0·02	11·33 ± 0·11	Sanes (16)
Brazilian (São Paulo, totals) . .	7,210	14·55 ± 0·01	14·42 ± 0·02	1·75 ± 0·01	12·02 ± 0·07	Mattos (34)
American (Urban, all cases) . .	2,864	14·58 ± 0·02	14·40 ± 0·03	1·70 ± 0·02	11·69 ± 0·11	Sanes (16)
French (Marseilles and Bouches du Rhône. Labouring classes) .	205	14·59 ± 0·11	14·28 ± 0·13	2·24 ± 0·07	15·38 ± 0·52	Queirel and Rouvier* (79)
Chinese (Canton. Urban) . .	869	14·59 ± 0·05	14·73 ± 0·06	2·05 ± 0·03	14·08 ± 0·23	Chau and Wright (25)
Brazilian (São Paulo, born in Spain)	406	14·61 ± 0·06	14·47 ± 0·08	1·81 ± 0·04	12·42 ± 0·30	Mattos (34)
Jewish (South Russia. Urban) .	1,273	14·65 ± 0·03	14·52 ± 0·03	1·44 ± 0·02	9·86 ± 0·13	Weissenberg (09)
Brazilian (São Paulo, born in Syria)	32	14·66 ± 0·16	14·63 ± 0·20	1·32 ± 0·11	8·99 ± 0·76	Mattos (34)
Austrian (Vienna. Advanced education. Brown hair)	573	14·66 ± 0·04	14·66 ± 0·04	1·26 ± 0·03	8·61 ± 0·17	Rosenfeld (29)

French (Montpellier, all classes)	600	14·67 ± 0·06	14·44 ± 0·08	2·20 ± 0·04	14·98 ± 0·30	Courty (81)
Brazilian (São Paulo, born in Italy)	669	14·70 ± 0·05	14·51 ± 0·06	1·82 ± 0·03	12·38 ± 0·23	Mattos (34)
French (Montpellier, insane women)	43	14·71 ± 0·23	14·50 ± 0·29	2·28 ± 0·17	15·50 ± 1·15	Courty (81)
Brazilian (São Paulo, born in Argentina)	22	14·73 ± 0·32	15·00 ± 0·40	2·22 ± 0·23	15·05 ± 1·56	Mattos (34)
Japanese (Hondo district)	1,526	14·73 ± 0·02	14·71 ± 0·03	1·36 ± 0·02	9·25 ± 0·11	Yamasaki* (09)
American (Urban, irregular type)	584	14·76 ± 0·05	14·53 ± 0·07	1·90 ± 0·04	12·88 ± 0·26	Sanes (16)
Austrian (Vienna. Advanced education)	1,145	14·77 ± 0·02	14·78 ± 0·03	1·25 ± 0·02	8·44 ± 0·12	Rosenfeld (29)
Japanese (Shikoku district)	250	14·81 ± 0·06	14·73 ± 0·08	1·46 ± 0·04	9·94 ± 0·30	Yamasaki* (09)
Russian (St. Petersburg. Educated women)	50	14·82 ± 0·16	14·63 ± 0·19	1·63 ± 0·11	10·99 ± 0·75	Tarnowsky (89)
Brazilian (Rio Janeiro, foreign-born white)	602	14·84 ± 0·05	14·67 ± 0·06	1·81 ± 0·04	12·19 ± 0·24	Araujo (29)
Austrian (Vienna. Advanced education. Blonde hair)	516	14·86 ± 0·04	14·89 ± 0·04	1·20 ± 0·03	8·09 ± 0·17	Rosenfeld (29)
French (Paris. Middle class)	135	14·88 ± 0·14	14·73 ± 0·18	2·45 ± 0·10	16·49 ± 0·70	Brierre de Boisment (42)
Japanese (All classes, all districts)	4,861	14·91 ± 0·01	14·87 ± 0·02	1·41 ± 0·01	9·46 ± 0·07	Yamasaki* (09)
Austrian (Vienna. Advanced education. Black hair)	45	14·92 ± 0·13	14·89 ± 0·16	1·26 ± 0·09	8·43 ± 0·60	Rosenfeld (29)
Spanish (Catalonia)	41	14·96 ± 0·19	14·56 ± 0·23	1·77 ± 0·13	11·84 ± 0·89	Haro Garcia (32)
Italian (Rome)	31,659	14·97 ± 0·01	14·72 ± 0·01	1·99 ± 0·01	13·30 ± 0·04	Doria (08)
French (Paris. All classes)	359	14·98 ± 0·09	14·85 ± 0·11	2·56 ± 0·06	17·08 ± 0·44	Brierre de Boisment (42)
Japanese (Kyusyu district)	3,085	15·00 ± 0·02	14·97 ± 0·02	1·42 ± 0·01	9·47 ± 0·08	Yamasaki* (09)
Chinese (Canton. Total group)	2,291	15·02 ± 0·03	15·15 ± 0·04	2·16 ± 0·02	14·41 ± 0·15	Chau and Wright (25)
Scots (Edinburgh. Hospital records)	10,119	15.04 ± 0·01	14·84 ± 0·01	1·72 ± 0·01	11·41 ± 0·05	Kennedy* (33)
Brazilian (São Paulo, born in Portugal)	511	15·05 ± 0·06	14·87 ± 0·07	1·97 ± 0·04	13·06 ± 0·28	Mattos (34)
English (London)	1,551	15·06 ± 0·04	14·89 ± 0·05	2·16 ± 0·03	14·36 ± 0·18	Tilt* (62)

Group	N	Mean (years)	Median (years)	Standard deviation (years)	Coefficient of variation (per cent.)	Source
French (Born and resident in Paris)	200	15·08±0·11	14·97±0·13	2·21±0·07	14·66±0·51	Raciborski (44)
English (London)	1,500	15·10±0·04	15·01±0·05	2·13±0·03	14·11±0·18	Guy (45)
French (Born out of, but resident in Paris)	437	15·10±0·09	14·82±0·11	2·71±0·06	17·91±0·42	Raciborski (44)
Russian (St. Petersburg prostitutes)	150	15·11±0·10	15·21±0·12	1·81±0·07	11·95±0·47	Tarnowsky (89)
Spanish (Urban)	467	15·12±0·07	15·01±0·08	2·08±0·05	13·78±0·31	Haro Garcia (33)
French (Poor. Lymphatic-sanguine temperament)	166	15·14±0·13	15·13±0·17	2·54±0·09	16·76±0·64	Brierre de Boismont (42)
French (Poor. Sanguine temperament	128	15·16±0·18	14·70±0·22	3·00±0·13†	19·78±0·87	Brierre de Boismont (42)
Spanish (Valencia)	116	15·16±0·11	14·90±0·14	1·80±0·08	11·88±0·53	Haro Garcia (32)
Brazilian (São Paulo, born in Germany)	155	15·17±0·09	15·10±0·12	1·74±0·07	11·47±0·45	Mattos (34)
French (Poor. Lymphatic-nervous temperament)	76	15·18±0·19	15·00±0·24	2·46±0·13	16·20±0·91	Brierre de Boismont (42)
Ainu women (Japan)	80	15·25±0·08	15·04±0·10	1·10±0·06	7·20±0·39	Yamasaki* (09)
French (All women in study)	1,200	15·26±0·05	15·17±0·06	2·59±0·04	16·96±0·24	Brierre de Boismont (42)
Spanish (Andalucía)	754	15·27±0·05	15·25±0·06	2·04±0·04	13·34±0·24	Haro Garcia (32)
French (Urban, excluding Paris)	205	15·27±0·13	15·09±0·16	2·74±0·09	17·94±0·62	Brierre de Boismont (42)
Chinese (Canton, rural)	1,422	15·28±0·04	15·35±0·05	2·19±0·03	14·31±0·19	Chau and Wright (25)
Brazilian (São Paulo, born in Russia)	81	15·31±0·16	15·23±0·20	2·11±0·11	13·76±0·74	Mattos (34)
French (Paris. Poorer classes)	171	15.32±0·14	15·28±0·18	2·75±0·10	17·94±0·67	Brierre de Boismont (42)
Dutch (Holland. Upper class blondes)	92	15·33±0·13	15·07±0·16	1·81±0·09	11·81±0·60	Bolk (26)
French (Rural)	276	15·34±0·10	15·26±0·13	2·53±0·07	16·49±0·49	Brierre de Boismont (42)
Italian	261	15·37±0·08	14·73±0·10	1·84±0·05	11·99±0·36	Marro (01)

Brazilian (São Paulo, born in Hungary)	74	15·39±0·14	15·50±0·17	1·76±0·10	11·43±0·64	Mattos (34)
Russian (South Russia. Urban and rural mixed)	768	15·39±0·04	15·29±0·05	1·61±0·03	10·45±0·18	Weissenberg (09)
Usbeg (Samarkand)	99	15·44±0·10	15·40±0·12	1·42±0·07	9·19±0·44	Gagajewa-Wischnewskaja (33)
Spanish (Rural)	558	15·45±0·07	15·35±0·08	2·28±0·05	14·74±0·30	Haro Garcia (33)
Tajik (Samarkand)	100	15·49±0·09	15·42±0·12	1·40±0·07	9·05±0·44	Gagajewa-Wischnewskaja (33)
Dutch (Holland. Upper class total)	140	15·51±0·11	15·33±0·14	1·91±0·08	12·28±0·51	Bolk (26)
Italian (Rome. Flat pelvis)	2,143	15·57±0·03	15·41±0·04	2·18±0·02	13·97±0·15	Doria (08)
Finnish (All classes)	3,500	15·57±0·02	15·45±0·03	1·85±0·01	11·87±0·10	Engström (94)
Spanish (Navarra)	60	15·57±0·17	15·33±0·21	1·97±0·12	12·65±0·79	Haro Garcia (32)
French (Villages near Paris)	50	15·58±0·23	15·67±0·29	2·44±0·16	15·66±1·08	Raciborski (44)
Czechoslovakian (Prague Obstetric Clinic. Czech women)	1,728	15·62±0·03	15·35±0·04	1·88±0·02	12·03±0·14	Baroch (27)
Dutch (Holland. Women born before 1880)	232	15·65±0·11	15·49±0·14	2·47±0·08	15·80±0·51	Bolk (26)
Spanish (Extremadura)	194	15·65±0·10	15·51±0·12	2·01±0·07	12·82±0·45	Haro Garcia (32)
Spanish (Murcia)	226	15·65±0·08	15·55±0·11	1·89±0·06	12·08±0·39	Haro Garcia (32)
Brazilian (São Paulo, born in Poland)	43	15·69±0·22	15·31±0·28	2·17±0·16	13·85±1·03	Mattos (34)
English (Manchester)	450	15·70±0·06	15·60±0·07	1·87±0·04	11·92±0·27	McLaury (87)
Swedish (Pure Swedish blood)	5,000	15·72±0·02	15·54±0·02	1·79±0·01	11·36±0·08	Essen-Möller (06)
Russian (Rural)	100	15·73±0·12	15·81±0·14	1·71±0·08	10·85±0·52	Weissenberg (09)
Czechoslovakian (Prague)	181	15·75±0·11	15·38±0·14	2·27±0·08	14·40±0·52	Baroch (27)
Czechoslovakian (Prague Obstetric Clinic. German women in Czechoslovakia)	67	15·75±0·14	15·58±0·18	1·76±0·10	11·16±0·66	Baroch (27)

† This figure was actually 2·9977. In rounding off to two places of decimals it became 3·00, but in making the inter-group frequency distribution of text Table 6, it naturally goes into the class 2·75–2·99 years.

Group	*N*	*Mean (years)*	*Median (years)*	*Standard deviation (years)*	*Coefficient of variation (per cent.)*	*Source*
German (Urban, private)	2,082	15·75 ± 0·03	15·65 ± 0·04	2·02 ± 0·02	12·83 ± 0·14	Heyn (20)
Italian (Rome. Generally contracted pelvis)	767	15·78 ± 0·06	15·64 ± 0·07	2·27 ± 0·04	14·41 ± 0·25	Doria (08)
Spanish (C. Nueva)	3,922	15·78 ± 0·02	15·61 ± 0·03	2·08 ± 0·02	13·16 ± 0·10	Haro Garcia (32)
Brazilian (São Paulo, born in Lithuania)	68	15·85 ± 0·16	15·75 ± 0·21	2·01 ± 0·12	12·71 ± 0·75	Mattos (34)
Russian (St. Petersburg thieves)	97	15·87 ± 0·13	16·02 ± 0·16	1·92 ± 0·09	12·08 ± 0·59	Tarnowsky (89)
Dutch (Holland. Upper class brunettes)	48	15·88 ± 0·20	15·78 ± 0·25	2·03 ± 0·14	12·77 ± 0·89	Bolk (26)
Spanish (Asturias)	1,970	15·89 ± 0·03	15·91 ± 0·04	1·89 ± 0·02	11·86 ± 0·13	Macías de Torres (32)
Spanish (All Spain. Total distribution)	7,950	15·92 ± 0·02	15·76 ± 0·02	2·16 ± 0·01	13·56 ± 0·07	Haro Garcia (32)
German (Rural, private)	497	15·97 ± 0·06	15·82 ± 0·08	2·04 ± 0·04	12·75 ± 0·28	Heyn (20)
French (Poor. Lymphatic temperament)	110	15·98 ± 0·17	16·20 ± 0·22	2·69 ± 0·12	16·84 ± 0·79	Brierre de Boisment (42)
Finnish (Helsingfors and environs. Period 1910–15)	2,784	16·02 ± 0·02	15·94 ± 0·03	1·86 ± 0·02	11·63 ± 0·11	Malmio* (19)
Finnish (Helsingfors and environs. Period 1905–9)	1,844	16·09 ± 0·03	15·98 ± 0·04	1·83 ± 0·02	11·38 ± 0·13	Malmio* (19)
Czechoslovakian (Rural)	234	16·14 ± 0·09	15·97 ± 0·11	2·01 ± 0·06	12·48 ± 0·40	Baroch (29)
Finnish (Helsingfors and environs. Period 1900–4)	1,648	16·17 ± 0·03	16·07 ± 0·04	1·81 ± 0·02	11·16 ± 0·13	Malmio* (19)
Russian (Illiterate rural women)	90	16·19 ± 0·08	16·30 ± 0·10	1·10 ± 0·06	6·82 ± 0·34	Tarnowsky (89)
Spanish (Aragón)	50	16·20 ± 0·23	16·11 ± 0·29	2·39 ± 0·05	14·77 ± 1·02	Haro Garcia (32)
German (Berlin. Polyklinik)	10,500	16·20 ± 0·01	16·09 ± 0·02	2·13 ± 0·01	13·13 ± 0·06	Schaeffer (06)
Spanish (León)	397	16·21 ± 0·07	16·01 ± 0·09	2·17 ± 0·05	13·38 ± 0·33	Haro Garcia (32)

German (Urban, 'Kassen')	623	16·21 ± 0·05	16·18 ± 0·07	2·02 ± 0·04	12·43 ± 0·24	Heyn (20)
Finnish (Helsingfors and environs. Period 1895–9)	1,463	16·24 ± 0·03	16·10 ± 0·04	1·77 ± 0·02	10·92 ± 0·14	Malmio* (19)
Yugoslavian (Hospital at Brežice)	59	16·26 ± 0·14	16·10 ± 0·18	1·61 ± 0·10	9·93 ± 0·62	Škerlj (27)
Finnish (Helsingfors and environs. Period 1875–9)	70	16·29 ± 0·15	16·15 ± 0·19	1·89 ± 0·11	11·58 ± 0·67	Malmio* (19)
Spanish (C. Vieja)	1,533	16·35 ± 0·04	16·31 ± 0·05	2·19 ± 0·03	13·38 ± 0·17	Haro Garcia (32)
German (Berlin and environs)	6,550	16·36 ± 0·02	16·00 ± 0·02	2·28 ± 0·01	13·94 ± 0·08	Krieger (69)
German (München)	1,641	16·37 ± 0·04	16·23 ± 0·05	2·17 ± 0·03	13·28 ± 0·16	Schlichting (80)
German (Königsberg Gynecologic Clinic. Large women)	910	16·39 ± 0·05	16·10 ± 0·06	2·22 ± 0·04	13·53 ± 0·22	Lullies (86)
Riukiu women (Japan)	184	16·42 ± 0·10	16·33 ± 0·12	1·91 ± 0·07	11·63 ± 0·41	Yamasaki* (09)
German (Königsberg Gynecologic Clinic. Weak girls)	405	16·43 ± 0·08	16·23 ± 0·10	2·35 ± 0·06	14·27 ± 0·35	Lullies (86)
Germany (Königsberg Gynecologic Clinic. Blondes)	1,679	16·46 ± 0·04	16·23 ± 0·06	2·69 ± 0·03	16·32 ± 0·20	Lullies (86)
German (Königsberg Gynecologic Clinic. Small women)	323	16·49 ± 0·09	16·28 ± 0·11	2·34 ± 0·06	14·16 ± 0·38	Lullies (86)
Finnish (Helsingfors and environs. Period 1880–4)	274	16·50 ± 0·08	16·31 ± 0·10	1·91 ± 0·06	11·60 ± 0·34	Malmio* (19)
German (Königsberg Gynecologic Clinic. General series)	3,000	16·50 ± 0·03	16·25 ± 0·04	2·29 ± 0·02	13·87 ± 0·12	Lullies (86)
German (Königsberg Gynecologic Clinic. Strong women)	1,458	16·52 ± 0·04	16·27 ± 0·05	2·24 ± 0·03	13·55 ± 0·18	Lullies (86)
Finnish (Helsingfors and environs. Period 1885–9)	499	16·53 ± 0·05	16·45 ± 0·07	1·76 ± 0·04	10·62 ± 0·23	Malmio* (19)
Finnish (Helsingfors and environs. Period 1890–4)	834	16·54 ± 0·04	16·43 ± 0·05	1·85 ± 0·03	11·17 ± 0·19	Malmio* (19)
German (Total cases)	8,881	16·57 ± 0·02	16·46 ± 0·02	2·13 ± 0·01	12·87 ± 0·07	Schlichting (80)

Group	N	Mean (years)	Median (years)	Standard deviation (years)	Coefficient of variation (per cent.)	Source
German (Königsberg Gynecologic Clinic. Medium-strong women)	371	16·59 ± 0·09	16·41 ± 0·10	2·33 ± 0·06	14·04 ± 0·35	Lullies (86)
German (Königsberg Gynecologic Clinic. Medium-sized women)	974	16·59 ± 0·05	16·40 ± 0·06	2·33 ± 0·04	14·03 ± 0·22	Lullies (86)
Finnish and Swedish (Helsingfors Obstetric Clinic)	3,500	16·61 ± 0·02	16·43 ± 0·03	1·83 ± 0·01	11·02 ± 0·09	Heinricius (83)
German (Königsberg Gynecologic Clinic. Brunettes)	598	16·64 ± 0·06	16·42 ± 0·08	2·32 ± 0·05	13·98 ± 0·28	Lullies (86)
Chinese (Living in Formosa)	135	16·69 ± 0·11	16·41 ± 0·14	1·86 ± 0·08	11·15 ± 0·46	Yamasaki* (09)
Spanish (Galicia)	327	16·81 ± 0·10	16·53 ± 0·12	2·58 ± 0·07	15·37 ± 0·42	Haro Garcia (32)
German (Rural, 'Kassen')	68	68·84 ± 0·16	16·75 ± 0·20	1·97 ± 0·11	11·69 ± 0·69	Heyn (20)
Spanish (Asturia)	250	16·98 ± 0·09	16·95 ± 0·12	2·21 ± 0·07	13·00 ± 0·40	Haro Garcia (32)

TABLE III

Biometric constants for age at menopause. Computed in Department of Biology, School of Hygiene, Johns Hopkins University, from frequency distributions given in indicated sources

Group	N	Mean (years)	Median (years)	Standard deviation (years)	Coefficient of variation (per cent.)	Source
French	181	43.96 ± 0.35	44.65 ± 0.44	7.00* ± 0.25	15.92 ± 0.58	Brierre de Boisment (42)
Spanish (Married. With children)	70	44.08 ± 0.28	44.80 ± 0.35	3.51 ± 0.20	7.96 ± 0.46	Campá (82)
Russian (South Russia)	64	44.75 ± 0.49	45.72 ± 0.61	5.82 ± 0.35	13.00 ± 0.79	Weissenberg (09)
Jewish (South Russia)	173	45.00 ± 0.25	45.74 ± 0.31	4.90 ± 0.18	10.88 ± 0.40	Weissenberg (09)
Usbeg (Samarkand)	26	45.08 ± 0.57	45.50 ± 0.71	4.30 ± 0.40	9.54 ± 0.90	Gagajewa-Wischnewskaja (33)
Spanish (All women studied)	100	45.12 ± 0.27	45.70 ± 0.33	3.93 ± 0.19	8.71 ± 0.42	Campá (82)
Tajik (Samarkand)	16	45.13 ± 0.78	45.80 ± 0.98	4.65 ± 0.55	10.31 ± 1.24	Gagajewa-Wischnewskaja (33)
French (Marseilles and Bouches du Rhône)	44	45.18 ± 0.58	46.33 ± 0.73	5.70 ± 0.41	5.70 ± 0.41	Queirel and Rouvier (79)
French (Montpellier)	176	45.39 ± 0.28	45.68 ± 0.35	5.48 ± 0.20	12.06 ± 0.44	Courty (81)
Various (Patients at Marienbad. Author's data as given)	500	45.49 ± 0.18	45.79 ± 0.22	5.88 ± 0.13	12.93 ± 0.28	Kisch (74)
English (London)	400	46.15 ± 0.15	46.35 ± 0.19	4.38 ± 0.10	9.50 ± 0.23	Guy (45)
French (Nimes)	206	46.36 ± 0.21	46.89 ± 0.27	4.52 ± 0.15	9.76 ± 0.33	Courty (81)
Various (Patients at Marienbad. Cases before age 36 omitted)	465	46.49 ± 0.15	46.28 ± 0.19	4.73 ± 0.10	10.17 ± 0.23	Kisch (74)
American (Private patients)	384	46.95 ± 0.21	47.79 ± 0.26	6.00 ± 0.15	12.78 ± 0.32	Sanes (16)
Russian	100	47.24 ± 0.23	48.13 ± 0.29	3.47 ± 0.17	7.34 ± 0.35	Courty (81)
Czechoslovakian (Prague)	446	47.33 ± 0.14	47.88 ± 0.18	4.43 ± 0.10	9.36 ± 0.21	Baroch (29)
Spanish (Unmarried and sterile)	30	47.55 ± 0.47	48.55 ± 0.47	3.79 ± 0.33	7.97 ± 0.70	Campá (82)
German (Berlin. Polyklinik)	903	47.58 ± 0.10	48.12 ± 0.12	4.34 ± 0.07	9.11 ± 0.15	Schaeffer (06)
Czechoslovakian (Rural districts)	549	47.94 ± 0.12	48.66 ± 0.15	4.19 ± 0.09	8.75 ± 0.18	Baroch (29)
German (Private patients)	188	48.28 ± 0.20	49.10 ± 0.20	4.09 ± 0.14	8.48 ± 0.30	Heyn (20)
American (Private patients)	200	48.64 ± 0.20	49.43 ± 0.25	4.25 ± 0.14	8.74 ± 0.47	Kelly (08)
Norwegian	391	49.40 ± 0.12	49.80 ± 0.15	3.44 ± 0.08	6.97 ± 0.17	Courty (81)

* The actual value here is 6.996, which in rounding off to two places of decimals becomes 7.00. But in making the inter-group frequency distribution of text table 9 this group goes, of course, in the 6.50–6.99 year class.

TABLE IV

Biometric constants for duration of reproductive span in women. Computed in Department of Biology, School of Hygiene, Johns Hopkins University, from frequency distributions in indicated sources

Group	*N*	*Mean (years)*	*Median (years)*	*Standard deviation (years)*	*Coefficient of variation (per cent.)*	*Source*
Various (Patients at Marienbad. Author's data as given, including abnormal)	490	$28·13 \pm 0·19$	$28·83 \pm 0·24$	$6·21 \pm 0·13$	$22·10 \pm 0·50$	Kisch (74)
French	178	$29·60 \pm 0·37$	$30·10 \pm 0·46$	$7·22 \pm 0·26$	$24·40 \pm 0·93$	Brierre de Boisment (42)
German (Reichenbach)	188	$31·54 \pm 0·22$	$32·50 \pm 0·27$	$4·44 \pm 0·15$	$14·08 \pm 0·50$	Heyn (20)
American (Urban)	178	$32·39 \pm 0·27$	$33·29 \pm 0·34$	$5·42 \pm 0·19$	$16·74 \pm 0·62$	Sanes (16)
Czechoslovakian (Rural)	237	$32·76 \pm 0·20$	$33·27 \pm 0·25$	$4·64 \pm 0·14$	$14·17 \pm 0·45$	Baroch (29)
Czechoslovakian (Urban)	189	$33·05 \pm 0·22$	$33·30 \pm 0·27$	$4·45 \pm 0·15$	$13·47 \pm 0·48$	Baroch (29)

TABLE V

Percentage of all children born alive in 1934 to parents of known ages that were produced by parents of specified ages

Region	Mothers under 15 (10–14)	Region	Mothers under 20 (10–19)	Region	Fathers under 20	Region	Mothers 45 and over	Region	Fathers 45 and over	Region	Fathers 50 and over	Region	Fathers 55 and over	Region	Mothers under 20, and 45 and over	Region	Fathers under 20, and 45 and over
Fla.	0·5	Fla.	21·9	Miss.	2·8	N.D.	0·6	Fla.	9·8	Fla.	4·1	Fla.	1·7	Fla.	22·2	Fla.	12·0
Miss.	0·5	Ga.	19·0	Ark.	2·7	Wyo.	0·6	Mont.	9·4	Miss.	4·0	Miss.	1·7	Ga.	19·5	Miss.	11·1
Del.	0·4	Miss.	18·9	Ga.	2·7	Idaho	0·5	N. Mex.	9·1	Ga.	3·9	Ga.	1·6	Miss.	19·3	Ark.	11·0
Ga.	0·4	S.C.	18·6	Md.	2·6	Ky.	0·5	Ala.	8·6	N. Mex.	3·5	Ark.	1·5	S.C.	19·0	Ala.	10·8
Ala.	0·3	Ala.	18·2	Ky.	2·5	Minn.	0·5	N.D.	8·6	Tenn.	3·5	Ala.	1·4	Ala.	18·6	Ga.	10·4
Ark.	0·3	Ark.	18·2	N.C.	2·5	S.D.	0·5	Ariz.	8·3	Ala.	3·4	Ky.	1·4	Ark.	18·4	Mont.	10·4
D.C.	0·3	La.	17·1	La.	2·4	Utah	0·5	Ark.	8·3	Ariz.	3·4	N.C.	1·4	La.	17·4	N.C.	10·4
La.	0·3	Okla.	16·9	Tenn.	2·4	Va.	0·5	Miss.	8·3	Ark.	3·4	S.C.	1·4	Okla.	17·2	Ky.	10·3
Md.	0·3	Tenn.	16·1	Okla.	2·3	W. Va.	0·5	Va.	8·0	Mont.	3·4	Va.	1·4	Tenn.	16·5	N. Mex.	10·3
Va.	0·3	W. Va.	16·1	Fla.	2·2	Ala.	0·4	N.C.	7·9	N.C.	3·4	N. Mex.	1·3	Va.	16·5	Tenn.	10·2
Ky.	0·2	Va.	16·0	Va.	2·2	Col.	0·4	W. Va.	7·9	Va.	3·4	Tenn.	1·3	W. Va.	16·5	Va.	10·2
N.C.	0·2	Del.	15·8	Ala.	2·1	Conn.	0·4	Ky.	7·8	Ky.	3·3	W. Va.	1·2	Del.	16·1	Ariz.	10·0
Tenn.	0·2	Md.	15·7	S.C.	2·1	Del.	0·4	Ga.	7·7	S.C.	3·3	Ariz.	1·1	Ky.	16·0	W. Va.	9·8
Tex.	0·2	Ky.	15·5	Ind.	1·9	Ga.	0·4	S.D.	7·7	N.D.	3·1	La.	1·1	Md.	16·0	S.C.	9·5
W. Va.	0·2	D.C.	15·3	Del.	1·8	Iowa	0·4	Tenn.	7·7	Vt.	3·1	Vt.	1·1	N.C.	15·7	La.	9·3
U.S.A.	**0·1**	N.C.	15·3	Mo.	1·8	Kan.	0·4	Vt.	7·5	W. Va.	3·1	Okla.	1·0	D.C.	15·4	N.D.	9·2
Ariz.	0·1	Tex.	14·9	W. Va.	1·8	La.	0·4	Minn.	7·4	Okla.	2·7	Tex.	1·0	Tex.	15·2	Okla.	9·0
Me.	0·1	Ariz.	14·0	Ariz.	1·7	Miss.	0·4	S.C.	7·3	La.	2·6	Me.	0·9	Ariz.	14·3	Vt.	8·5
Mo.	0·1	Mo.	14·0	D.C.	1·7	Mont.	0·4	Idaho	6·9	Col.	2·5	Mont.	0·9	Mo.	14·3	Md.	8·2
Okla.	0·1	Idaho	13·2	Me.	1·6	Neb.	0·4	Wyo.	6·9	Idaho	2·5	N.D.	0·9	Idaho	13·7	Mo.	8·2
Pa.	0·09	Ind.	13·1	Tex.	1·6	N. Mex.	0·4	Col.	6·8	Me.	2·5	**U.S.A.**	**0·8**	Ind.	13·5	S.D.	8·2
Col.	0·08	N. Mex.	12·9	**U.S.A.**	**1·5**	N.C.	0·4	La.	6·8	N.H.	2·5	Col.	0·8	Wyo.	13·5	Tex.	8·2
Mont.	0·08	Wyo.	12·9	Pa.	1·5	Pa.	0·4	Okla.	6·8	S.D.	2·5	Idaho	0·8	N. Mex.	13·3	Col.	8·1
N.D.	0·08	Col.	12·8	Kan.	1·4	R.I.	0·4	Ore.	6·8	Tex.	2·5	Mo.	0·8	Col.	13·1	Idaho	8·1
Ohio	0·08	**U.S.A**	**12·5**	Wash.	1·4	S.C.	0·4	Tex.	6·6	Mo.	2·4	N.H.	0·8	**U.S.A.**	**12·8**	Me.	8·1

TABLE V—*continued*

Region	Mothers under 15 (10–14)	Region	Mothers under 20 (10–19)	Region	Fathers under 20	Region	Mothers 45 and over	Region	Fathers 45 and over	Region	Fathers 50 and over	Region	Fathers 55 and over	Region	Fathers under 20, and 45 and over	Region	Fathers under 20, and 45 and over
Cal.	0·07	Nev.	12·3	Col.	1·3	Tenn.	0·4	Me.	6·5	Ore.	2·4	Ore.	0·8	Nev.	12·5	Wyo.	8·1
Ill.	0·07	Ore.	11·7	Iowa	1·3	Wis.	0·4	Kan.	6·4	**U.S.A.**	**2·3**	Kan.	0·7	Me.	12·0	Minn.	8·0
Ind.	0·07	Me.	11·6	Ohio	1·3	**U.S.A.**	**0·3**	Mo.	6·4	Kan.	2·3	Minn.	0·7	Ore.	11·9	**U.S.A.**	**7·8**
Kan.	0·07	Wash.	11·6	Idaho	1·2	Ariz.	0·3	**U.S.A.**	**6·3**	Minn.	2·3	S.D.	0·7	Wash.	11·9	Kan.	7·8
Nev.	0·07	Mont.	11·2	N.H.	1·2	Ark.	0·3	Nev.	6·3	Wash.	2·3	Wash.	0·7	Mont.	11·6	Ore.	7·7
S.D.	0·07	Cal.	11·0	N. Mex.	1·2	Fla.	0·3	Neb.	6·2	Wyo.	2·3	Wyo.	0·7	Pa.	11·4	Del.	7·5
Wyo.	0·07	Pa.	11·0	Wyo.	1·2	Ind.	0·3	N.H.	6·1	Ind.	2·0	Cal.	0·6	Cal.	11·2	Ind.	7·5
Mich.	0·06	Mich.	10·9	Vt.	1·1	Me.	0·3	Wash.	6·1	Md.	2·0	Ind.	0·6	Mich.	11·2	N.H.	7·3
N.J.	0·06	Ohio	10·9	Wash.	1·1	Md.	0·3	Utah	6·0	Neb.	2·0	Md.	0·6	Ohio	11·2	Utah	7·3
Idaho	0·05	Kan.	10·7	Ill.	1·0	Mass.	0·3	Wis.	6·0	Nev.	2·0	Neb.	0·6	Kan.	11·1	Wash.	7·2
Iowa	0·05	Utah	10·7	Mich.	1·0	Mich.	0·3	Iowa	5·8	Cal.	1·9	Nev.	0·6	Utah	10·8	Iowa	7·1
N. Mex.	0·05	Iowa	10·2	Mont.	1·0	Mo.	0·3	Cal.	5·7	Iowa	1·9	Utah	0·6	Iowa	10·6	Neb.	7·1
R.I.	0·05	Ill.	10·1	Cal.	0·9	N.J.	0·3	Del.	5·7	Utah	1·9	Iowa	0·5	Ill.	10·3	Nev.	7·1
Vt.	0·05	Vt.	10·0	Neb.	0·9	Ohio	0·3	Ind.	5·6	Ohio	1·7	Mich.	0·5	Vt.	10·3	Pa.	7·0
Neb.	0·04	N.H.	9·3	Nev.	0·8	Okla.	0·3	Md.	5·6	Wis.	1·7	Ohio	0·5	Neb.	9·5	Cal.	6·6
N.Y.	0·04	Neb.	9·2	N.J.	0·8	Ore.	0·3	Pa.	5·5	Del.	1·6	Wis.	0·5	N.H.	9·5	Wis.	6·6
Ore.	0·04	N.J.	8·7	Ore.	0·8	Tex.	0·3	Conn.	5·3	Pa.	1·6	Conn.	0·4	N.J.	8·9	Ohio	6·5
Mass.	0·03	Wis.	8·2	R.I.	0·8	Vt.	0·3	Ohio	5·2	Conn.	1·5	Del.	0·4	Wis.	8·6	Ill.	6·2
Minn.	0·03	S.D.	8·0	Mass.	0·7	Wash.	0·3	Ill.	5·1	Ill.	1·5	D.C.	0·4	S.D.	8·5	Mich.	6·2
Wis.	0·03	Minn.	7·4	Wis.	0·7	Cal.	0·2	Mich.	5·1	Mich.	1·5	Ill.	0·4	N.D.	8·1	Conn.	5·9
S.C.	0·02	N.D.	7·4	Conn.	0·6	Ill.	0·2	Mass.	5·0	D.C.	1·4	Mass.	0·4	Minn.	7·8	N.J.	5·8
Utah	0·02	N.Y.	7·0	Minn.	0·6	N.H.	0·2	N.J.	5·0	Mass.	1·4	N.J.	0·4	R.I.	7·3	Mass.	5·7
Wash.	0·02	R.I.	6·9	N.Y.	0·6	N.Y.	0·2	R.I.	4·9	N.J.	1·4	N.Y.	0·4	N.Y.	7·2	R.I.	5·7
Conn.	0·01	Mass.	6·5	N.D.	0·5	D.C.	0·1	N.Y.	4·6	R.I.	1·4	Pa.	0·4	Mass.	6·9	D.C.	5·6
N.H.	0·01	Conn.	6·4	S.D.	0·5	Nev.	0·1	D.C.	3·9	N.Y.	1·3	R.I.	0·4	Conn.	6·8	N.Y.	5·2

TABLE VI

Mean litter size, based upon live and still-births of 1930–2 combined, in the U.S.B.R.A. and in each state, together with the mean birth-rates per 1,000 population of 1930, for the same years combined and the same areas

State	*Mean litter size*	*Birth-rate*	*State*	*Mean litter size*	*Birth-rate*
Arkansas	1·01735 ± 0·00026	21·4	Kansas	1·01149 ± 0·00023	17·3
South Carolina	1·01535 ± 0·00024	23·3	Ohio	1·01141 ± 0·00012	16·3
North Carolina	1·01471 ± 0·00017	23·8	Maryland	1·01140 ± 0·00024	17·8
Louisiana	1·01409 ± 0·00022	20·3	Arizona	1·01138 ± 0·00043	21·3
Oklahoma	1·01388 ± 0·00022	17·5	Illinois	1·01102 ± 0·00012	15·5
West Virginia	1·01380 ± 0·00023	22·8	Oregon	1·01093 ± 0·00036	13·3
Alabama	1·01351 ± 0·00018	23·7	California	1·01087 ± 0·00014	13·9
North Dakota	1·01338 ± 0·00037	21·1	Massachusetts	1·01086 ± 0·00015	16·5
Mississippi	1·01323 ± 0·00021	23·0	New Jersey	1·01077 ± 0·00016	15·7
Virginia	1·01323 ± 0·00019	22·2	Pennsylvania	1·01076 ± 0·00009	18·4
Tennessee	1·01318 ± 0·00019	19·9	Colorado	1·01072 ± 0·00029	17·5
New Mexico	1·01317 ± 0·00040	28·7	Idaho	1·01065 ± 0·00042	20·1
Utah	1·01313 ± 0·00040	24·1	Iowa	1·01059 ± 0·00020	16·8
Georgia	1·01310 ± 0·00018	21·3			
Kentucky	1·01297 ± 0·00018	22·3	District of Columbia	1·01057 ± 0·00040	19·6
Montana	1·01285 ± 0·00045	17·8	Maine	1·01054 ± 0·00031	20·3
Minnesota	1·01217 ± 0·00020	18·2	Vermont	1·01050 ± 0·00049	18·2
Florida	1·01216 ± 0·00026	18·0	Washington	1·01018 ± 0·00026	14·1
Wyoming	1·01207 ± 0·00064	19·4	Connecticut	1·01011 ± 0·00024	15·8
Missouri	1·01190 ± 0·00017	16·7	Michigan	1·01011 ± 0·00013	18·7
			Rhode Island	1·01000 ± 0·00036	16·7
Registration Area	1·01188 ± 0·00003	18·1	Delaware	1·00963 ± 0·00057	18·1
Wisconsin	1·01171 ± 0·00018	18·5	New Hampshire	1·00905 ± 0·00042	17·1
Indiana	1·01164 ± 0·00018	17·2	New York	1·00803 ± 0·00008	16·2
Nebraska	1·01163 ± 0·00026	19·0	Nevada	1·00765 ± 0·00094	13·8

TABLE VII

Total and net potentially effective copulations indulged in (a) per pregnancy actually experienced, and (b) per live birth produced, by age of wife in a sample of 199 white women living in wedlock, all of whom were fertile, and in whose marital experience no contraceptive effort whatever had been made

Age period (years)	Number of couples in the experience	Total copulations	Net potentially effective copulations	Total pregnancies	Total live births	Total copulations per pregnancy	Net potentially effective copulations per pregnancy	Total copulations per live birth	Net potentially effective copulations per live birth	Average number of pregnancies per couple	Average number of live births per couple
Under 20	96	37,450	22,901	130	111	288	176	337	206	1·4	1·2
20–29	184	187,031	123,295	611	506	298	202	360	244	3·3	2·8
30–39	138	125,970	95,921	331	284	381	290	444	338	2·4	2·1
40–49	75	45,675	43,026	30	27	1,522	1,434	1,692	1,594	0·4	0·4
All ages (up to 50)	199	403,290	292,084	1,148	970	351	254	416	301	5·8	4·9

TABLE VIII

Biometric constants for age of primiparae and multiparae producing births in 1930 (From Pearl, 37)

Group	N	Mean (years)	Median (years)	Standard deviation (years)	Coefficient of variation (years)
Native White Primiparae					
First live births	527,072	22·931±0·004	22·356±0·005	4·712±0·003	20·548±0·014
First still-births	18,542	23·564±0·028	22·617±0·035	5·565±0·020	13·615±0·087
Native White Multiparae					
Live births of II and higher parities	1,051,784	29·192±0·004	28·579±0·005	6·134±0·003	21·012±0·010
Still-births of II and higher parities	27,639	30·859±0·028	30·626±0·035	6·816±0·020	22·088±0·066
Foreign-born White Primiparae					
First live births	56,013	25·482±0·014	24·807±0·017	4·882±0·010	19·157±0·040
First still-births	1,421	26·979±0·106	26·363±0·132	5·899±0·074	21·866±0·290
Foreign-born White Multiparae					
Live births of II and higher parities	174,090	31·963±0·010	31·857±0·012	5·971±0·007	18·681±0·022
Still-births of II and higher parities	4,777	34·528±0·060	35·199±0·075	6·128±0·042	17·748±0·126
Coloured Primiparae					
First live births	71,929	20·311±0·011	19·336±0·013	4·269±0·008	21·021±0·039
First still-births	5,681	20·753±0·042	19·554±0·053	4·696±0·030	22·630±0·150
Coloured Multiparae					
Live births of II and higher parities	176,283	27·857±0·010	26·933±0·013	6·460±0·007	23·189±0·028
Still-births of II and higher parities	12,438	28·092±0·042	27·084±0·053	6·927±0·030	24·658±0·112

TABLE IX

Percentages of living first births to all living births in the U.S. Birth Registration Area as constituted in 1920 and 1930 respectively, with designated age, nativity, and race (colour) groups

Age of mothers	Native Whites			Foreign-born Whites			Coloured		
	1930	1920	Diff.	1930	1920	Diff.	1930	1920	Diff.
10–14	99·6	98·5	+1·1	100·0	95·2	+ 4·8	99·7	98·0	+1·7
15–19	79·3	82·1	−2·8	78·5	76·7	+ 1·8	72·5	77·2	−4·7
20–24	46·0	48·4	−2·4	51·0	41·3	+ 9·7	29·3	33·5	−4·2
25–29	24·3	24·8	−0·5	28·0	16·6	+11·4	10·4	12·9	−2·5
30–34	12·3	12·1	+0·2	12·2	7·0	+ 5·2	5·2	6·6	−1·4
35–39	6·4	6·1	+0·3	5·3	3·6	+ 1·7	3·0	3·2	−0·2
40–44	3·7	3·3	+0·4	2·6	2·3	+ 0·3	1·8	2·1	−0·3
45–49	2·7	1·9	+0·8	1·7	0·6	+ 1·1	1·5	1·6	−0·1
50 and over	9·2	7·7	+1·5	0	0	0	2·4	3·3	−0·9
Total all ages	33·38	32·58	+0·80	24·34	18·55	+ 5·79	28·98	28·14	+0·84

TABLE X

Percentages of adequate reproducers (mothers IV-para and higher) in various groups

Date	Place and group	N	Per cent. adequate reproducers	Source
1933	Samarkand. Tajik women. Rep. Fin.	33	97·0	Gagajewa-Wischnewskaja (33)
1886	Russia. Peasants. Husband lives at home. Rep. Fin. (presumably).	522	95·6	Zhbankoff (86)
1929	Massachusetts. Foreign-born mothers of mentally defective children. 'Unknown' omitted. Rep. Fin.	783	92·1	Dayton (29). Table 7
1933	Samarkand. Usbeg women. Rep. Fin.	37	91·9	Gagajewa-Wischnewskaja (33)
1875	Gablenberg near Stuttgart. Rep. Fin.	515	87·6	Weinberg (09)
1904–7	Berlin. Working-class women. Rep. Fin.	374	87·2	Hamburger (08)
1929	Massachusetts. Native-born mothers of mentally defective children. 'Unknown' omitted. Rep. Fin.	187	80·2	Dayton (29). Table 7
1886	Russia. Peasants. Husband goes to town to earn living. Rep. Fin. (presumably)	521	78·7	Zhbankoff (86)
1926	New York State. Families of delinquent boys in 3 reformatory institutions. Rep. Inc. (probably in some degree but not much)	1,522	76·7	Slawson (26). Table 75
1800	Hyde, Waldo, and Stone genealogies. Rep. Fin.	. .	71·1	Wilson and Hilferty (35). Table IV
1926	West Riding of Yorkshire. Families of miners. Children 11–13 years old. Rep. Inc.	1,106	69·1	Sutherland (29)

TABLE X—*continued*

Date	*Place and group*	*N*	*Per cent. adequate reproducers*	*Source*
1926	München. Mothers of 725 feeble-minded children in special schools. Rep. Inc.	650	66·6	Prokein (26)
1898–1902	New Hampshire births to foreign-born mothers. Rep. Inc.	18,818	48·9	Young (05). Table X
1904–7	Berlin. Wealthy women. Rep. Fin.	66	47·0	Hamburger (08)
1936	Cleveland, O. Clients of Maternal Health Clinic. Rep. Inc.	3,536	44·3	Robishaw (36). Table 1
1929	Connecticut rural families. Rep. Fin.	507	43·8	Whetten (33). Table 1
1933	Tsinan, China. Cheeloo Hospital Pediatric Service. Live births. Rep. Inc.	2,500	41·1	Fan (33). Table 1
1930	U.S.B.R.A. Foreign-born white. Live births. Rep. Inc.	230,103	40·4	Pearl (37). Table 9
1930	U.S.B.R.A. Coloured. Live births. Rep. Inc.	248,212	40·3	Pearl (37). Table 9
1929	Connecticut, native-born Protestant farm women. Rep. Fin.	144	31·9	Whetten (33). Table 4
1931	Kurashiki, Japan. Textile workers. Rep. Inc.	1,010	31·3	Teruoka (31). Table 7
1898–1902	New Hampshire births to native mothers. Rep. Inc.	21,405	30·1	Young (05). Table X
1890–1922	French and Belgian ducal families. Rep. Inc.	95	29·5	Savorgnan (25)
1930	U.S.B.R.A. Native white. Live births. Rep. Inc.	1,578,856	29·3	Pearl (37). Table 9
1920–33	New York State exclusive of New York City. Native white mothers. Rep. Fin.	. .	27·9	Wilson and Hilferty (35). Table IV
1890–1923	English, Scottish, and Irish nobility. Rep. Inc.	90	26·7	Savorgnan (25a)
1930	'A good New England university.' Faculty members. Rep. Fin. (practically)	27	18·5	Willoughby (30)

TABLE XI

Biometric constants for age of mother at birth of living children of designated parity orders, by nativity and race (colour). U.S. Birth Registration Area, 1930

Parity order of birth	Native White: Mean (years)	Native White: Standard deviation (years)	Native White: Coefficient of variation (per cent.)	Foreign-born Whites: Mean (years)	Foreign-born Whites: Standard deviation (years)	Foreign-born Whites: Coefficient of variation (per cent.)	Coloured: Mean (years)	Coloured: Standard deviation (years)	Coloured: Coefficient of variation (per cent.)
1	22.931 ± 0.004	4.712 ± 0.003	20.55 ± 0.01	25.48 ± 0.01	4.88 ± 0.01	19.12 ± 0.04	20.31 ± 0.01	4.02 ± 0.01	19.78 ± 0.04
2	25.613 ± 0.006	4.921 ± 0.004	19.21 ± 0.02	27.94 ± 0.02	4.87 ± 0.01	17.42 ± 0.04	22.78 ± 0.01	4.36 ± 0.01	19.13 ± 0.05
3	27.801 ± 0.007	5.072 ± 0.005	18.24 ± 0.02	30.09 ± 0.02	5.06 ± 0.01	16.81 ± 0.05	25.01 ± 0.02	4.49 ± 0.01	17.97 ± 0.05
4	29.667 ± 0.009	5.082 ± 0.006	17.13 ± 0.02	31.71 ± 0.02	5.09 ± 0.02	16.07 ± 0.05	26.91 ± 0.02	4.73 ± 0.01	17.58 ± 0.06
5	31.423 ± 0.010	4.897 ± 0.007	15.58 ± 0.02	33.73 ± 0.03	4.94 ± 0.02	14.93 ± 0.06	28.91 ± 0.02	4.88 ± 0.02	16.89 ± 0.06
6	33.007 ± 0.012	4.673 ± 0.008	14.16 ± 0.03	34.50 ± 0.03	4.70 ± 0.02	13.62 ± 0.06	30.56 ± 0.03	4.77 ± 0.02	15.61 ± 0.06
7	34.532 ± 0.013	4.406 ± 0.010	12.76 ± 0.03	35.63 ± 0.03	4.47 ± 0.02	12.55 ± 0.06	32.10 ± 0.03	4.76 ± 0.02	14.82 ± 0.07
8	35.923 ± 0.015	4.219 ± 0.011	11.74 ± 0.03	36.66 ± 0.03	4.21 ± 0.02	11.47 ± 0.06	33.61 ± 0.03	4.66 ± 0.02	13.85 ± 0.07
9	37.133 ± 0.018	3.970 ± 0.012	10.69 ± 0.03	37.73 ± 0.03	3.90 ± 0.02	10.34 ± 0.06	34.88 ± 0.04	4.47 ± 0.03	12.81 ± 0.08
10	38.194 ± 0.021	3.880 ± 0.015	10.16 ± 0.04	38.71 ± 0.04	3.73 ± 0.03	9.63 ± 0.07	36.07 ± 0.04	4.40 ± 0.03	12.20 ± 0.08
11	39.047 ± 0.027	3.847 ± 0.019	9.85 ± 0.05	39.36 ± 0.05	3.67 ± 0.03	9.32 ± 0.08	37.04 ± 0.05	4.39 ± 0.04	11.84 ± 0.10
12	39.949 ± 0.032	3.606 ± 0.023	9.03 ± 0.06	40.08 ± 0.05	3.56 ± 0.04	8.88 ± 0.10	38.08 ± 0.06	4.07 ± 0.04	10.70 ± 0.11
13	40.429 ± 0.044	3.610 ± 0.031	8.93 ± 0.08	40.70 ± 0.07	3.48 ± 0.05	8.56 ± 0.12	38.83 ± 0.07	4.04 ± 0.05	10.39 ± 0.13
14	40.798 ± 0.064	3.781 ± 0.045	9.27 ± 0.11	40.80 ± 0.09	3.32 ± 0.06	8.17 ± 0.16	39.51 ± 0.10	4.27 ± 0.07	10.80 ± 0.18
15–25	41.272 ± 0.062	3.614 ± 0.044	8.76 ± 0.11	41.63 ± 0.09	3.38 ± 0.06	8.13 ± 0.15	40.44 ± 0.09	4.12 ± 0.06	10.20 ± 0.15

TABLE XII

Occupations of husbands (and unmarried consorts when known) of women in present material (hospital reproductive histories). For explanation of headings see text

Occupational groups	Whites							Negroes							Totals	
		OUTWED							OUTWED							
	INWED	A ILLEG	B PRENUP	Total A+B	PARTLY	Total whites	Per cent. whites	INWED	A ILLEG	B PRENUP	Total A+B	PARTLY	Total Negroes	Per cent. Negroes	Absolute	Per cent.
Owners, managers, and higher officials	2,037	32	29	61	29	2,127	8·4	47	12	3	15	14	76	1·3	2,203	7·1
Professional men	1,517	21	26	47	15	1,579	6·2	51	10	10	20	5	76	1·3	1,655	5·3
Skilled and semi-professional workers in:																
A. Agriculture, forestry, fisheries, and mining	125	..	5	5	5	135	0·5	7	..	..	..	1	8	0·1	143	0·5
B. Manufacturing and mechanical industries	5,924	45	212	257	225	6,406	25·3	265	7	36	43	55	363	6·4	6,769	21·9
C. Transportation and communication	2,506	26	104	130	98	2,734	10·8	303	10	36	46	56	405	7·2	3,139	10·1
D. Trade	2,802	35	73	108	68	2,978	11·8	119	18	29	47	32	198	3·5	3,176	10·3
E. Public and professional service	446	6	32	38	17	501	2·0	30	..	3	3	9	42	0·7	543	1·8
F. Domestic and personal service	325	5	14	19	10	354	1·4	71	7	24	31	18	120	2·1	474	1·5
G. Clerical occupations	1,207	13	37	50	25	1,282	5·1	20	2	..	2	2	24	0·4	1,306	4·2
All skilled and semi-professional workers (sub-total)	13,335	130	477	607	448	14,390	56·8	815	44	128	172	173	1,160	20·6	15,550	50·2
Unskilled and semi-skilled labourers	5,610	61	280	341	326	6,277	24·8	2,555	160	303	463	588	3,606	64·0	9,883	31·9
Unemployed (regularly and chronically)	225	12	14	26	7	258	1·0	56	20	8	28	8	92	1·6	350	1·1
Occupation unknown	241	411	10	421	23	685	2·7	47	531	6	537	39	623	11·1	1,308	4·2
Totals	22,965	667	836	1,503	848	25,316	100·0	3,571	777	458	1,235	827	5,633	99·9	30,949	99·8

TABLE XIII

Number of women and their mean ages

Items	White					Negro			
	Totals	*Very poor*	*Poor*	*Mod. circ.*	*Well-to-do and rich*	*Totals*	*Very poor*	*Poor*	*Mod. circ.*
1. *Number of women* (Totals)	19,613	3,635	9,069	5,605	1,304	3,044*	1,590	1,380	73
(*a*) Primiparae non-contraceptors	4,662	827	2,428	1,284	123	721	345	355	21
(*b*) Primiparae contraceptors	2,837	187	957	1,300	393	109	42	60	7
(*c*) Multiparae non-contraceptors	5,925	1,716	2,919	1,154	136	1,721	982	715	24
(*d*) Multiparae contraceptors	6,189	905	2,765	1,867	652	492	221	250	21
2. *Mean age in years at time of record* (Totals)	26·60 ± 0·03	26·39 ± 0·07	25·91 ± 0·04	27·21 ± 0·05	29·29 ± 0·09	25·03 ± 0·07	25·45 ± 0·10	24·50 ± 0·10	25·92 ± 0·48
(*a*) Primiparae non-contraceptors	22·78 ± 0·05	21·23 ± 0·09	22·08 ± 0·06	24·72 ± 0·09	26·77 ± 0·34	20·86 ± 0·10	20·76 ± 0·14	20·91 ± 0·14	21·55 ± 0·54
(*b*) Primiparae contraceptors	24·56 ± 0·05	22·21 ± 0·19	23·12 ± 0·09	25·24 ± 0·08	26·91 ± 0·13	22·00 ± 0·28	21·67 ± 0·43	21·50 ± 0·33	28·21 ± 1·39
(*c*) Multiparae non-contraceptors	28·20 ± 0·05	28·19 ± 0·11	27·71 ± 0·08	29·16 ± 0·11	30·59 ± 0·29	26·34 ± 0·09	26·74 ± 0·12	25·77 ± 0·14	27·29 ± 0·83
(*d*) Multiparae contraceptors	28·87 ± 0·05	28·54 ± 0·13	28·34 ± 0·07	29·10 ± 0·08	30·94 ± 0·11	27·24 ± 0·17	27·75 ± 0·27	26·72 ± 0·22	27·98 ± 0·88

* Including one multipara contraceptor in the 'Well-to-do and rich' economic class, who does not appear in any other table.

TABLE XIV

Mean age at marriage and mean duration of marriage to time of record

Items	White					Negro			
	Totals	*Very poor*	*Poor*	*Mod. circ.*	*Well-to-do and rich*	*Totals*	*Very poor*	*Poor*	*Mod. circ.*
3. *Mean age in years at marriage* (Totals)	21·13 ± 0·02	19·68 ± 0·04	20·53 ± 0·03	22·41 ± 0·04	23·78 ± 0·07	19·02 ± 0·04	18·80 ± 0·05	19·16 ± 0·06	20·99 ± 0·30
(*a*) Primiparae non-contraceptors	21·15 ± 0·04	19·63 ± 0·08	20·58 ± 0·05	22·82 ± 0·08	25·06 ± 0·30	19·28 ± 0·08	19·11 ± 0·12	19·37 ± 0·11	20·36 ± 0·54
(*b*) Primiparae contraceptors	21·98 ± 0·05	19·99 ± 0·15	20·78 ± 0·07	22·56 ± 0·07	23·96 ± 0·12	19·89 ± 0·21	19·17 ± 0·28	19·75 ± 0·25	25·36 ± 1·29
(*c*) Multiparae non-contraceptors	20·76 ± 0·04	19·63 ± 0·06	20·49 ± 0·05	22·66 ± 0·08	24·74 ± 0·25	18·87 ± 0·05	18·64 ± 0·07	19·09 ± 0·08	21·46 ± 0·53
(*d*) Multiparae contraceptors	21·07 ± 0·03	19·76 ± 0·08	20·45 ± 0·04	21·87 ± 0·06	23·23 ± 0·09	18·96 ± 0·09	18·93 ± 0·14	18·94 ± 0·13	19·64 ± 0·30
4. *Mean duration of marriage in years* (Totals)	5·42 ± 0·03	6·62 ± 0·08	5·32 ± 0·05	4·76 ± 0·06	5·57 ± 0·11	6·06 ± 0·08	6·59 ± 0·11	5·50 ± 0·12	5·21 ± 0·57
(*a*) Primiparae non-contraceptors	1·57 ± 0·07	1·47 ± 0·12	1·47 ± 0·08	1·83 ± 0·12	1·64 ± 0·45	1·74 ± 0·13	1·76 ± 0·18	1·74 ± 0·18	1·30 ± 0·76
(*b*) Primiparae contraceptors	2·52 ± 0·07	2·11 ± 0·24	2·21 ± 0·12	2·65 ± 0·10	3·05 ± 0·18	1·98 ± 0·35	1·99 ± 0·51	1·77 ± 0·41	3·76 ± 1·90
(*c*) Multiparae non-contraceptors	7·36 ± 0·06	8·49 ± 0·13	7·14 ± 0·09	6·39 ± 0·14	5·88 ± 0·38	7·53 ± 0·10	8·00 ± 0·14	6·92 ± 0·16	6·57 ± 0·98
(*d*) Multiparae contraceptors	7·78 ± 0·06	8·70 ± 0·15	7·85 ± 0·08	7·23 ± 0·10	7·77 ± 0·14	8·16 ± 0·19	8·76 ± 0·30	7·65 ± 0·26	8·05 ± 0·93

TABLE XV

Person-years free of pregnancy

Items	White: Totals	White: Very poor	White: Poor	White: Mod. circ.	White: Well-to-do and rich	Negro: Totals	Negro: Very poor	Negro: Poor	Negro: Mod. circ.
6. *Total person-years free of pregnancy* (Totals)	70,555·5	15,196·2	31,278·0	18,676·1	5,405·2	11,296·6	6,372·5	4,683·2	240·9
(*a*) Primiparae non-contraceptors	4,228·4	667·5	1,940·5	1,498·4	122·0	780·4	378·6	389·3	12·5
(*b*) Primiparae contraceptors	5,277·3	272·1	1,491·7	2,579·4	934·1	141·2	53·5	66·2	21·5
(*c*) Multiparae non-contraceptors	27,548·1	9,097·6	13,049·4	4,890·3	510·8	7,915·4	4,775·9	3,047·1	92·4
(*d*) Multiparae contraceptors	33,501·7	5,159·0	14,796·4	9,708·0	3,838·3	2,459·6	1,164·5	1,180·6	114·5
7. *Average number of years free of pregnancy per woman* (Totals)	3·60	4·18	3·45	3·33	4·15	3·71	4·01	3·39	3·30
(*a*) Primiparae non-contraceptors	0·91	0·81	0·80	1·17	0·99	1·08	1·10	1·10	0·59
(*b*) Primiparae contraceptors	1·86	1·46	1·56	1·98	2·38	1·30	1·27	1·10	3·07
(*c*) Multiparae non-contraceptors	4·65	5·30	4·47	4·24	3·76	4·60	4·86	4·26	3·85
(*d*) Multiparae contraceptors	5·41	5·70	5·35	5·20	5·89	5·00	5·27	4·72	5·45

TABLE XVI

Pregnancy and live-birth rates per 100 person-years aggregate opportunity for pregnancy

Items	White					Negro			
	Totals	Very poor	Poor	Mod. circ.	Well-to-do and rich	Totals	Very poor	Poor	Mod. circ.
8. *Pregnancies experienced per 100 person-years of opportunity* (Totals)	72·0	81·9	77·2	61·7	49·7	89·1	90·7	87·1	83·0
(*a*) By primiparae non-contraceptors	110·3	123·9	125·1	85·7	100·9	92·4	91·1	91·2	168·7
(*b*) By primiparae contraceptors	53·8	68·7	64·2	50·4	42·1	77·2	78·6	90·6	32·6
(*c*) By multiparae non-contraceptors	81·9	83·7	84·2	72·5	81·8	89·3	90·7	86·7	104·0
(*d*) By multiparae contraceptors	61·9	73·9	66·1	55·5	45·6	87·9	91·3	86·7	66·4
9. *Live births produced per 100 person-years of opportunity* (Totals)	64·2	72·9	68·8	55·3	44·5	78·7	79·4	78·2	71·8
(*a*) By primiparae non-contraceptors	107·5	120·0	122·1	83·8	98·4	87·6	86·1	86·6	168·7
(*b*) By primiparae contraceptors	52·9	68·0	63·2	49·3	41·8	75·1	78·6	86·1	32·6
(*c*) By multiparae non-contraceptors	72·2	74·4	74·2	63·2	70·1	78·2	78·6	77·4	83·4
(*d*) By multiparae contraceptors	53·9	64·4	57·5	48·5	40·0	77·9	80·7	76·8	59·4
10. *Effectiveness of the contraceptive efforts made in lowering pregnancy rates*									
(*a*) By primiparae (percentage lowering of rate)	51·2	44·6	48·7	41·2	58·3	16·5	13·7	0·7	80·7
(*b*) By multiparae (percentage lowering of rate)	24·4	11·7	12·7	23·4	44·3	1·6	−0·7*	0	36·2
11. *Effectiveness of the contraceptive efforts made in lowering live-birth rates*									
(*a*) By primiparae (percentage lowering of rate)	50·8	43·3	48·2	41·2	57·5	14·3	8·7	0·6	80·7
(*b*) By multiparae (percentage lowering of rate)	25·3	13·4	22·5	23·3	42·9	0·4	−0·3*	0·8	28·8

* Meaning that in this class of women contraception was not effective at all in lowering either pregnancy or birth-rates, since these rates were *higher*, by the stated percentages, in contraceptors than in non-contraceptors.

TABLE XVII

Age specific mean pregnancy rates per 100 computed ovulations in women living in wedlock, married once only, and free of gynecologic disease, by economic class and race (colour)

A. White Primiparae

Age period	Contra-ception class	Very poor		Poor		Moderate circumstances		Well-to-do and rich	
		N	Mean pregnancy rate	*N*	Mean pregnancy rate	*N*	Mean pregnancy rate	*N*	Mean pregnancy rate
10–14	Non-Con.	21	10·57 ± 2·69	28	11·04 ± 2·98	3	..	0	..
	Con.	1	..	5	17·40 ± 10·20	1	..	0	..
15–19	Non-Con.	524	28·61 ± 0·85	1,229	29·81 ± 0·54	350	23·55 ± 0·96	15	20·23 ± 4·08
	Con.	106	16·04 ± 1·45	434	13·46 ± 0·64	311	10·69 ± 0·68	35	3·23 ± 0·77
20–24	Non-Con.	304	27·07 ± 1·07	1,064	27·84 ± 0·56	690	23·09 ± 0·66	65	19·80 ± 1·91
	Con.	101	13·31 ± 1·23	564	12·89 ± 0·51	867	9.98 ± 0·34	265	8·32 ± 0·66
25–29	Non-Con.	68	24·13 ± 2·27	342	24·88 ± 1·00	359	17·20 ± 0·89	48	32·51 ± 3·09
	Con.	25	17·22 ± 3·22	190	12·92 ± 0·76	471	9·81 ± 0·47	200	9·97 ± 0·65
30–34	Non-Con.	22	22·18 ± 4·15	82	19·55 ± 2·01	128	16·13 ± 1·32	15	21·00 ± 4·15
	Con.	6	4·58 ± 1·36	41	11·00 ± 1·28	123	10·04 ± 0·80	54	12·17 ± 1·75
35–39	Non-Con.	5	19·90 ± 8·43	27	11·13 ± 2·47	35	13·74 ± 1·78	8	17·25 ± 4·67
	Con.	2	..	9	6·39 ± 1·15	25	14·74 ± 2·30	11	5·59 ± 1·00

B. White Multiparae

10–14	Non-Con.	69	2·31 ± 0·53	74	1·78 ± 0·33	8	4·06 ± 1·23	1	..
	Con.	31	3·50 ± 0·96	45	3·72 ± 0·83	5	7·40 ± 4·16	0	..
15–19	Non-Con.	1,080	8·42 ± 0·23	1,540	8·92 ± 0·20	325	7·48 ± 0·43	16	9·56 ± 2·40
	Con.	536	8·12 ± 0·33	1,401	6·91 ± 0·17	626	5·96 ± 0·28	108	3·47 ± 0·37
20–24	Non-Con.	1,379	10·63 ± 0·22	2,220	11·15 ± 0·18	819	9·29 ± 0·28	73	8·92 ± 0·81
	Con.	779	8·64 ± 0·24	2,333	8·21 ± 0·13	1,480	6·35 ± 0·15	469	4·58 ± 0·24
25–29	Non-Con.	955	10·15 ± 0·26	1,526	10·12 ± 0·19	742	9.17 ± 0·27	93	9·49 ± 0·66
	Con.	564	8·88 ± 0·32	1,667	8·28 ± 0·19	1,311	7·05 ± 0·17	570	5·49 ± 0·22
30–34	Non-Con.	541	9·13 ± 0·31	842	9·10 ± 0·24	399	9.46 ± 0·36	64	11·70 ± 1·31
	Con.	290	8·63 ± 0·46	852	8·23 ± 0·29	626	8·77 ± 0·37	308	7·48 ± 0·44
35–39	Non-Con.	289	11·32 ± 0·60	373	11·58 ± 0·49	150	11·53 ± 0·75	22	11·23 ± 2·48
	Con.	129	9·57 ± 0·76	335	9·61 ± 0·47	212	9·20 ± 0·55	88	11·87 ± 1·17

TABLE XVII—*continued*

C. Negro Primiparae

Age period	*Contra-ception class*	*Very poor* *N*	*Very poor* *Mean pregnancy rate*	*Poor* *N*	*Poor* *Mean pregnancy rate*	*Moderate circumstances* *N*	*Moderate circumstances* *Mean pregnancy rate*
10–14	Non-Con.	19	18·84 ± 3·67	5	42·20 ± 18·57	1	. .
	Con.	1	. .	0	. .	0	. .
15–19	Non-Con.	224	30·22 ± 1·42	235	30·20 ± 1·42	10	28·35 ± 4·30
	Con.	28	27·45 ± 3·54	36	22·96 ± 2·86	2	. .
20–24	Non-Con.	122	27·19 ± 1·85	135	24·27 ± 1·57	7	42·14 ± 7·17
	Con.	17	24·35 ± 5·06	26	14·08 ± 2·61	1	. .
25–29	Non-Con.	36	17·86 ± 3·10	35	15·10 ± 2·35	3	10·00 ± 4·13
	Con.	7	5·86 ± 2·07	8	7·38 ± 1·88	4	1·50 ± 0·58
30–34	Non-Con.	9	14·94 ± 4·81	11	19·82 ± 4·40	0	. .
	Con.	1	. .	2	. .	4	7·63 ± 3·38
35–39	Non-Con.	0	. .	2	. .	0	. .
	Con.	0	. .	0	. .	0	. .

D. Negro Multiparae

Age period	*Contra-ception class*	*Very poor* *N*	*Very poor* *Mean pregnancy rate*	*Poor* *N*	*Poor* *Mean pregnancy rate*	*Moderate circumstances* *N*	*Moderate circumstances* *Mean pregnancy rate*
10–14	Non-Con.	79	2·63 ± 0·47	43	3·77 ± 0·82	0	. .
	Con.	18	2·83 ± 0·76	15	9·17 ± 2·44	0	. .
15–19	Non-Con.	729	10·40 ± 0·34	481	10·77 ± 0·41	10	18·70 ± 6·08
	Con.	145	10·01 ± 0·79	174	8·28 ± 0·56	12	13·00 ± 2·51
20–24	Non-Con.	783	11·89 ± 0·33	546	11·24 ± 0·36	16	11·53 ± 2·11
	Con.	191	11·25 ± 0·65	209	10·32 ± 0·60	19	12·05 ± 2·16
25–29	Non-Con.	492	9·95 ± 0·28	304	10·34 ± 0·47	13	15·65 ± 3·51
	Con.	125	12·14 ± 0·92	126	12·37 ± 0·90	11	5·09 ± 0·79
30–34	Non-Con.	223	10·61 ± 0·56	129	10·60 ± 0·69	6	10·67 ± 2·04
	Con.	63	9·51 ± 0·79	54	14·16 ± 1·31	6	3·58 ± 1·42
35–39	Non-Con.	70	14·41 ± 1·13	48	8·28 ± 0·81	2	. .
	Con.	27	15·54 ± 1·78	16	11·47 ± 1·45	3	3·83 ± 0·57

TABLE XVIII

Frequency distributions of live births to multiparae at time of record

N.C.=Non-Contraceptor. C.=Contraceptor.

No. of live births produced	Whites										Negroes							
	Totals		Very poor		Poor		Moderate circumstances		Well-to-do and rich		Totals		Very poor		Poor		Moderate circumstances	
	N.C.	C.	N.C.	C.	N.C.	C.	N.C.	C.	N.C.	C.	N.C.	C.	N.C.	C.	N.C.	C.	N.C.	C.
0	24	14	9	..	9	10	5	4	1	..	13	..	5	..	7	..	1	..
1	525	476	94	43	267	187	144	191	20	55	114	30	71	11	41	17	2	2
2	2,315	2,805	554	290	1,148	1,131	550	994	63	390	573	133	267	56	296	71	10	6
3	1,113	1,395	308	198	551	656	230	390	24	151	332	114	199	48	129	58	4	8
4	656	708	197	134	338	350	106	182	15	42	250	69	152	26	97	42	1	1
5	432	361	160	91	213	201	55	60	4	9	153	42	93	19	57	22	3	1
6	287	168	123	52	130	92	27	22	7	2	103	32	72	18	30	13	1	1
7	204	111	95	38	91	61	18	11	..	1	74	31	47	19	27	11	..	1
8	132	71	56	26	65	40	10	4	1	1	44	18	33	6	10	11	1	1
9	107	32	60	14	43	12	4	5	..	1	20	8	13	7	7	1	..	..
10	64	20	31	6	29	12	3	2	1	..	20	5	12	3	7	2	1	..
11	21	12	11	6	8	6	2	..	..	..	8	7	7	6	1	1	..	..
12	23	8	11	4	12	3	..	1	..	..	11	..	6	..	5	..	..	..
13	11	4	3	1	8	2	..	1	..	..	5	3	4	2	1	1	..	..
14	5	3	3	1	2	2	..	..	..	..	..	..	..	..	..	..	..	..
15	4	..	..	..	4	..	..	..	..	..	1	..	1	..	..	..	..	..
16	2	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Totals	5,925	6,189*	1,716	905*	2,919	2,765	1,154	1,867	136	652	1,721	492	982	221	715	250	24	21

* Includes one woman for whom the total number of live births was unknown. These columns, therefore, add to one less than the stated totals.

TABLE XIX

Reproductive wastage

Items	White					Negro			
	Totals	Very poor	Poor	Mod. circ.	Well-to-do and rich	Totals	Very poor	Poor	Mod. circ.
15. *Live births produced per 100 pregnancies experienced* (Totals)	89·2	89·0	89·0	89·6	89·6	88·4	87·5	89·7	86·5
(*a*) By primiparae non-contraceptors	97·5	96·9	97·6	97·7	97·6	94·9	94·5	94·9	100·0
(*b*) By primiparae contraceptors	98·3	98·9	98·5	97·8	99·2	97·2	100·0	95·0	100·0
(*c*) By multiparae non-contraceptors	88·2	88·9	88·2	87·2	85·6	87·5	86·6	89·3	80·2
(*d*) By multiparae contraceptors	87·2	87·1	87·0	87·3	87·8	88·6	88·4	88·7	89·5
16. *Reproductive wastage (abortions, miscarriages, and still-births per 100 pregnancies experienced)* Totals	11·8	11·0	11·0	10·4	10·4	11·6	12·5	10·3	14·5
(*a*) Among primiparae non-contraceptors	2·5	3·1	2·4	2·3	2·4	5·1	5·5	5·1	0
(*b*) Among primiparae contraceptors	1·6	1·1	1·5	2·2	0·8	2·8	0	5·0	0
(*c*) Among multiparae non-contraceptors	11·8	11·1	11·8	12·8	14·4	12·5	13·4	10·7	19·8
(*d*) Among multiparae contraceptors	12·8	12·9	13·0	12·7	12·2	11·4	11·6	11·3	10·5

TABLE XX

Age specific mean pregnancy rates per 100 computed ovulations in women living in wedlock, married once only, and free of gynecologic disease, by degree of formal education experienced and race (colour)

A. White Primiparae

		Illiterate		Elementary		High School		College	
Age period	Contra-ception class	N	Mean pregnancy rate	N	Mean pregnancy rate	N	Mean pregnancy rate	N	Mean pregnancy rate
10–14	Non-Con.	0	..	38	10·63 ± 2·55	12	10·63 ± 2·42	0	..
	Con.	0	..	5	2·10 ± 0·96	2	..	0	..
15–19	Non-Con.	20	36·03 ± 5·44	1,286	28·44 ± 0·52	786	28·45 ± 0·69	26	23·67 ± 3·21
	Con.	2	..	425	12·67 ± 0·63	427	12·25 ± 0·61	32	10·61 ± 2·57
20–24	Non-Con.	20	23·75 ± 3·87	1,159	26·14 ± 0·54	818	26·58 ± 0·62	116	22·01 ± 1·54
	Con.	5	24·30 ± 11·04	608	10·70 ± 0·44	884	11·06 ± 0·36	300	10·23 ± 0·66
25–29	Non-Con.	7	27·29 ± 9·29	444	24·13 ± 0·87	278	20·31 ± 0·97	88	24·82 ± 1·93
	Con.	6	4·17 ± 0·91	235	12·77 ± 0·77	425	10·02 ± 0·47	220	10·07 ± 0·67
30–34	Non-Con.	5	10·20 ± 2·37	135	19·69 ± 1·51	77	15·29 ± 1·72	30	19·47 ± 3·06
	Con.	2	..	51	10·07 ± 0·94	112	9·35 ± 0·81	59	13·58 ± 0·84
35–39	Non-Con.	0	..	39	14·54 ± 2·37	27	12·67 ± 1·95	9	12·22 ± 2·21
	Con.	0	..	9	4·06 ± 0·55	27	13·96 ± 2·18	11	7·45 ± 1·02

B. White Multiparae

10–14	Non-Con.	12	3·21 ± 1·31	123	2·22 ± 0·34	16	..*	0	..
	Con.	3	..	66	4·63 ± 0·78	12	..*	0	..
15–19	Non-Con.	109	5·17 ± 0·36	2,231	8·54 ± 0·17	610	9·27 ± 0·35	11	12·05 ± 2·15
	Con.	61	5·74 ± 0·51	1,694	7·16 ± 0·16	868	6·36 ± 0·24	48	3·03 ± 0·56
20–24	Non-Con.	180	8·22 ± 0·40	3,188	10·51 ± 0·14	1,022	11·56 ± 0·29	101	8·67 ± 0·79
	Con.	112	6·96 ± 0·60	2,841	7·50 ± 0·12	1,779	7·65 ± 0·16	329	5·84 ± 0·26
25–29	Non-Con.	174	8·35 ± 0·49	2,326	10·03 ± 0·17	684	10·43 ± 0·33	132	9·11 ± 0·49
	Con.	115	6·72 ± 0·62	2,244	7·53 ± 0·15	1,341	7·98 ± 0·19	412	6·80 ± 0·26
30–34	Non-Con.	149	7·60 ± 0·40	1,281	9·12 ± 0·20	343	10·17 ± 0·43	73	11·22 ± 1·21
	Con.	88	4·84 ± 0·38	1,186	8·72 ± 0·27	581	8·02 ± 0·32	221	8·50 ± 0·55
35–39	Non-Con.	85	10·88 ± 0·90	604	11·71 ± 0·41	120	9·38 ± 0·66	25	18·04 ± 3·00
	Con.	45	7·70 ± 1·50	461	9·53 ± 0·40	189	10·15 ± 0·57	69	11·48 ± 1·38

* All these had a pregnancy rate of zero in the age class, because they became pregnant fewer than nine months before reaching age 15.

C. Negro Primiparae

10–14	Non-Con.	0	..	18	31·44 ± 5·15	7	14·00 ± 8·43	0	..
	Con.	0	..	1	..	0	..	0	..
15–19	Non-Con.	4	28·25 ± 9·45	240	29·83 ± 1·40	219	30·50 ± 1·43	6	33·50 ± 8·68
	Con.	0	..	26	22·92 ± 3·58	38	25·64 ± 2·91	2	..
20–24	Non-Con.	5	26·20 ± 10·51	141	25·11 ± 1·68	100	27·14 ± 1·88	18	27·97 ± 3·88
	Con.	0	..	23	16·57 ± 3·33	17	21·82 ± 4·69	4	13·25 ± 2·58
25–29	Non-Con.	1	..	45	13·98 ± 2·30	24	19·71 ± 3·55	4	24·75 ± 8·34
	Con.	0	..	9	3·39 ± 0·49	5	8·30 ± 3·03	4	8·38 ± 3·27
30–34	Non-Con.	2	..	14	20·00 ± 4·00	4	3·50 ± 1·03	0	..
	Con.	0	..	1	..	3	19·67 ± 9·58	2	..
35–39	Non-Con.	0	..	0	..	2	..	0	..
	Con.	0	..	0	..	0	..	0	..

TABLE XX—*continued*

D. Negro Multiparae

Age period	Contra-ception class	*Illiterate* N	*Illiterate* Mean pregnancy rate	*Elementary* N	*Elementary* Mean pregnancy rate	*High School* N	*High School* Mean pregnancy rate	*College* N	*College* Mean pregnancy rate
10–14	Non-Con.	15	0·90 ± 0·26	100	3·38 ± 0·50	8	2·31 ± 1·14	0	..
	Con.	0	..	29	5·76 ± 1·38	4	5·38 ± 0·21	0	..
15–19	Non-Con.	77	11·98 ± 1·10	850	10·47 ± 0·32	288	10·83 ± 0·49	4	1·75 ± 0·72
	Con.	1	..	226	9·00 ± 0·54	97	10·10 ± 0·90	7	4·14 ± 1·30
20–24	Non-Con.	80	9·40 ± 0·58	928	10·53 ± 0·26	321	15·32 ± 0·65	16	11·66 ± 1·70
	Con.	5	6·20 ± 1·51	285	10·39 ± 0·53	116	11·63 ± 0·81	14	13·82 ± 2·15
25–29	Non-Con.	50	10·38 ± 0·84	617	9·41 ± 0·25	132	13·85 ± 0·93	10	9·25 ± 1·48
	Con.	3	18·00 ± 7·44	190	11·42 ± 0·71	61	11·76 ± 1·18	9	23.50 ± 5·00
30–34	Non-Con.	22	11·66 ± 2·48	292	10·58 ± 0·46	39	8·86 ± 0·99	5	21·00 ± 3·62
	Con.	0	..	101	11·43 ± 0·82	20	8·98 ± 1·21	2	..
35–39	Non-Con.	6	7·83 ± 1·54	97	12·58 ± 0·91	17	9·94 ± 0·86	0	..
	Con.	0	..	36	11·89 ± 1·13	9	19·06 ± 3·91	1	..

TABLE XXI

Age specific mean pregnancy rates per 100 computed ovulations of white women living in wedlock, married once only, and free of gynecologic disease, by broad classes of religious affiliation

A. White Primiparae

Age period	Contra-ception class	*All Protestants* N	*All Protestants* Mean pregnancy rate	*All Catholics* N	*All Catholics* Mean pregnancy rate	*All Jews* N	*All Jews* Mean pregnancy rate	*All 'No Religion'* N	*All 'No Religion'* Mean pregnancy rate
10–14	Non-Con.	35	5·37 ± 1·17	11	10·82 ± 4·42	2	..	2	..
	Con.	5	17·40 ± 10·20	1	..	1	..	0	..
15–19	Non-Con.	1,075	28·49 ± 0·58	871	28·39 ± 0·65	107	29·98 ± 1·84	25	33·90 ± 4·54
	Con.	412	13·72 ± 0·71	297	12·13 ± 0·69	146	9·99 ± 0·86	10	2·60 ± 0·39
20–24	Non-Con.	944	24·37 ± 0·58	966	27·52 ± 0·57	162	26·81 ± 1·53	18	27·14 ± 4·25
	Con.	848	10·31 ± 0·38	447	12·00 ± 0·52	452	11·12 ± 0·52	17	6·79 ± 1·11
25–29	Non-Con.	372	19·11 ± 0·83	354	25·50 ± 0·98	76	29·18 ± 2·22	5	19·80 ± 11·34
	Con.	515	10·17 ± 0·45	149	12·12 ± 0·91	192	11·70 ± 0·79	6	11·00 ± 2·02
30–34	Non-Con.	141	16·47 ± 1·29	84	21·73 ± 2·06	15	18·40 ± 4·14	5	7·40 ± 4·16
	Con.	149	11·36 ± 0·90	38	9·25 ± 1·08	27	9·69 ± 1·36	1	..
35–39	Non-Con.	48	12·28 ± 1·66	18	19·75 ± 3·80	3	4·83 ± 1·11	4	7·75 ± 2·44
	Con.	31	12·29 ± 1·96	11	6·77 ± 0·94	4	9·38 ± 1·12	0	..

B. White Multiparae

10–14	Non-Con.	79	1·81 ± 0·32	57	2·96 ± 0·64	4	..	3	..
	Con.	43	4·10 ± 0·98	31	5·94 ± 0·86	5	0·90 ± 0·23	1	..
15–19	Non-Con.	1,414	8·46 ± 0·20	1,338	8·70 ± 0·22	99	7·30 ± 0·84	38	13·24 ± 2·12
	Con.	1,210	6·92 ± 0·18	956	7·31 ± 0·24	404	5·01 ± 0·24	34	11·10 ± 1·92
20–24	Non-Con.	1,903	10·46 ± 0·20	2,254	10·92 ± 0·18	214	8·71 ± 0·47	42	11·35 ± 1·01
	Con.	2,255	7·61 ± 0·14	1,658	8·22 ± 0·16	1,011	5·62 ± 0·15	39	9·17 ± 0·92
25–29	Non-Con.	1,331	9·52 ± 0·21	1,730	10·58 ± 0·20	181	7·80 ± 0·46	21	12·31 ± 2·06
	Con.	1,867	7·52 ± 0·16	1,229	8·55 ± 0·22	916	6·37 ± 0·17	29	8·21 ± 0·89
30–34	Non-Con.	692	9·18 ± 0·23	1,007	9·57 ± 0·22	106	7·03 ± 0·43	7	9·07 ± 1·97
	Con.	990	8·30 ± 0·25	599	8·42 ± 0·33	445	8·27 ± 0·48	10	8·65 ± 0·93
35–39	Non-Con.	304	10·20 ± 0·50	457	12·13 ± 0·47	52	14·51 ± 1·83	4	4·25 ± 0·72
	Con.	392	9·58 ± 0·44	223	10·46 ± 0·57	130	9·48 ± 0·87	1	..

APPENDIX II

THE purpose of this appendix is to present a complete copy of the instructions given the hospital workers who filled out the record blanks upon which our fertility–contraception study is based. Together with the text of the instruction book that follows are explanatory notes and comments by the writer, so that the reader may more clearly understand the matter. These notes and comments are enclosed in square brackets, to indicate that they did not form a part of the *printed* instructions given the workers.

INSTRUCTIONS TO RECORDERS IN COLLECTING FERTILITY DATA

The purpose of the investigation is to gather a mass of unbiased objective information relative to two primary problems; viz. (1) The extent to which contraceptive (birth control) practices are employed by women in a large sample of the American urban population; and (2) the reproductive histories of this group of normal American women.

The plan for accomplishing this purpose, in which you are asked to co-operate, involves the following elements:

1. The regular and systematic filling out of a simple card form for each and every woman delivered in the obstetrical service of the hospital with which you are connected.

2. These cards will be furnished by the Department of Biology. They will be filled out by a designated member of the staff (resident, intern, or other, but *not* a nurse). For this service a fee of five cents per card will be paid.

[The idea of the restriction as to who should fill out the cards was that the data should always be taken by medically trained persons, having the confidence of the patient, on the one hand, and the technical knowledge and training, on the other hand, to ensure the scientific accuracy and completeness of the records. As a matter of fact, as the work progressed, it became necessary in a few cases to employ graduate nurses for the actual record making, working under the supervision of a staff member. In each such case they have done the work faithfully and intelligently. In fact, some of the best records turned in during the whole investigation, from the standpoint of neatness, completeness, fullness, and intelligence of notes, and precision in quantitative details, were produced by some of these graduate nurses.]

HOSPITAL
OBST. NO.

DATE OF DELIVERY

LEGIT OR ILLEGIT.

DO NOT WRITE IN THIS SPACE

COLOR: W. C
RACE STOCK
RELIGION
HAS PATIENT ANY GYNECOLOGICAL DISEASE? IF SO SPECIFY.

REPRODUCTIVE HISTORY
INCLUDING PRESENT ADMISSION

PREGNANCY	YEAR	RESULT
1		L. S. M. T. O.
2		L. S. M. T. O.
3		L. S. M. T. O.
4		L. S. M. T. O.
5		L. S. M. T. O.
6		L. S. M. T. O.
7		L. S. M. T. O.
8		L. S. M. T. O.
9		L. S. M. T. O.
10		L. S. M. T. O.
11		L. S. M. T. O.
12		L. S. M. T. O.
13		L. S. M. T. O.
14		L. S. M. T. O.
15		L. S. M. T. O.

L=LIVE BABY S=STILL BORN.
M=SPONTANEOUS MISCARRIAGE
T=THERAPEUTIC ABORTION
O=OTHER ABORTION

HAS PATIENT EVER USED ANY METHOD FOR PREVENTION OF CONCEPTION? YES. NO
(FILL IN DETAILS ON OTHER SIDE OF CARD)

DATE OF BIRTH OF PATIENT?
DATE OF BIRTH OF HUSBAND?
DATE OF MARRIAGE?

WARD, PAY, OR PART PAY PATIENT

OCCUPATION OF HUSBAND?

EDUCATION OF PATIENT { ILLITERATE. ELEMENTARY SCHOOL HIGH SCHOOL COLLEGE

ECONOMIC POSITION { VERY POOR POOR MODERATE CIRCUMSTANCES WELL-TO-DO RICH

HAS PATIENT EVER HAD SELF-INDUCED ABORTION? YES. NO.
HAS PATIENT EVER HAD ABORTION INDUCED BY SOMEONE ELSE? YES. NO
(IF ANSWER IS YES IN EITHER CASE, DESCRIBE METHOD USED)

NOTES:

THIS CARD WAS FILLED OUT BY:

OVER

FIG. A. History card used in the investigation. Obverse.

METHODS OF CONTRACEPTION USED
(TO BE FILLED IN WITH AS MUCH DETAIL AS POSSIBLE)

METHOD	CHECK USE	HOW LONG WAS EACH OF SPECIFIED METHODS PRACTISED?	WHAT IS PATIENT'S OPINION AS TO EFFECTIVENESS OF METHODS SHE HAS USED?
COITUS INTERRUPTUS (WITHDRAWAL)			
CONDOM { RUBBER / SKIN			
PESSARY ALONE			
PESSARY WITH MEDICATED JELLY			
PESSARY WITH DOUCHE			
MEDICATED VAGINAL SUPPOSITORIES OR JELLIES*			
DOUCHE ALONE—WATER			
DOUCHE ALONE—MEDICATED*			
INTRA-UTERINE MECHANICAL DEVICE*			
"SAFE PERIOD" (ABSTINENCE DURING PART OF MONTH)			
ANY OTHER METHOD*			

* SPECIFY KIND HERE:	DO NOT WRITE IN THIS SPACE

OVER

FIG. B. History card used in the investigation. Reverse.

3. The accumulated cards from the previous week properly filled in will be mailed each Monday morning, in self-addressed envelopes which will be furnished for the purpose. You will be reimbursed for the postage.

4. The data will be analysed and tabulated in the Department of Biology, and from time to time progress reports upon the investigation will be issued.

Primary essentials to a successful and significant outcome to the investigation are:

1. Painstaking accuracy in getting the information and putting it on the cards.

2. Absence of selection of cases. *Every* case delivered in the hospital should be included.

3. Systematic and prompt return of the cards to the Department of Biology.

The Supervising Field Worker will explain the details of the plan and help you to get started. The work began with the leading hospitals in Baltimore, and has gradually extended to other cities in the eastern part of the United States.

INSTRUCTIONS FOR FILLING OUT THE CARDS

A. *General Instructions*

(*a*) The records on the cards should always be made in ink.

(*b*) Please write legibly. In particular, be careful to make all *figures* perfectly legible.

(*c*) Whenever *dates* are called for in the record do not *abbreviate*, but write them out in full as, for example, March 12, 1930. Such a record for the date as 3/12/30 *is not acceptable*, because it is ambiguous. A statistical worker two years hence in the laboratory can never be quite sure whether you meant March 12th or December 3rd.

(*d*) Before starting the work read *all* the instructions over carefully and thoughtfully, comparing them at each point with the card.

B. *Special Instructions*

1. Hospital. The *name* of the hospital will be filled in here, either in writing or by means of a rubber stamp.

2. Obst. No. This means the obstetrical case or service number of the particular patient to whom the card applies, in the series of case histories of the particular hospital where the record is made. It should be filled in by the worker. It might be for example, No. 18,476 of the case histories in the Obstetrical Service of the Johns Hopkins Hos-

pital. The purpose of recording it on the card is to provide for the contingency that it might be necessary for us at some time to look up again the original hospital history.

3. Date of Delivery. Write out in full, as August 30, 1931, the date when the patient to whom the card applies was delivered of her baby (or alternatively the date when her pregnancy was terminated in some other way). This will also, of course, be the date of birth of the baby.

4. Legit. or Illegit. If the baby is *legitimate* draw a line around Legit. If the baby is *illegitimate* draw a line around Illegit.

5. Colour. If the woman to whom the card applies is *white*, draw a line around W. If the woman is *coloured*—Negro, mulatto, &c.—draw a line around C.

6. Race Stock. The purpose of this item is to get some record of the racial origins of the persons included in the records. There follows a printed list of the official designations of racial stocks which may be found represented in the American population. Against each of these titles is a code number. These code numbers may be used instead of the titles in filling out this item on the cards.

RACIAL CODE

00 Scandinavian
01 Swede
02 Norwegian
03 Dane
04 Finnish

10 German
11 Dutch
12 Flemish

20 Russian
21 Slovak
22 Lithuanian and Ruthenian
23 Polish
24 Magyar
25 Croatian
26 Bohemian and Moravian
27 Bulgarian, Serbian, Montenegrin
28 Roumanian
29 Dalmatian, Bosnian, and Herzogovinian

30 Hebrew

40 English
41 Irish
42 Scots
43 Welsh

50 Italian, South
51 Italian, North
52 French
53 Portuguese
54 Spanish
55 Greek

60 Syrian
61 Armenian
62 Turkish

70 Cuban
71 Mexican
72 West Indian (except Cuban)
73 Spanish-American

80 Japanese
81 Chinese
82 Korean
83 East Indian
84 Pacific Islander

90 Negro

98 North American (to be qualified in every case by indication of racial stock from which descended)

Thus, if a woman is native born of native parents, the appropriate designation is $98 \left\langle \begin{matrix} 98 \\ 98 \end{matrix} \right.$.

If it is known that the woman is native born of native parents, but the parents were of German descent, the appropriate designation is $98\left\langle\begin{matrix}98\text{–}10\\98\text{–}10\end{matrix}\right.$.

If the woman is native born but of German parents the appropriate designation is $98\left\langle\begin{matrix}10\\10\end{matrix}\right.$, but if her father was German and her mother English, the appropriate designation is $98\left\langle\begin{matrix}10\\40\end{matrix}\right.$.

If the woman is a Russian Jewess, the appropriate designation is 30–20.

It is hoped that the above examples will make clear the method of procedure under this item. But if there is any doubt or difficulty either write to Doctor Pearl or consult the Supervising Field Worker upon her next visit to your hospital, for further explanations and instructions.

[This plan originally adopted (necessarily in the absence of any extensive or detailed knowledge of the material itself, be it noted, because when one starts coding new material one has to start, and therefore has to build his codes *a priori*) was that the coder (R.P.) could assign such a two-figure code number to indicate preponderance of race stock back of the individual as in his judgement the record set down on the history (in the manner described above) warranted. In other words, the code numbers on this item represented really a sort of combined anthropological, genetic, and geographical judgement reached by one person (the coder) from the factual information at hand.

This plan was followed with slowly growing dissatisfaction until some 14,000 histories had been so coded. The dissatisfaction arose from various considerations. The first and most important was the essential lack of clear, precise, objective meaning to be attached to the concept 'race' or 'race stock' in the premisses. The factual record included no anthropometric measurements or even photographs of the individual. What the record gave at best was only information of the country or countries of origin of the stirps from which the individual came. Then the problem presented by a woman whose father's parents were German and whose mother's parents were French, for example, was a problem that could only be settled, in the sense of assigning a code number, by some completely arbitrary procedure within the restriction necessarily imposed by a two-column field on the punch card and therefore a two-digit code number. The arbitrary procedure could, of course, be made uniform for all such cases, and was, but after all this was only the tiniest crumb of comfort biologically.

So then a new plan for coding race was adopted and continued through the remainder of the histories. This was to code simply by nativity into the following classes:

Native born of native parents.
Native born with one parent foreign born, the other native.
Native born of foreign parents.
Foreign born.
Native born, without specification of parent nativity.

It became clear that this plan was going to furnish much more useful and biologically valid and meaningful information than the first plan. Logically, the thing then to have done would have been to go back and do over again the first 14,000 odd cards on this new plan. This was not done, for two reasons. In the first place, a substantial part of the 14,000 odd cards had already been punched, and with only one person available to do all the punching as well as the many other operations in connexion with the enterprise that have already been specified we simply did not feel justified in taking the time and expense that would have been necessary. In the second place, samples of 14,000 to 16,000 each are statistically substantial, and it seemed of some interest to leave the situation so that we could examine the fertility results both ways relative to this race or nativity factor. So that is what we did. In so far as a sin has been committed, the writer, who is alone responsible, confesses and apologizes, with the hope of at least partial absolution in the light of the explanation.]

7. Religion. Write in the religious affiliation or preference of the patient, as, for example, Methodist, Catholic, Jewish, &c.

8. Gynecological Disease. If the patient has, or at any time in her life has had any gynecological disease, such as, for example, salpingitis, uterine myomata, &c., write down its name in this space. If she has ever been surgically treated for any gynecological disorder this fact should be specified, as, for example, 'dilation and curettage following abortion', &c.

[The Supervising Field Workers instructed the hospital personnel in detail regarding this 'gynecological disease' item, especially emphasizing that it was to include venereal diseases, and their after-effects, the results of Wassermann tests, &c.]

9. Reproductive History. The purpose of the three columns under this head is to include a succinct but complete record of all the pregnancies which the woman who is the subject of the card has ever had. It is one of the most important records of the whole study.

Therefore great pains and care should be taken in filling it out, to the end that the resulting record may be accurate and complete.

(*a*) *Pregnancy*. The first column prints the ordinal number of the patient's successive pregnancies, whatever their outcome, beginning with the first and going to the 16th. In case that some particular woman is pregnant for the 16th (or some greater) time, the table should be extended as far as necessary by attaching to her card a sheet of paper setting forth the additional data for which there is no space on the card.

(*b*) *Year*. In this column is to be recorded the *year* in which each successive pregnancy *terminated*. Thus, if the patient had her first baby born in 1917, you will write in the year column, in the row marked '1', the figures 1917, and correspondingly, *mutatis mutandis*, for all other pregnancies, *including the present one*.

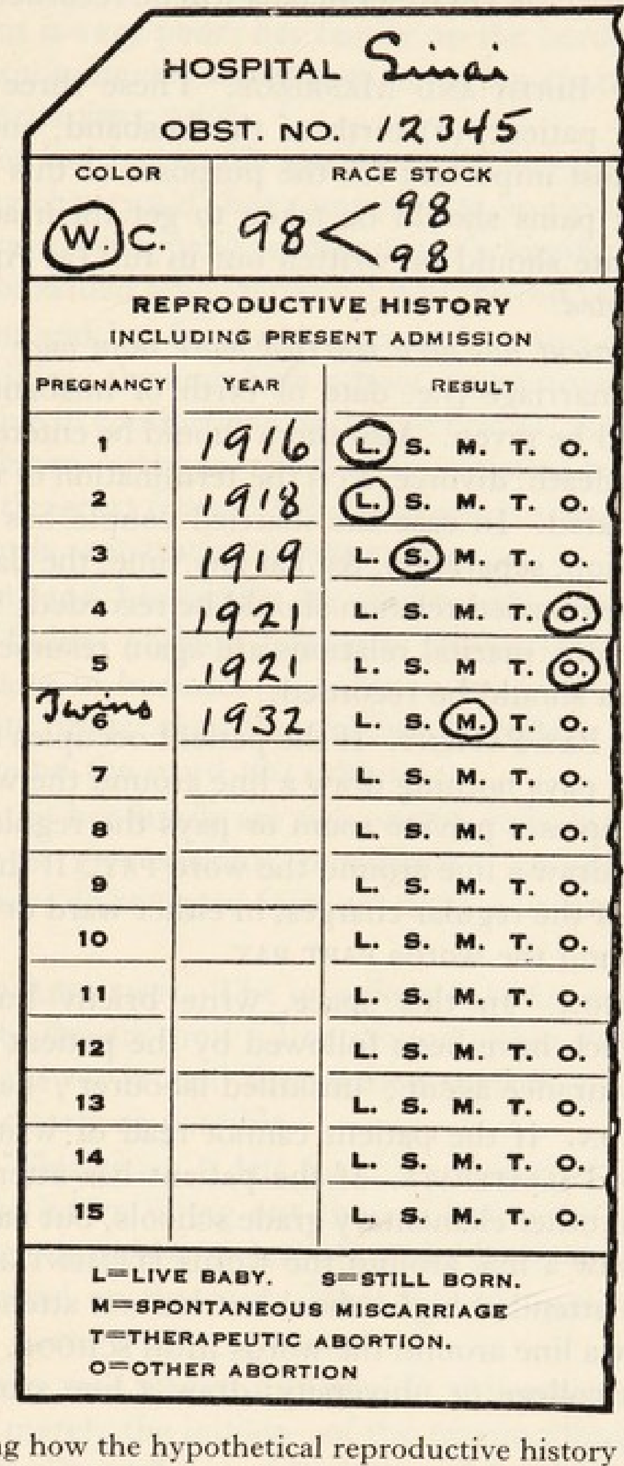
(*c*) *Result*. Each of the patient's pregnancies must terminate, or have terminated, in one, and only one, of the following ways: (1) By the birth of a live baby. If this is a fact draw a circle around the 'L' in this column; (2) By the birth of a still-born baby, in which event draw a line around the 'S' in this column; (3) By a spontaneous miscarriage at any time in the course of the pregnancy, in which event draw a line around the letter 'M' in this column; (4) By an abortion legitimately induced by a qualified medical man for therapeutic reasons (such as danger to the mother's life from some complicating disease) at any time during pregnancy, in which event draw a line around the letter 'T' in this column; (5) By an abortion induced for criminal or other non-therapeutic reasons, in which event draw a line around the letter 'O' in this column.

In case a particular pregnancy results in *twins* the fact should be noted on the card, in connexion with the year of that pregnancy. Further, it should be noted for each of the pair of twins whether it was 'L', 'S', 'M', 'T', or 'O', in the manner indicated above for single births.

The method of filling out the records under this general head *Reproductive History* may be made clearer by describing a hypothetical case and illustrating the filled out card.

A woman had her first pregnancy and a live baby in the first year after her marriage in 1916. This was followed by a second pregnancy and live baby two years later. In the following year, a pregnancy led to a still-born child. In the second year following, she became pregnant twice, and resorted to an abortionist both times. There followed a long rest till the present pregnancy which resulted in a spontaneous miscarriage of twins.

The record of this woman's reproductive history would appear on the card as shown in Fig. C.



HOSPITAL Sinai

OBST. NO. 12345

COLOR	RACE STOCK
W. C.	98 < 98 98

REPRODUCTIVE HISTORY
INCLUDING PRESENT ADMISSION

PREGNANCY	YEAR	RESULT
1	1916	L. S. M. T. O.
2	1918	L. S. M. T. O.
3	1919	L. S. M. T. O.
4	1921	L. S. M. T. O.
5	1921	L. S. M T. O.
Twins 6	1932	L. S. M. T. O.
7		L. S. M. T. O.
8		L. S. M. T. O.
9		L. S. M. T. O.
10		L. S. M. T. O.
11		L. S. M. T. O.
12		L. S. M. T. O.
13		L. S. M. T. O.
14		L. S. M. T. O.
15		L. S. M. T. O.

L=LIVE BABY. S=STILL BORN.
M=SPONTANEOUS MISCARRIAGE
T=THERAPEUTIC ABORTION.
O=OTHER ABORTION

FIG. C. Showing how the hypothetical reproductive history described in the text will appear when recorded on the card.

10. FIRST CONTRACEPTIVE QUESTION. If the patient has ever used any method or methods for the prevention of conception, or any methods which she used in the belief that they would produce such effect, draw a line about the word YES in this space.

If she has never used any such methods of any sort whatever, draw a line around the word NO in this space.

In case the answer is YES fuller details will be recorded on the other side of the card.

11. DATES OF BIRTH AND MARRIAGE. These three dates of the (*a*) birth of the patient, (*b*) birth of the husband, and (*c*) of their marriage, are most important for the purposes of this investigation. Therefore great pains should be taken to get them accurately. In each case the date should be written out in full (as April 10, 1931) and *not abbreviated*.

In case the patient has been married more than once the necessary dates for *each* marriage (i.e. date of birth of husband and date of marriage) should be given. Also there should be entered the date of, and reason for (death, divorce, &c.) the termination of each marriage that has terminated. In case the married couple has ceased living together (desertion, separation, &c.) at any time, the date of such interruption of the married relation should be recorded. Also if, under such circumstances, marital relations are again resumed, the date of such resumption should be recorded.

12. WARD OR PAY PATIENT. If the patient occupies a free ward in the hospital and pays nothing draw a line around the word WARD. If the patient occupies a private room or pays the regular charges for hospitalization, draw a line around the word PAY. If the patient pays for only a part of the regular charges, in either ward or private room, draw a line around the words PART PAY.

13. OCCUPATION. In this space, write briefly but clearly, the occupations which have been followed by the patient's husband, as 'machinist', 'insurance agent', 'unskilled labourer', 'barber', &c.

14. EDUCATION. If the patient cannot read or write draw a line around the word ILLITERATE. If the patient has attended primary, intermediate, or other elementary grade schools, but has *not* attended high school, draw a line around the words ELEMENTARY SCHOOL. If the patient has attended high school but has *not* attended college or university draw a line around the words HIGH SCHOOL. If the patient has attended a college or university, draw a line around the word COLLEGE.

15. ECONOMIC POSITION. The purpose of this item is to provide a further approximation to the social and economic status of the patient. It is realized that this is a difficult and embarrassing matter to take up directly with the patient. On this account the classification is purposely made very broad, because it is expected that only the interne's judgement or estimate of the situation will be given. But in most

cases the interne will, in fact, have a fairly accurate notion of the economic status of each patient.

The classification is intended to have the following meanings:

If the patient is very poor; her family on the border line of actual subsistence requirements; sometimes requiring charity; draw a line around the words VERY POOR.

If the patient and her family are above the last-mentioned status; never requiring charity aid; but compelled to live in the most careful and modest way; the typical working-man's family (except for the upper grades of skilled labour) draw a line around the word POOR.

If the patient and her family have enough to live on comfortably; educate the children through high school, enjoy modest luxuries and amusements, live in comfortable well-kept homes; as the upper levels of skilled workmen, artisans, small shop-keepers, &c., in short like the *average* of the great mass of the American population, draw a line around the words MODERATE CIRCUMSTANCES.

If the patient and her family are well-to-do; able to live in part from invested funds; perhaps belong to the professional classes; or managerial classes in business; are able to have whatever they want within moderate limits; send the children to college and university; draw a line around the word WELL-TO-DO.

If the patient or her family are rich or very rich; beyond the necessity of having to give serious consideration to economic matters because they have an invested fortune; draw a line around the word RICH.

16. INDUCED ABORTION. The questions here are self-explanatory. To indicate the answers draw a line around either YES or NO.

In case the answer is 'yes' the method used should be described briefly, but as clearly as possible.

17. NOTES. This space is left for the purpose of permitting and encouraging the intern filling out the card to write down *anything whatever* that seems *to him* (*or her*) of special interest about the particular case reported on the card. Here is your opportunity. Please use it.

18. THIS CARD WAS FILLED OUT BY. In this space should appear the *name*—not merely the initials—of the person filling out the card. If requested, the Department of Biology will furnish gratis a rubber stamp for this purpose.

19. METHODS OF CONTRACEPTION USED. We come now to the reverse side of the card. The information called for here forms, in a way, the keynote of the investigation. To get this information from the patient requires tact on the part of the worker, and the establishment

of relations of mutual confidence with the patient. Long experience in similar investigations has demonstrated, however, that it is possible to get the desired information in an accurate and trustworthy form in at least 99 per cent. of all cases, provided the worker approaches the matter intelligently, sympathetically, and persistently. The Supervising Field Worker will give you personal instructions and suggestions regarding methods of handling the patient relative to this matter which have proved useful in previous experience. Do not accept a statement from the patient to the effect that she has never used any contraceptive method until by further questioning and study of her reproductive history in its entirety you are satisfied that her statement represents the real facts.

In the first column are listed all the commonly practised methods of contraception. The patient may have used one or more, or none of these methods, or various combinations of them.

In the second column put check marks against any methods used.

In the third column write, in the same line as the checked methods, a statement of the length of time this specified method was used, as accurately as possible.

In the fourth column write down the patient's own opinion about the specified method.

Fig. D gives an example of a hypothetical case which will indicate the sort of record desired.

[The coding of contraceptive procedures needs detailed explanation. In coding the extensive and manifold information on the original record cards a distinction was made between contraceptive *genus* and *species*. By contraceptive genus is meant how, in general, contraception has been practised; and by contraceptive species what particular device or method or combination of devices and methods was used. The distinction will be made clearer by the presentation of the entire contraceptive genus code, and the beginning and samples from the contraceptive species code.

CONTRACEPTIVE GENUS CODE

Code No.	*Way in which contraception was practised*
B	No information.
X	Practice of contraception intermittent without statement of reason for intermittence.
0	No contraception practised.
1	Contraception regularly and steadily practised without intermittence.
2	Contraceptive practice intermittent through carelessness.
3	Contraceptive practice intermittent through dislike.

METHODS OF CONTRACEPTION USED
(TO BE FILLED IN WITH AS MUCH DETAIL AS POSSIBLE)

METHOD	CHECK USE	HOW LONG WAS EACH OF SPECIFIED METHODS PRACTISED?	WHAT IS PATIENT'S OPINION AS TO EFFECTIVENESS OF METHODS SHE HAS USED?
COITUS INTERRUPTUS (WITHDRAWAL)	✓	First 18 months after marriage	Fairly safe but not satisfying to either husband or wife.
CONDOM { RUBBER / SKIN }	✓	Occasionally throughout wedlock, especially when travelling.	Unsatisfactory. Accidentally broke with resulting pregnancy.
PESSARY ALONE			
PESSARY WITH MEDICATED JELLY			
PESSARY WITH DOUCHE	✓	Regularly since abandonment of coitus interruptus until Jan. 1929.	Safe, but too much trouble
MEDICATED VAGINAL SUPPOSITORIES OR JELLIES*			
DOUCHE ALONE—WATER			
DOUCHE ALONE—MEDICATED*			
INTRA-UTERINE MECHANICAL DEVICE*	✓	From Jan. 1929 to March, 1931, when all contraception was stopped to produce "wanted" baby.	Perfectly satisfactory.
"SAFE PERIOD" (ABSTINENCE DURING PART OF MONTH)			
ANY OTHER METHOD*			

*SPECIFY KIND HERE: Gold "hairpin" inserted in uterus by physician Monthly inspection, removal, and cleaning by physician.

DO NOT WRITE IN THIS SPACE

OVER

FIG. D. Reverse side of record card filled in for a hypothetical case.

Code No.	*Way in which contraception was practised*
4	Contraceptive practice intermittent through planning for children.
5	Contraceptive practice intermittent through carelessness and dislike.
6	Contraceptive practice intermittent through carelessness and planning.
7	Contraceptive practice intermittent through carelessness and dislike and planning.
8	Contraceptive practice intermittent through dislike and planning.
9	Contraceptive practice intermittent for other reasons.

The three-digit code for contraceptive species was built up on the plan of assigning a separate code number for each of the eleven different methods of contraception specified on the *verso* of the original record card, and for each possible combination of these in either space or time or both, by twos, by threes, and so on.

PART OF CONTRACEPTIVE SPECIES CODE

Code No.	*Contraceptive methods and/or devices used*
BBB	No information.
XXB	Observer regards information as unreliable.
000	No contraception.
001	Coitus interruptus only.
002	Condom only.
003	Pessary alone only.
004	Pessary with medicated jelly only.
005	Pessary with douche only.
006	Medicated vaginal suppositories or jellies only.
007	Douche alone—water—only.
008	Douche alone—medicated—only.
009	Intra-uterine mechanical device only.
010	'Safe period' only.
011	Any other method only.
012	Coitus interruptus and/or condom together or alternately.
—	&c., &c., &c.
—	&c., &c., &c.
—	&c., &c., &c.
—	&c., &c., &c.
436	Pessary alone and/or pessary with medicated jelly and/or pessary with douche and/or medicated vaginal suppositories or jellies, together or alternately in any combination as to time.
—	&c., &c., &c.
—	&c., &c., &c.
—	&c., &c., &c.
801	Investigator (R.P.) on basis of internal evidence in the history regards data on contraception as unreliable.
—	&c., &c., &c.
—	&c., &c., &c.]

The above instructions, save for the parts here included in square brackets, were bound up into books, and a copy of this book was given to each co-operating physician, resident, intern, or nurse, together with a supply of cards and envelopes by one of the Supervising Field Workers. These women, of whom there were three in the course of the investigation, were really travelling organizers and instructors. One of them would go to a city, visit the obstetrician-in-chief of each of the hospitals whose co-operation was desired, and explain to him the purpose, plan, and method of the study, and solicit his general co-operation. After this had been secured, as it almost invariably was when requested, contacts were made with the residents or interns who were to be responsible for filling out the history cards. The Supervising Field Worker then instructed them in detail as to how the work was to be done, often spending several days and working with them in getting records from the patients. The early record cards from any given hospital first went to the Supervising Field Worker while she was still in the city, so that she might check and re-check the reporting on the ground and until the workers had become thoroughly familiar with the routine and had met some of the puzzling situations that were constantly arising.

The three Supervising Field Workers were all trained medical women, experienced in social as well as medical work. They were: Iva M. Miller, M.D., C.P.H., who worked from July 1, 1931, to the end of February 1932; Gertrude Sturges, M.D., and Dorothy Cobb Adams, M.D., both of whom worked from February 1932 to the termination of the record taking in January 1933. It is impossible to speak in too high praise of the work these women did. I am extremely grateful for the faithful, loyal, and efficient efforts they gave to the project.

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The following list of literature contains only titles that have been consulted, and in large part specifically cited, in the preparation of this book. It represents only a selected fraction of the writer's much more extensive working bibliography of fertility, population, and cognate subjects. Perhaps it may, even so, be found useful on its own account by professional students of population, particularly because many such workers seem not to be aware of the considerable amount of material of direct interest to them that is buried in medical and biological journals. Because the aim has been throughout the writing of this book to confine the bibliography strictly to material directly consulted or cited, there are omissions that will at once strike the eye of the professional population student. For these gaps the only apology the writer can offer is that of consideration of space—and he is fully aware of the fact that expediency at the best always has a faint odour of sin about it, and he is correspondingly sorry and abased. But, after all, there are limits beyond which an author cannot vex his publisher, and the bibliography as it stands is long.

Strictly logical alphabetization of personal names is a perpetual thorn in the flesh of bibliographers. In fact, few persons have ever lived who were such complete and soulless disciples of Procrustes as to achieve it. Furthermore, national customs about personal nomenclature vary greatly. In the following list these rules have been fairly consistently followed: (1) all German letters carrying the umlaut are treated as though written out (ö = oe, &c.); (2) *Mac's*, *Mc's*, and their ilk are put where they come in strict alphabetization regardless of capitals and punctuation; (3) prefixes like *von*, *van*, *de*, &c., are divorced from their following patronymics (Adele von Jankovich-Simon makes her contribution as Jankovich-Simon, Adele von, for example), save in the case of the Latin races, where the name *before* the *de*, for example, is the one used more as Anglo-Saxons use their father's family name (e.g., Macias de Torres, E.).

Persistent and strenuous efforts have been made to eliminate errors in the following list, but it is too much to hope that we have been wholly successful.

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The individual States in the United States are not separately indexed except where there is a special reason for so doing, other than appearance in a table or list.

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