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The Outlook for World Population

Population control has begun to receive serious attention from governments and other organizations.

J. Mayone Stycos

There are at least two remarkable and unprecedented aspects to the population problem today—the first is the rate of population growth, the second is the growing inclination on the part of national governments to manipulate this rate.

Rapid population growth was characteristic of most European countries in the past century, and much of the excess population found its way to the New World. But rates of growth in underdeveloped areas today, ranging from about 2 to 3½ percent per year, are about twice those of European countries during the period of their most rapid growth. A population growing at the rate of 3 percent per year will double in 23 years, and one growing at the rate of 2 percent in 35 years. Since the population bases in the underdeveloped areas today far exceed those of Europe, the implications in sheer numbers of a rapid rate of growth are truly impressive. For example, if India alone were to grow for the next century somewhat more slowly than it is growing now, it would still have millions more inhabitants than the entire world has today.

The basic ingredients of this growth are by now well known. Low death rates, which it took European countries a century to a century and a half to achieve, are being approached in underdeveloped areas in a fifth of the time, but birth rates, which it took Europe 60 to 70 years to bring down to modern levels, show little sign of decline.

Various kinds of concern are expressed about the "population explosion." Some people seem concerned about sheer physical space and cite figures to show that there will be "standing room only" at some future date. Others see the increase as outrunning food resources or as hastening the end of our nonrenewable resources. Some are convinced that the increase spells genetic disaster, others are esthetically revolted by human crowding, and still others see it as a cause of wars. All such arguments, while they may have some truth, have serious limitations and in any event have had little impact on policy makers in underdeveloped areas. But there is one general line of reasoning which is having a major impact on leaders in the underdeveloped areas: it is demonstrable that current rates of population growth are slowing down economic development and that a reduction in the rate of growth would have substantial salutary consequences for the economy. This argument does not imply that population control is a substitute for the usual ingredients of modernization—education, industrialization, technological development, and so forth—but that it will enable underdeveloped countries to take full advantage of such developments and make it possible for them to add to their per capita wealth and productivity.

The recent upsurge of interest in the relation between economic development

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and population growth has various causes. Despite bootstrap efforts and foreign aid, most underdeveloped countries have been unable to make substantial gains in per capita income since the war. Further, the postwar period has seen the establishment in many countries of planning boards and commissions whose task it is to assess future national needs and to plan policies accordingly. The importance of these boards cannot be overestimated for, in the broadest sense, their existence implies that rationality in human affairs is not only possible but desirable. It further implies that economic and social variables should be manipulated to meet future needs in the service of modernization and that a professional group can legitimately advise on or implement such manipulation. Where such groups are conscientious they cannot avoid looking at population growth estimates, since the number of jobs, schools, hospitals, roads, and so forth needed in the next 5 or 10 years is partly fixed by the population size expected at that time. On looking, the planners sometimes cannot believe their eyes and call for foreign experts, an improvement in their statistical and census services, or both. But the second look is often worse than the first, since inadequate statistical facilities tend to give too low, rather than too high, an estimate of growth rates. Disbelief then often turns to alarm. A solution which is perhaps not so unique was cited at a recent international conference, where the deputy head of Pakistan's Planning Commission admitted ruefully that the 1.4 percent growth rate assumed for their 1955–60 5-year plan had been calculated "to keep despair away. We are all convinced that population is growing faster than that."

Some countries, including Pakistan, do more than despair, and take steps to slow down the rate of population growth. There are only three ways in which this can be done—by raising the death rate, lowering the birth rate, or increasing the rate of migration. Since it is neither humane nor politic to slow down the decline in the death rate, this solution is rarely discussed, although eventually some countries may be pushed into considering it. International migration is almost as unfeasible a solution. Since most countries today are worried about their own population growth, few are interested in adding to it with foreigners. In any event, population growth today is of such dimensions that migration as a solution is impracticable. Every year, for example, there are 10,000,000 more Indians than in the previous year. What then of birth rates?

Short-Run Prospects of Fertility Decline

Many leaders in underdeveloped areas believe that economic development and urbanization will bring down birth rates "as they did in Europe without explicit policies." Leaving aside the obvious point that the population growth is slowing down the very economic growth which is supposed to check it, it is probable that in some unspecified "long run" birth rates will in fact decline. (Of course, in a period when the peoples of underdeveloped areas are in a hurry for the goods and skills of the modern world, to leave any solution to the "long run" is both politically inexpedient and ethically questionable.) But in the short run there are reasons for believing that "letting nature take its course" may leave fertility much where it is today. Historically, birth rates responded only slowly to the processes of modernization. In the late 19th century, European populations were characterized by higher literacy and less rigid social stratification than are typical for most underdeveloped areas today. People married at relatively late ages, and the birth rates were considerably below those of the underdeveloped areas today. Despite these favorable conditions, it took European countries 60 to 70 years to bring their birth rates down to modern levels. The dimensions of today's problem are considerable. Births in underdeveloped areas average 40 to 45 per year for every 1000 population. To bring this rate down to the 17 to 20 per 1000 characteristic of Europe would mean an annual reduction of 50 million births.

There is no magic about the relation between economic development and fertility decline. It operated in certain ways in the West and cannot be assumed to be automatic. Probably the greatest part of the decline in most countries can be attributed to deliberate efforts by couples to restrict their number of children because of the decreasing advantages and increasing disadvantages of having large families. But the use of birth control is not the only factor which affects the birth rate. The birth rate of a society is determined by other factors, such as the nutritional level, the proportions single, widowed, and divorced, the age at marriage, the frequency of sexual intercourse, the incidence of individual sterility and infertility, and the extent of lactation. While the birth rate of underdeveloped areas is high relative to that of Western nations, it by no means approaches the biological limit. Under ideal conditions the average woman can have about 12 live births; but in most underdeveloped areas the average does not exceed seven. India is a good example. By the end of childbearing, the average woman has had between six and seven live births, and the average period between the birth of one child and another is about three years. The incidence of birth control practice is so low that it cannot possibly account for this, but there are a number of aspects to Indian culture which might. Among these are the custom of the wife returning to her parents' village for an extended period after the birth of a child; the custom of breast-feeding children; customs which forbid sexual relations on various ceremonial days and for a period after the birth of a child; and the low nutritional level.

The most significant point here is that all the above conditions can be expected to decline or disappear with economic development.

In other regions there are other relevant patterns. In the Caribbean the instability of marital unions has had a marked negative effect on fertility, and in other areas taboos on the remarriage of widows have had a similar effect. In most countries the number of people who live through their entire reproductive period is increasing. Indeed, recent historical investigations indicate the probability that in most European countries fertility rose in the last century before it declined. Although the data are somewhat deficient, it is perhaps significant that in the last decade a number of countries, especially in the Western Hemisphere, have shown increases in birth rates, while very few have shown declines. This has been a period when most countries have made at least modest advances in economic and social development. Thus, the short run holds little hope for "natural" decreases in birth rates as a result of

economic development. Is there any chance that declines can be induced?

One of the principal reasons for optimism here is that, for the first time in history, national governments and major national institutions are devoting substantial resources to this problem. It must be remembered that the decline in birth rates in Europe and England occurred *despite* the concerted opposition of church and state, and that the culture of the 19th century militated against the spread of information and ideas on family planning. In many underdeveloped nations, non-Christian religions forbid neither birth control nor its discussion, and the vast prestige and resources of the state may be marshalled to spread the practice of birth control. Thus, the governments of India, Pakistan, and Korea sponsor active programs; Malaysia, Ceylon, Hong Kong, Barbados, and Puerto Rico have programs sanctioned by the government; and Taiwan, Tunisia, Turkey, and the United Arab Republic have pilot programs in progress as preliminaries to the formation of national policies.

Birth Control and Death Control

While it is a major step for governments to introduce national programs of family planning, it by no means guarantees that the problem is over. So far the problem of reducing fertility has proven far more difficult than that of reducing mortality. There are several reasons for this.

1) Technology in family planning has been primitive compared to medical technology as a whole. This is largely the result of the poor state of scientific knowledge concerning reproductive physiology, a situation which presents an interesting question for the sociology of science.

2) The most effective public health procedures are directed at communities rather than individuals and thus avoid the problems of individual decision making. Highly successful public health methods, such as mass DDT spraying, sewage control, and water filtration, have no parallels in fertility control, where individual couples must normally make frequent and continual decisions to apply existing technology. The fact that the application is usually at the time of the sexual act or associated with it makes the decision-making process particularly difficult and prone to error.

3) Mortality control methods are in the service of goals which are universally shared—the prolongation of life, the alleviation of pain, the prevention and care of disease. Fertility control may be running counter to deep-seated motivations. Children provide prestige, amusement, religious blessing, social security, and pleasure in most societies, and, where infant mortality is high, the society must encourage high fertility in order to guarantee perpetuation.

While these considerations render fertility control a more difficult problem than mortality control, a number of recent advances in knowledge have provided grounds for optimism. For example, over the past decade there has been a certain amount of favorable evidence concerning the efficacy and acceptability of unconventional methods of fertility control—sterilization, abortion, and intrauterine devices.

Unconventional Methods

Surveys of public opinion in underdeveloped areas indicate that women develop a strong interest in birth control only after they have had several children. They have little interest in spacing children, but once they have their desired number they wish to stop having children. Sterilization is the ideal technique for such individuals. It has the additional advantages of being easy to talk about, since, unlike most contraceptives, it does not require references to the sexual act or sexual organs. Finally, it is performed in a hospital, thus partaking of the aura of prestige and safety to health which contraceptives lack for many. Since it is normally a postpartum operation requiring only a few additional days in the hospital after delivery, it can be accomplished inconspicuously. The widespread use of this method in such differing cultures as Puerto Rico and India show that what appears to be a drastic solution to many middle class people can be a swift and simple solution to lower income groups.

Sterilization of males is an even more promising technique, for it is a simpler operation which does not require hospitalization. Certain of the states of India are promoting this approach, utilizing mobile camp techniques and offering the men small subsidies (10 to 30 rupees) and transportation facilities. The demand for this technique has exceeded the expectation of most Indian experts—between 1956 and 1963 at least 240,000 male operations were performed. Whereas in 1957 there were about three female for every male sterilization, in 1962 there were three male for every female sterilization.

Abortion is another technique which Americans tend to regard as drastic, unethical, or dangerous to health; but in other countries it is considered none of these and is highly popular as well. The remarkable decline in birth rates in Japan can be attributed largely to the utilization of this method. In 1961 there were about a million and a half live births and over a million legal abortions. With the exception of East Germany and Albania, all the Communist countries in Europe have official abortion programs. In Czechoslovakia and Hungary for example, there were 7 and 17 abortions respectively for every 1000 population in 1961. In the latter case there were more officially recorded abortions than births. In all the countries which have such programs, birth rates have declined markedly in recent years. Even in Latin America there is increasing evidence of a high incidence of abortion—in this case illegal. For example, in an unusual survey of 2000 randomly selected women between the ages of 20 and 50 in Santiago, a quarter of the women admitted at least one induced abortion. In Chilean hospitals about a third of the total cost of maternity services is expended on women with complications due to induced abortion.

Abortion has the advantage of being required only when a pregnancy is absolutely certain. It requires no foresight, planning, or interference with the sexual act. Under proper medical supervision the risk is little greater than the risk of a tonsilectomy. Both medically supervised abortion and sterilization, then, avoid to a considerable degree the problems associated with repeated decision-making around the time of the sexual act. On the other hand, since they require skilled personnel, they are relatively expensive; most sterilizations are irreversible and cannot be used for child spacing; and repeated abortions are a greater health hazard than are standard contraceptives.

Virtually all the advantages of these methods and none of their disadvantages are present with certain contraceptive methods currently under test. The most promising are the intrauterine devices. Easily produced for a few cents each, these plastic devices once inserted may need to be removed only when the woman wishes to become pregnant. Current tests indicate they may be left alone for at least two years, have a high rate of effectiveness, and cause problems with only a small minority of women. While they must be inserted under aseptic conditions by trained persons, this can probably be done by paramedical personnel such as midwives and nurses. Thus, the intrauterine devices are a kind of cheap, easily reversible, and nonoperative sterilization. Although they are still at an early stage of experimentation, they have been shown to be generally acceptable to poorly educated people in a variety of religions and cultural settings.

The Desired Family Size

While there is doubtless a crude inverse correlation between the simplicity of the method and the degree of motivation required for its adoption, even the simplest method requires some interest. It has been claimed repeatedly that the general population in underdeveloped areas desires large families or as many children as possible or that they are totally indifferent to the number of children they have. Under such conditions any contraceptive other than a surreptitious or obligatory one (such as one put in the water by the state) is unlikely to be acceptable to enough people to have any impact on the birth rate.

Fortunately the last decade has witnessed the assembly of an extraordinary series of sample surveys which allows us to begin to answer this question. These surveys have asked more detailed and more intimate questions than are possible in the official censuses, eliciting data ranging from complete pregnancy histories to attitudes toward family size and contraception. Such studies have been or shortly will be completed in 13 countries of the Western Hemisphere, 3 African, 3 Middle Eastern, 5 European, and 7 Oriental nations. According to W. Parker Mauldin, Associate Demographic Director of the Population Council, "This is the most substantial set of comparative social data ever collected across such a range of societies, and a few of the pilot projects in the field of family planning are among the most elaborate and extensive social experiments ever carried on in the natural setting."

With respect to questions on desired number of children, the countries fall into three rough categories—those in which the average respondent wants a very large family or is indifferent to the number she has, those in which a limited but moderately large number of children are desired, and those in which a small number of children are desired.

Thus far, only a few studies have yielded responses of the first type, and they have been limited to highly underdeveloped areas—rural South Sahara Africa and rural Haiti. For example, an average of ten children was desired by a sample from rural Ghana, and, in a small village in Haiti, the people refused to articulate a preference. Responses such as the following were typical:

> If God gives me two, I would be happy. If he gave me 10 children, I would be happy too, because that is not for me to decide.

> If I have ten children, I will say thank you. If he gives me only four or five, I will say thank you, too, and if he gives me none, I will say thank you.

But such results are exceptional. The ideal in most countries tends to be a family of three or four children. In surveys conducted by the writer over the past decade in countries as different as Turkey, Peru, and Jamaica, most women who have two or fewer children want to have more, but most women who have three children (or more) want no more children. The reasons given by both women and men are largely economic: the high cost of clothes, food, education, and so forth, for the children.

Finally, a handful of countries, mostly European, where mortality is very low and education and income very high, express preferences for small families. In the United States about 90 percent of a national sample preferred between two and four, with the average about three and a half. Puerto Rico also falls in this category. As early as 1948, more than half of the women thought two or fewer children ideal.

National Birth-Control Programs

While the evidence indicates an interest in having fewer children than women in fact have in most countries, it is a long and tortuous path between such verbally expressed ideals and behavior which would bring them about. While most of the studies show that the average woman has an interest in family planning, they also reveal ignorance of the most elementary facts of reproductive biology and birth control. Thus, the expressed attitudes are based on little information and little thought. The attitudes are probably not very intense, and the opinions not very salient. For many countries, the provision of technology will not be enough.

Partly for this reason, national programs of family planning have thus far shown few encouraging results; but there are other reasons. The early programs of several countries tended to copy the administrative, technical, and philosophical orientation of the planned parenthood movements of the United States and England, where, for historical reasons, they have been dominated by feminist, medical, and middle-class thinking. As a result, there has been heavy reliance on the person-to-person and "confidential private interview" approach typical of relations between doctor and patient or caseworker and client. On the contrary, group and community education techniques are indicated in nonpuritanical societies where a major obstacle to use of birth control is ignorance that one's peers are as favorable to the idea as oneself. There has been excessive concentration on the clinic as the major dispenser of supplies and information, with too little attention paid to commercial and other communal nonmedical distribution systems. In Western countries clinics and clinically prescribed methods have been of minimal significance in contrast with commercial (condom), folk (coitus interruptus), and extralegal (abortion) methods. In non-Western and predominantly rural countries the clinic has the special disadvantage of being most inaccessible to large sections of the very populations which most need its services. Western birth control movements and organizations have been led by women and for women, despite the fact that methods used by males are almost entirely responsible for the major declines in fertility. In non-West-

ern societies, where the male has greater authority in the family and community than in Europe and the United States, the typical concentration of female personnel emphasizing female contraceptives seems particularly misplaced. There has also been undue emphasis on medical staffs and medical rationalizations for family planning, when in fact most people view the problem as a social and economic one. Finally, there has been virtually no attention to less direct approaches to reducing fertility, such as raising the age at marriage and encouraging female employment, discouraging cottage industry, and providing economic and social rewards for moderate fertility. But the programs are young and the nations are learning that approaches which never had much impact in Europe and the United States can be expected to have even less in underdeveloped areas.

The Case of India

India, the first country to establish a national program, has accumulated sufficient experience to provide valuable guides for other nations. India's three Five Year Plans since independence show increasing concern, commitment, and sophistication with respect to family planning. The governmental allotment to this area has increased from about $1.4 million in 1951–56 to $56 million in 1961–66.

The program in the first two plans was distinguished by a laudable emphasis on research (25 percent of the first budget and 10 percent of the second) and by an almost total lack of imagination in its practical aspects. By the time of the third Five Year Plan, however, the absence of a decline in the national birth rate, combined with increasing feedback from research, caused a major shift in emphasis. In April 1963, B. L. Raina, Director of Family Planning for India, released a report on past efforts and future plans. The document is remarkable for its sociological sophistication and takes into account virtually every point of criticism cited in the past paragraph. It boldly sets out a single and precise objective—the reduction of the national birth rate from its present probable level of 40 births per 1000 population to 25 per 1000 by 1973. It then lays out three general "operational goals" which are regarded as necessary steps to the basic objective:

(i) *Group acceptance*: Each individual should know and feel that the immediate society or community to which he belongs has agreed, as a group, that having a smaller family size is the normal, desirable behavior for the members of that group. Without such a feeling, any couple will hesitate seriously to adopt family planning; with such a feeling most couples will proceed to obtain the necessary information needed for them to conform to the norms of their group.

(ii) *Knowledge about family planning*: Two types of information are desirable. Firstly, knowledge that having a smaller family is valuable, for various personal reasons. Need for conformity to group norms of family size is value enough to justify action for most individuals. In addition, people should know that smaller family size helps them achieve other values, such as economic welfare and better health.

Secondly, people should have further knowledge about specific methods of birth control. Knowledge of contraceptive methods refer to the normal use of abstinence, withdrawal, and the rhythm method, as well as knowledge about the possible availability and use of condoms, foam tables and other devices.

(iii) *Availability of supplies*: Any couple wishing to have simple contraceptive supplies should be able to get them within easy geographic distance, without questions being asked, and without other psychological barriers being interposed such as inconvenient hours, having to wait, or lack of privacy.

To achieve these goals various "organizational principles" such as the following are listed:

Group self-help and community "extension" approach should be emphasized in contrast to "primarily individual approaches." Greater reliance will be placed on general community leadership groups and less on outsiders for both education and distribution of supplies. Male personnel will be emphasized in the extension program. "Presence of contraceptives in usual supply channels further supports the feeling that their use is a normal part of life. . . . Distribution . . . should be arranged widely through village panchayats, midwives and at other local depot holders . . . purchase in the market is often preferred by the people themselves . . . strong encouragement needs to be given to mass manufacture of condoms in India. Steps are needed to foster marketing through commercial channels and consumer cooperatives."

Whether such policies will achieve the intended decline in the birth rate remains to be seen; but there is little doubt that India's imaginative experimentation will be of immense value to other countries beginning such programs. Of course, other regions may be expected to approach the problem differently. For example, in Latin America birth control programs will probably emerge as antiabortion campaigns and from present tendencies it seems that oral progesterones may receive church support there. But there is no simple explanation such as "the church" for Latin America's high birth rates, and the removal of church opposition is only a first and perhaps not even a necessary step to the reduction of fertility rates. Careful observations and evaluation of programs presently being carried out, such as the nonclinical system of contraceptive distribution in Puerto Rico, the oral progesterones program in Mexico, and the intrauterine device programs in Chile can provide valuable leads for introducing programs in other Latin countries.

The Role of Research

Indeed, the need for research on the demographic, biomedical, and sociopsychological aspects of the population problem is one of the most pressing scientific demands today. Ignorance in this field is very great. For example, probably fewer than half of the world's births and a third of its deaths are registered; thus we have only crude estimates of the vital rates of most of the world, and we have least knowledge about those countries for which demographic knowledge is needed most.

In another research area, the intrauterine devices are proving to be among the cheapest, safest, simplest, and most effective contraceptives ever developed; yet so elementary is our knowledge about basic physiology of reproduction that how these devices work is unknown. (Hudson Hoagland, President of the American Academy of Arts and Sciences, states that "as a result of prudery about sex, and of religious and political opposition to birth control, investigators have not been encouraged to enter the very important field of mammalian reproduction.")

Finally, while we know a good deal in some countries about the social char-

acteristics (religion, income, education, and so forth) of people who practice birth control as opposed to those who do not, we are virtually ignorant of the social psychological processes which impel one family to adopt family planning and another not to.

But serious attention to the population problem is new. The Population Council, the principal organization devoted to supporting research in this area, is only 11 years old and as late as 1960 had a total budget of only $2.7 million (although this had increased to $5 million by 1964). The major foundations have announced significant support for population research only within the past few years. In 1961, the National Institutes of Health, which expended $880 million on control of fatalities, expended only $1.3 million on research relating to fertility control. Only a handful of universities are producing demographers, and virtually no psychologists, anthropologists, or political scientists have turned their attention to population problems. American government agencies are only beginning to give official recognition to the problem, and international agencies such as the United Nations and the World Health Organization are circling the problem seriously, but gingerly.

In short, major attention to population dynamics is in its infancy. In the next decade we can expect breakthroughs not only of a scientific nature, but in successful national programs of population control.

Venture into Politics: Scientists and Engineers in the Election Campaign (I)

One week before election day, Lyndon Johnson was campaigning in Albuquerque when he saw a sign that read, "New Mexico Scientists and Engineers Welcome LBJ." Pointing to the sign, the President declared that "about the best supporters I have are the scientists and engineers."

Campaign hyperbole and the presence of a good number of people from nearby research facilities may have combined to inspire this compliment, but the fact is that the last political campaign energized the American scientific and engineering communities to a pitch of unprecedented political activity, virtually all of it in support of Lyndon Johnson. In 1956 and 1960, in what was the first conspicuous emergence of scientists and engineers into elective politics, a handful of them contributed their names and position papers and briefings to the presidential candidates, but the campaign that has just ended brought forth something altogether different: the establishment of a nationwide network of political action centers, organized, financed, and almost exclusively staffed by scientists and engineers, ranging from Nobel laureates and high-level administrators to undergraduate science majors and laboratory technicians.

In mid-July, when Senator Goldwater received the Republican nomination, these centers did not exist, and there was no plan to set them up. Within 45 days, headquarters, bearing "Scientists and Engineers for Johnson-Humphrey" signs, had sprung up in prominent downtown sections in all but two or three states; almost all employed at least one full-time paid executive or secretary and scores of volunteer workers, drawn from the scientific and engineering community, and they operated 7 days a week, 12 to 18 hours a day. Before the campaign was over they had listed over 50,000 scientists and engineers on their membership rolls; had raised some $500,000; had written and financed over 100 newspaper advertisements, 3000 spot radio broadcasts, and a half-hour nationwide TV show; and had elicited hundreds of column inches of newspaper notice. But, most important of all, by skillfully combining their energy and resources with deliberate exploitation of the prestige of science, engineering, and medicine, and the respect with which the public generally regards them, they contributed to burdening Senator Goldwater with the image that appears to have contributed most to his overwhelming defeat—namely, that he was unfit to control the nation's nuclear forces.

The electorate's repudiation of Goldwater was so overwhelming that it is impossible to establish that any one campaign effort, or that even the entire campaign, was of any significance in determining the outcome. But whether it was self-destruction or outside assault that did most to bring down the Senator, it is clear that the scientific and engineering communities brought remarkable political fervor to the campaign. And though it can be reasonably argued that this venture into political action did no more than add a few pebbles to a predestined national avalanche, it is clear also that, within the boundaries of science and engineering, the involvement in the campaign was an extraordinary event.

How and why was this activity organized, and what can be said of its significance as a phenomenon in the life of the American scientific and engineering communities? The answers, based on interviews throughout the country during the past few weeks, can perhaps best be developed by looking at the great network of institutions and individuals that comprise these communities, and tracing what happened when it became obvious that Senator Goldwater was unstoppable in his quest for the Republican presidential nomination.

Justifiably or not, a lot of people were profoundly disturbed by the prospect of the Senator's nomination and wanted to do something about it, and among them was a 33-year-old physical chemist, Donald M. MacArthur, who manages the chemical and life sciences research center at Melpar, Inc., in the Virginia suburbs of Washington. MacArthur, who holds a B.Sc. with honors from St. Andrews, in Scotland, where he was raised, and a doctorate from Edinburgh, had had no previous experi-