duction and contraceptive methods, and the practice of family planning.

Against the background of the demographic argument, presented in the preceding section, we must inquire into the social factors, broadly defined, that are involved in population growth and its control. Here we deal with many of the basic elements affecting human behavior: cultural institutions, religious beliefs, economic arrangements, family organization, sexual practices. All these and more are involved in the determination of attitudes and practices related to human fertility and in any effort to change such attitudes and practices.

It is encouraging to note that the norm of the small family and the practice of family limitation have been established across a wide range of societies: across religious affiliations (Catholic Southern Europe and Protestant Northern Europe); political ideologies (the United States and the Soviet bloc); industrial and agricultural economies, rich and poor nations, better-educated and poorer-educated societies (all European); the West and the East (as in Japan); and, just beginning, the tropical countries as well as the temperate ones.

Almost every survey on attitudes toward family planning, from urban areas in the United States to villages in India, shows that a large proportion of people say they are favorable to the idea of limiting family size, and especially after the third or fourth child—roughly 60 to 80 per cent over all, both men and women. The figures vary somewhat from one locality to another and, of course, the interview questions are varied, but there is an impressive body of favorable interview responses from Mysore and Singur in India; from low-income women in Pakistan; from Mexican factory workers; from Ceylon and Japan; from Jamaica and Puerto Rico; from the United States and Great Britain. Many persons of the world are now persuaded, at least in principle, of the desirability of limiting family size —limiting the birth of children to the number wanted, when they are wanted. The major single reason for this attitude toward family planning, in all areas where it exists, is concern for the economic welfare of the family—a better standard of living and a better chance in life for all children.

Information about family planning is unevenly disseminated in all countries, especially in the less-developed areas; it is usually sparse

and rudimentary among the large, poorer, rural masses. Studies in certain districts of India have shown, for example, that even elementary knowledge about contraceptive methods is limited to approximately 20 to 25 per cent of the married population, and is even more limited among the illiterate in rural areas. Among such populations, most people do not know of the possibility of birth control except by abstinence; such knowledge of contraceptive methods as there is is poor; folk superstitions are abundant.

The *use* of contraception is also uneven throughout the world. In the United States, 70 to 80 per cent of all married couples have used contraceptive devices. In Puerto Rico, the figure is approximately 40 per cent; in the Far East, except for Japan, perhaps not over 10 per cent. Given the prevailing conditions of life in the less-developed areas, only the simplest methods can be employed.

In every population, the urban, the better-educated, and the more modernized groups accept and use contraception earliest, most often, and most effectively. Such people are a small minority among the populations in less-developed areas, of course; even a large decrease in their birth rates would have little effect upon the total national figures.

This quick review begins to suggest some of the social factors that in different areas stand in the way of family limitation in emerging nations.

Familial factors

High marriage rates: Almost all mature women are married.

Early marriage: Virtually the whole range of reproductive years is available for childbearing.

Status of women: Few alternatives to the domestic role are available; the customary male dominance confines women to care of home and children.

Desire for children, especially sons: This may be for familial reasons (care of parents in their old age), economic reasons (workers in an agricultural economy), or status reasons (many sons implying a manly father). A wide range of social values has traditionally supported the appropriateness of the large family, especially when coupled with traditionally high mortality rates.

Little differential fertility: The model of the small family is not apparent within the society.

Personal factors

Housing facilities: There is little or no privacy for parents, and there are few facilities for sanitation, storage of contraceptive supplies, and other personal requirements.

Social support: In some societies there may be little conversation about the subject because of its personal nature, and hence little opportunity for the development of necessary social rapport and support; the occasional practitioner of family planning may therefore feel that he is an alien in his own community.

Absence of social rewards: As a consequence of the above, the innovator in family planning does not receive the social rewards needed to encourage his innovating behavior (as he might, for example, in connection with innovation directed toward improving agricultural practices), and the reward of not having unwanted children is both remote and, with many traditional methods of contraception, problematic.

Attitudinal factors

Religious, moral, political, or ideological objections to fertility control: These often apply to particular contraceptive methods, and sometimes to any method whatever.

Peasant inertia, apathy, resistance to change: These tend to color the whole of life in many societies, and thus to make innovation of any kind difficult.

Strength of motivation: The highest motivation for fertility control may be felt when nothing needs to be done, i.e., during pregnancy or soon after delivery. With some contraceptive methods, it may even be that motivation declines with successful practice, through carelessness and false confidence.

Communication factors

Ignorance of purposes, means, and consequences of family planning: The concept of voluntary fertility control is often accepted when presented, but communication is sometimes difficult.

Low literacy: Especially when women are illiterate, informational programs are handicapped from the outset.

Perception of lowered mortality: Decline in the death rate is not always quickly apparent, so considerable time is required to establish the recognition that it is no longer necessary to bear several children in order for some to survive; in some cases, a decline in infant mortality within the community is viewed as an increase in births, with no appreciation of the fact that the death rate has been reduced.

Lack of communication between husband and wife: The necessary joint decision may be difficult when sex and reproduction are not considered appropriate topics of conversation between husband and wife.

Organizational factors

Dispersal: Populations are typically divided into many small villages, complicating the problems of communication and supply.

Lack of trained personnel: The necessary administrative leadership and technical competence to support a mass program are often lacking.

Economic factors

Lack of distribution facilities: Economic arrangements are typically inadequate to cope with problems of distribution, partly because of the dispersal of populations noted above and partly because of the rudimentary character of economic systems.

Costs: These may be too high for the individual or the society.

In short, a program for voluntary fertility control often faces an apparently insurmountable barrier of traditional behavior in traditional societies, reinforced by social customs and cultural arrangements of long standing. These are formidable obstacles to the success of any effort to promote voluntary fertility control in the type of society that needs it most. The difficulties are altogether real and discouragingly numerous. Only the importance of the task would appear to justify the necessary effort.

But there are also some favorable factors in the situation that should not be overlooked or underestimated. The first is the growing recognition of the problem by major social institutions, including governments, and their consequent support of study and action programs on population control. Among the governments most involved,

India, Pakistan, and Korea have taken steps toward a solution. During the long decline of the birth rate in the West, there was active resistance by major legal, governmental, medical, and religious institutions, but family planning was nevertheless undertaken by individual couples without institutional support. In many of the less-developed areas, there is now active institutional support, and governments are in the forefront of the movement rather than lagging behind.

Another favorable factor is large-scale social change. The pace of the modern world is being felt even in the most backward areas, and there are accelerating trends toward industrialization, rationalization of agriculture, better health and sanitation, greater literacy and education, the freeing of women—in short, toward modernization of societies in general. Fertility regulation is part of this movement and hence benefits from whatever advances are made. Unfortunately, such progress is slow.

In the past decade or so, there have been several systematic attempts to study the impact of efforts to spread the practice of family planning. (By "systematic" we mean more or less controlled experiments in natural settings with reasonably careful measurement of the consequences beyond clinical activity.) Eight to ten such efforts are now going on, some of them continuations of earlier efforts. Such studies have been or are being made in India, Pakistan, Ceylon, Taiwan, Japan, Puerto Rico, Jamaica, and the United States. In spite of the critical importance of the problem, however, only about fifteen of these limited efforts have been made to find out whether and how voluntary regulation of fertility can—with presently available techniques—be implemented among populations that need it most.

We can draw some tentative conclusions from these studies:

1. There is a wide range of motivation for family planning in all societies investigated. Substantial numbers of people at the lower end of the economic and literacy range perhaps cannot be interested, at least within a period of five years or so, but a significant number at the other end (especially those with large families), representing at least a fourth to a third of the community, appears to be ready now. Voluntary fertility regulation in such countries, at least with traditional methods, is thus much more a matter of stopping childbearing than of spacing it. In all probability, the best way to motivate new users is to satisfy those that are already motivated.

2. Clinical programs alone do not appear to be sufficient for the task.

3. Continued promotion in the field is necessary for continued effect; the point of self-maintaining activity is hard to reach. At the same time, it seems clear that it is not necessary to reach an entire population in order to achieve substantial effect. In some areas the people themselves help to spread information through informal and often highly effective channels.

4. Personal communication between field workers or local leaders and the people is apparently the best single influence for the adoption of voluntary fertility control in many areas, though mass communication may become increasingly important.

5. Experimental efforts to promote family planning with traditional contraceptives that require sustained motivation and preparatory action often fail. The number of people willing to accept the idea is not large and the number of continuing users is even smaller.

6. Results of the few successful efforts so far suggest that the use of traditional contraceptives can be expected to produce an average reduction of five to seven points in the birth rate in less-developed areas in a period of five years (for example, from 42 births per thousand population to 35-37 per thousand). Because of the backlog of interest among large families, the reduction is often greater in the first year than in subsequent years.

7. Despite all the difficulties, successful results can be obtained. In a set of Indian villages, continuous personal contact by field workers providing information, support, and supplies led to a five-point reduction in the birth rate in a period of four years. In some villages in Ceylon a similar program has apparently produced a seven-point decrease within three years. In a county of Taiwan, personal contact through a health service resulted in a birth rate for the users of contraception ten points below that of a matched group. In some Japanese villages a similar program was successful in turning a substantial proportion of couples from abortion to contraception. In Puerto Rico, an informational program increased the use of contraceptive methods by 10 to 20 per cent, and the distribution of free supplies through volunteer leaders attracted new users among those with many children. A similar informational program in Jamaica doubled the proportion

of users in urban but not in rural areas. As a result of a current effort in the United States among deprived groups with birth rates as high as India's about 20 per cent of the subjects with two or more children have so far undertaken family planning.

But there have been failures as well as successes. As yet, we have an extremely small and tentative body of knowledge on social factors with which to attack an extremely large and complex problem. In contrast to hundreds of demographic and bio-medical studies, there have been only a few social studies.

The above listing indicates a great disparity between what we know and what we need to know in order to deal effectively with the problem. Further study is certainly needed. More specifically, experimental efforts in natural settings, conducted with resources available locally on a mass basis, must be multiplied many times in order to learn how family planning can be implemented in all societies that recognize the need for it. Such efforts, across a range of countries and with a range of methods, should produce knowledge and techniques on which general programs can be based.

Such efforts must be closely tied to the local administrative machinery by which such programs must ultimately be managed in particular countries and districts. That machinery is typically based on or in the health services. A new type of professional practitioner, the family-planning administrator, is needed to develop programs; training institutions and programs for such administrators in both health and the social sciences should be high on the list of priorities.

Effective programs also require the services of specialists in information and education from such fields as agricultural extension, audio-visual methods, marketing, and advertising, to disseminate information effectively and provide motivation for broader use.

In no other social problem is the interconnection between human and technical factors so critically important as in fertility regulation. The better the contraceptive—better in ease of use and in effectiveness —the less the social resistance to the acceptance of family planning and the greater the efficiency of implementing voluntary fertility regulation where it is needed. Thus the two sets of factors, the social and the bio-medical, are closely interwoven, and the social acceptability of family planning depends heavily on the development of applied knowledge in the bio-medical field, to which we now turn.

Bio-Medical Factors

The preceding section has suggested the importance of the development of contraceptive procedures that meet the personal and cultural needs of people with different economic, social, and religious backgrounds. The social acceptance and individual motivation necessary for continued voluntary fertility regulation depend to a large extent upon the ease of use and the effectiveness of contraceptive procedures. The diverse needs among people throughout the world require development of a variety of methods and procedures.

Some effective methods of preventing reproduction are unacceptable—methods that remove or destroy the organs (testes or ovaries) that produce germ cells (sperm or ova), or that permanently prevent the germ cells from leaving the body. Thus, castration is a completely effective method, but cannot be regarded as acceptable. The same end-result may be secured by the application of irradiation and by the use of some chemical substances, but these techniques are equally unacceptable.

Also effective, when properly executed, is surgical occlusion of the gonadal ducts—vasectomy in the male and salpingectomy in the female. Such procedures do not interfere with hormone production and in some cases it has been possible to restore fertility by reuniting the ducts. Acceptance of this method of preventing reproduction appears to be increasing in some parts of the world; for example, vasectomy is widely used in one state of India and in Korea, and undoubtedly it will be used even more widely in the future.

Short of such final methods, there are various well-known temporary techniques of contraception that can be used selectively by individual couples—diaphragms, condoms, various types of jellies, creams and foams, *coitus interruptus,* and periodic or total abstinence. All these methods operate on the simple and direct principle of preventing the sperm from physically meeting the egg, and they may all be considered, in greater or lesser degree, as mechanical means of contraception.

These procedures can and do affect the birth rate to varying degrees in accordance with the extent of motivation, proper use, and the skill of the individuals concerned. Obviously, the effectiveness of such methods varies widely depending upon the individual couples using them; a recent study has shown that couples who have all the children they want are much more successful in their use than those who still want to add to their families on a spacing basis. A major drawback of most of these methods, of course, is that they are too closely related to the sexual act itself; for that and other reasons they may not provide sufficient effectiveness for the large majority of people in the world.

For the majority we need simpler and less-demanding methods than are now available—methods consonant with weak motivation, inferior educational attainment, ignorance of biological processes, and other cultural differences. Development of better methods of this kind requires greater knowledge, which can be acquired only through bio-medical research.

Our present knowledge of the reproductive process in human beings is meager, and the study of reproduction does not receive the attention it deserves. We do know that human reproduction is exceedingly complex and is based upon the integration of many essential processes. Indeed, one might well wonder that reproduction is accomplished at all! In the normal course of events, the process of reproduction frequently does fail, as evidenced by human sterility and spontaneous abortion. The knowledge that would enable all couples to enjoy the fulfillment of parenthood by producing children, and to achieve a sense of personal responsibility in limiting the size of their families to the number of children desired, would contribute substantially to human happiness.

In devising methods for voluntary physiological regulation of fertility, the reproductive processes susceptible to interference must be considered. There are several major steps at which physiological reproductive mechanisms are subject to control. Blocking any one of these steps will effectively prevent reproduction, since each step is essential. These steps are:

1) production and release of the pituitary gonadotrophic hormones,
2) stimulation by gonadotrophic hormones of egg and hormone production in the ovary and of spermatozoa and androgenic hormone production in the testes,
3) ovulation and passage of the egg into the oviduct,
4) transport of spermatozoa into and through the epididymis and physiologic maturation of the spermatozoa,
5) passage of spermatozoa through the vas deferens to the ampulla,
6) suspension of spermatozoa in the seminal plasma during ejaculation,
7) passage of spermatozoa through the cervix,
8) ascent of spermatozoa through the uterus and oviducts and acquisition by the spermatozoa of fertilizing capacity,
9) penetration of the ovum by one spermatozoon and formation of the zygote,
10) cleavage and early development of the zygote during passage through the oviduct,
11) preparation of the endometrium of the uterus for reception of the blastocyst,
12) entrance of the zygote into the uterus and formation of the blastocyst, and
13) implantation of the blastocyst in the endometrium, and maintenance of continuing embryonic development.

Attention is now being given to each of these steps by investigators, but accelerated and expanded effort is essential if we expect to devise a sufficient variety of regulatory methods quickly enough to affect significantly the world's population growth rate.

METHODS CURRENTLY MOST PROMISING

At the present time, four methods of great promise have been developed. These are the inhibition of ovulation, the inhibition of zygote development, the inhibition of spermatogenesis, and the action of the newly developed intra-uterine devices.

Inhibition of ovulation

It is now well known that the cyclic use of a variety of steroid substances will inhibit ovulation with extreme effectiveness, as a result of the suppression of the gonadotrophic hormones. The preparations most used are a combination of a synthetic progestin and an estrogen—substances normally responsible for the build-up of the uterine endometrium prior to the implantation of the blastocyst. The oral ingestion of these agents for 20 days, beginning on the fifth day of the menstrual cycle, will effectively abolish the normal ovulatory cycle and substitute an artificial anovulatory cycle—one in which no eggs are released from the ovary. It is estimated that almost two million women in the United States now use oral contraceptives as their only means of regulating fertility, and it is likely that at least another two million are doing so in other parts of the world. At the present time there are two widely used preparations that are taken orally, and many more preparations are under development and study. Further investigation is needed, and is in process, especially on the possibility of serious side-effects from long-term ingestion of such compounds. Their cost is currently a barrier to wide distribution in the poorer countries, but there is hope that mass production can meet this problem. In addition, experiments are under way to develop a preparation that could be injected once a month, or even less frequently, and still provide continuous protection. The injectible agent may be combined with other substances that permit a slow but sustained release of the compounds over an extended period of time, thus replacing a daily oral regimen.

Antizygotic agents

These substances appear to inhibit development of the cleaving egg (the zygote) during its transport through the oviduct. It appears that the recently fertilized egg is extremely vulnerable to diverse influences, both spontaneous and induced. It is estimated that death of early zygotes occurs, spontaneously, at least as frequently as once in four instances. The causes of this fetal wastage are numerous, and not well understood, but, in part, may be due to deleterious chemicals. It is well known that the cleaving eggs of many kinds of animals are very susceptible to inhibition by a wide variety of chemical substances. Some of these compounds have proved effective in preventing embryonic development in experimental animals when administered within three or four days after mating. Thus it is possible that a single pill, taken after coitus, will inhibit development of the egg, should fertilization occur. Animal studies have indicated that such compounds act directly on the young zygote and not primarily on physiological mechanisms in the maternal organism. Since numerous compounds which produce these or related effects are under investigation, it seems highly likely that effective agents, safe for human use, will become available. If so, they will have certain important advantages over the oral contraceptives presently available.

Antispermatogenic agents

It has been known for approximately ten years that certain compounds of the nitrofuran and thiophene type are capable of inhibiting spermatogenesis in animals by halting this process at the primary spermatocyte stage, one of the early stages in the formation of mature sperm. This is a completely reversible phenomenon and does not involve the endocrine functions of either the testes or the anterior pituitary gland. Inhibition of sperm production by this procedure has a distinct advantage over the spermatogenic inhibition induced by the same compounds that prevent ovulation in females. Although these latter drugs are exceptionally effective in preventing maturation

of sperm cells, they cannot be regarded as acceptable contraceptives in the male since they also inhibit secretion of male sex hormones and hence lower libido and potency.

The nitrofurans and thiophenes have not been applied to human fertility regulation because the doses necessary for suppression of spermatogenesis have induced unpleasant side-effects. More recently a series of bis-(dichloroacetyl) diamine compounds has been synthesized. Although the compounds were developed initially for their amebacidal activity, studies of the testes of experimental animals showed the same kind of effects that had been observed earlier for the nitrofurans and thiophenes. Experimental tests in human beings demonstrated that spermatogenic inhibition can be achieved, and that the effect is reversible: Sperm production returned to pretreatment levels about two months after treatment ceased. These observations, secured in two separate groups of volunteer institutionalized individuals, were sufficiently encouraging to suggest clinical studies on the contraceptive effectiveness of these compounds. When the trials were made, however, an unexpected side-effect quickly became manifest: Individuals ingesting the drugs experienced exaggerated responses to the peripheral effects of alcohol, which, though not serious, were unpleasant enough to suggest that general acceptance of this form of contraception would be unlikely.

Subsequent investigations have been directed toward development of compounds that will be effective antispermatogenic agents without unpleasant side-effects, and a number of preparations will probably be available soon for laboratory and clinical study. When one or more of these compounds can be proven effective and safe, another method will thus be added to the battery of contraceptive techniques, assuming its general acceptability.

Another group of compounds that seem promising at present are the dinitropyrroles, one of which has been particularly effective as an antispermatogenic in rats. A single oral dose, after exhaustion of sperm already formed, induces a period of infertility lasting four weeks, and an infertile state has been maintained indefinitely by administering single doses at four-week intervals. The process of spermatogenesis is halted at the primary spermatocyte stage, and it recovers when treatment is withdrawn.

Intra-uterine devices

The recent revival of interest in the use of intra-uterine devices is a highly significant development. Although intra-uterine devices are scarcely a physiological method for fertility regulation, in the usual sense, they probably operate by means of physiological mechanisms. At present they represent a rather good possibility for use in a relatively cheap and acceptable procedure. A variety of improved devices is now available, including several constructed from plastics and rings formed from silkworm gut, nylon thread, and stainless steel. Some of these can be inserted into the uterine lumen without dilation of the cervix, thus facilitating their use. The record for effectiveness and acceptability of each of these devices appears to be exceptionally good; several thousand women are currently using one or another of these devices in experimental programs under careful clinical supervision.

For many years, the medical profession has questioned the use of intra-uterine devices; more recently, however, they have been the subject of renewed interest, centering upon those manufactured with inert plastics. Current investigations have indicated strongly that these devices are both safe and effective in preventing reproduction. The mechanism of their action is as yet unknown, and studies are being undertaken to acquire that important knowledge. In view of the potential importance of this means of contraception for mass application, providing safety and effectiveness over a long period with a single insertion, it deserves the most serious and careful consideration.

METHODS OF FUTURE PROMISE

Inhibition of implantation

It was noted above that some compounds inhibit early development of the fertilized egg or zygote. Attention is also being directed toward compounds with the capacity to inhibit implantation of the blastocyst in the endometrium. This effect might be accomplished by a substance that interferes with the action of progesterone, so that the proper preparation of the tissue lining the uterus would not occur,

or by a substance that would interfere with mechanisms essential to the implantation process.

Control of hypothalamic factors

It is now recognized that a neurohumoral factor that originates in the hypothalamic area causes the pituitary to secrete two gonadotrophic hormones necessary for stimulating ovulation and spermatogenesis. It is highly probable that, as our knowledge of this hypothalamic-pituitary relationship is extended, it will be possible to interfere selectively with the secretion of either of the two gonadotrophic hormones—the follicle-stimulating hormone (FSH) and the luteinizing hormone (LH). It would be desirable to be able to inhibit FSH selectively so as not to interfere with LH, which is the hormone essential for the production of other hormones that are important for maintaining the sex drive. Thus it would be possible in either sex to inhibit germ-cell production without causing a decrease in the production of sex hormones.

Immunologic procedures

One of the most challenging areas of current investigation is designated as immuno-reproduction. Most of the proposed procedures for the immunological control of fertility are based upon the classical principle of disease control by vaccines—the development of antibodies against the causative agent. Theoretically it is possible, by the application of such immunologic procedures, to interfere selectively with any one or all of the processes related to reproduction. Some immunologists believe, for example, that it should be possible to develop a vaccine (as in the recent development of polio vaccine) to immunize females against spermatozoa, against reception of the fertilized ovum into the endometrium, and against the development of placental tissues. In the male, active immunization using testicular vaccines is known to prevent sperm development. The formed antibodies destroy and prevent further formation of sperm cells for extended periods of time. It might be possible to develop an immunizing vaccine that

would prevent the development of active sperm motility. It is also believed that it is possible to invoke an immunologic situation that would prevent fertilization. This latter type of regulation would be not only effective but also, in all likelihood, widely acceptable. There are numerous other possibilities for the application of immunologic principles to the control of fertility, and it is reasonable to anticipate the development of various methods of inhibiting fertility by induction of antibodies against substances involved in specific reproductive processes. When such methods are developed, it will be possible voluntarily to maintain an infertile state for any length of time desired by administration of occasional booster treatments. Immunologic procedures for controlling disease have a high degree of acceptability throughout the world; with further refinement, immunologic fertility regulation should also be well received.

Detection of ovulation

Any sure method for predicting ovulation would be extremely valuable in making the rhythm method of contraception more dependable and thus more acceptable to many people. Furthermore, the ability to predict ovulation almost certainly would permit effective treatment of some cases of infertility. Procedures now available reveal the occurrence of ovulation *post factum,* but obviously these are not applicable to the pertinent need. Claims have been made for a chemical method and for two methods of detecting incipient ovulation by use of "test" papers applied to the cervix or vagina, but impartial investigators have been unable to confirm the value of these procedures. Other studies now in progress may lead to more reliable methods; perhaps the most promising involves the application of immunologic procedures for determining changes in levels of the gonadotrophic hormones. Furthermore, at least three groups of investigators have shown independently that immunologic methods (antigen-antibody reactions) can be used to detect hormones related to the occurrence of pregnancy. Since each of the procedures depends upon the presence of a gonadotrophic hormone (chorionic gonadotrophin), it is reasonable to anticipate that progressive refinement of techniques may eventually provide a method of foretelling ovulation.

Summary Statement

This brief statement of population problems indicates the pervasive and depressive effect that uncontrolled growth of population can have on many aspects of human welfare. Nearly all our economic, social, and political problems become more difficult to solve in the face of uncontrolled population growth. It is clear that even in the wealthier nations many individuals and families experience misery and unhappiness because of the birth of unwanted children. The desirability of limiting family size is now fairly generally, though not universally, recognized, particularly among the better-educated and culturally advanced segments of the population in many countries.

Effective voluntary control of family size essentially depends upon the successful interaction of two variables: level or intensity of motivation and the availability and utility of procedures. When motivation is high and sustained, difficult procedures for controlling fertility can be used successfully, but when motivation is weak and erratic, simple procedures that impose few demands are essential. Quite obviously any comprehensive program for solving population problems must work with both these variables, must seek to enhance motivation and also to improve procedures for voluntary control of fertility.

A broadly based effort to develop clearer understanding of the physiology and biochemistry of the reproductive process is a primary requirement. Work in this area can be effectively strengthened by expansion and coordination of the activities of the few existing laboratories now devoted to basic problems of human reproduction.

There is a parallel need—no less important—for extensive, systematic application of new basic knowledge in the development of new techniques, procedures, devices, and medically active compounds for the regulation of fertility. Inherent in this requirement is the necessity for assurance of safety in techniques and procedures, and freedom from undesirable side-effects from compounds and treatments.

These objectives require extensive studies in chemistry, physiology, and biochemistry, with large animal colonies and clinical facilities for large-scale animal and, subsequently, human tests.

The limited field surveys and experiments reported upon in this document must be enlarged, and new projects of this kind undertaken on a continuing basis in many more parts of the world, making effective use of growing bio-medical knowledge and newly developed devices, techniques, and compounds. The objectives of these projects should be two-fold: (1) to determine the advantages and disadvantages of various techniques, procedures, and devices, and (2) to determine the degree and scope of their acceptability in various societies, cultures, and economies. To reach the objective, the means must be provided and they must be accepted and used.

We believe that the implementation of the recommendations in this report will lead to substantial increases in our effective knowledge and will also encourage the use of this increased knowledge in a successful attack on the many problems of rapid and uncontrolled population growth.