THE UNIVERSITY OF CHICAGO
CHICAGO 37 · ILLINOIS

PROGRAM OF EDUCATION AND RESEARCH
IN PLANNING

Dear Leo:

Two weeks ago you asked me about the costs of ~~extraction~~ extraction. At that time I was able to give you only very vague figures. Now in the November issue of the (Journal of Industrial and Engineering Chemistry an announcement is made of a new piece of equipment which appears to be adapted to the processes you were imagining.

This piece of equipment can process 2,000 litres of filtered solution (it was a 1.0 g./l. solution of tryptophan as I recall) per hour about 20 hours a day — the remainder of the time being devoted to cleaning and maintenance.

@ 300 days per year
∴ 12,000 kilo litres/yr.
and 12,000 kg. of ~~d~~ tryptophan ~~e~~ extracted

(over)

Costs

Labor	$25/day for 3 shifts	$ 7500
Solvent Loss		$ 2-5000
Power Costs, etc		$ 1-2000
Amortization on mach (5yr.)		$ 2600
Amortization on services, bldg., etc.		$ 2-3000
Total Cost		$15,100 - 20,100

Thus the cost of tryptophan in solvent solution (i.e. before evaporation or crystallization) is $0.55 - .75 per lb. under the conditions you described. The efficiency of recovery was taken to be in the range 97-99%. For this recovery that is quite a cheap price to pay.

R. L. Meier

₦20,000 12,000 ton

or ₦2 per ton 1 gm/l

1 Kg/ton

1155 East 57th Street
Chicago 37, Illinois
February 16, 1950

Dr. Richard Meier
24 Brundretts Road
Charton-cum-Hardy
Manchester 21, England

Dear Meier:

I am writing to find out whether you would be interested in the following possibility:

As you know, the University has created three institutes which are financed by industrial sponsors. The industrial companies who join as sponsors either join one institute or they join all three, and in the latter case, pay a membership fee of $50,000 a year. The larger of these companies don't really care to obtain anything in return, but the smaller companies would like to feel that they get something in return, even though they perfectly understand that the institutes cannot accept "projects." I was impressed by the questions asked by the research director of one of these industrial corporations which, in my opinion, we did not satisfactorily give any answer. This man asked whether we could advise him on the general question whether his laboratory should take up radio-active isotopes as a research tool. Would this be worthwhile, he wanted to know, and could we tell him just what would be involved. He also wondered whether we could be of any assistance to him in enlisting the cooperation of some medical school for clarifying the issue whether or not cholesterol might be responsible for the increased incidence of coronary

attacks. His interest is derived from the fact that the products of his company contain cholesterol. The University was not able to give him an encouraging answer on either of these discussions because there is no one in the institutes who is sufficiently acquainted on the one hand with the University and on the other hand with industrial research problems to be able to put this research director in touch with those men in our University who might be able to give him advice or put him in touch with men in other Universities who might be able to give advice.

It occurred to me that if we had attached to the Development Office someone who is sufficiently interested in the research problems of our industrial sponsors, (not necessarily on all of them, but at least some of them) and at the same time had a good acquaintance with the men in our own University, ~~that~~ such a man could fill an important gap by keeping contact with the research directors of these corporations and put them in touch with those who can give them advice.

Assuming that your job in the Planning Division does not necessarily require your full time, it occurred to me that perhaps you might be interested in working part-time for the Development Office in this capacity. My guess would be that your final financial compensation would be considerably higher ~~there than is that part that~~ for the part of your time which is ear marked for the Development Office, and that you might find this activity both useful to the University and stimulating to yourself. If you are interested at all, I would suggest to Lynn Williams, Vice President in charge of development, that he arrange a meeting with you. Perhaps you could fly here and back to England, taking a total of not more than ten days or a fortnight (I understand that return tickets to London of two weeks duration can be obtained in this season for something like $350), and I think that the University should be willing to invest this amount in order to arrange for an interview.

In order to explore whether what I have in mind is feasible, I spent one and a half days with the Beechnut Company, who are making chewing gum and baby food, and it was my impression that in one to three days, one can learn a lot about their problems and thus put oneself in a position in which one can be helpful to them by steering them to the right people. I believe a number of smaller companies would really benefit from contact with such a large University as the University of Chicago, provided that such contact can in fact be established through the catalytic action of someone who is interested in industrial research problems. Please let me know what you think about this.

Sincerely,

Leo Szilard

P.S. Thanks for your letter of November 17. Let me know sometime about English reaction concerning the H-bomb, if you can.

wv

THE UNIVERSITY OF CHICAGO
CHICAGO 37 · ILLINOIS
PROGRAM OF EDUCATION AND RESEARCH IN PLANNING
1126 EAST 59TH STREET

May 6, 1953

Professor Leo Szilard
c/o Mr. A. N. Spanel
International Latex Corporation
Empire State Building
New York, New York

Dear Leo,

Enclosed is a second draft manuscript, intended eventually for my book on world development, which deals with what I have been able to pick up on the problem of birth control. In casting about for a competent critic and source of new information relevant to the problem, there seemed to be none better than yourself at the moment. Planned Parenthood, I feel sure, remains always too optimistic--probably in order to keep the money rolling in.

The next time you are in town again do call me up. We haven't had a good discussion in a long time. I have been generating a few more radical ideas in the past few months, in addition to sweating out the elaboration of those of some years back for publication. Tried some of them out in Boulder, Colorado, where they seemed not too indigestible for faculty members, students and guests there but they need more testing.

About the end of June we are off for Berkeley by car. They have an interesting pilot plant design there for getting fresh water from sea water which looks like the cheapest proposition yet, and three or four other developments in the San Francisco area worth looking into at the moment. We expect to be back by the second week in September to get things going in the Fall quarter.

Have fun!

Dick Meier

Richard L. Meier

RLM:rb

please return
to R.L. Meier

NEW PATTERNS OF LIVING

New foods and new sources of energy would, by themselves, require that a new mode of life be developed. However there are at the same time many other important problems requiring solution, and other forces impinging upon the folkways. Some of these are related to the enigma of human reproduction; still others to the necessary relocation of people. But above all others is the task of revamping human institutions so that the opportunities presented by new technology can indeed be grasped.

These are largely social problems, since they deal primarily with interrelationships between human beings, and do not now involve materials, or the man-machine interaction. Most people would instinctively exclude the scientist and the technologist in the search for solutions. Yet, in many instances, a social problem can be restated so that it is also a scientific or an engineering problem which is not only researchable, but soluble! Epidemics of some infectious diseases were once primarily such a social problem. If the analysis is accurate, the ensuing investigations successful, and the results put to use, the difficulty may disappear, just as most epidemic diseases have disappeared in the past half century.

Another more elaborate example of the restatement of a problem so that a technologist's tools become useful may be drawn from education -- certainly as much a social process as any that can be imagined. Often nowadays in a changing society it is discovered that some rather complex information must be transferred rapidly to a large section of the population, but at the moment of crisis only a handful of persons possess this information. If the problem were to be solved by a purely social process each of the informed persons would teach a handful. These groups would break

up into individuals and they would bring together and teach new groups. This process would continue until the whole prescribed section of the population had been reached. Such a procedure is quite slow and requires a considerable amount of human effort. At the same time, garbling of the message -- the so-called "rumor effect" -- is probable. This could mean that the essential elements were not communicated as originally intended, but some other messages of an unpredictable nature were communicated. Prevention of garbling requires great discipline among the message carriers, and a much more involved human transmission system which incorporates several arrangements for making internal checks and corrections.

The communications technician would take a different tack. He would look for some economical means for transcribing the lesson into widely understood symbols and then use communications devices, such as printed publications, radio, film, or some other medium for conveying these symbols. The transcription would be pretested on a sample audience, so that one could have some confidence that the correct message would be conveyed. Such a system requires much less effort, and usually saves time, but one cannot be completely sure that of its being understood because it is seldom feasible to provide a means for the recipients to talk back or ask questions for clarification. Nevertheless under most conditions, this second solution would have a markedly higher probability of success. Communications technology has been developed over the past few decades to meet such social needs at lower cost, especially if the time allowed is short.

Thus the technician can bring forward "solutions" to this and many other social problems. The real source of success, however, is in finding a formulation of the problem which permits use of some of the store of scientific knowledge which has accumulated so rapidly over the past few

decades. Therefore the economic and social analysis in the pages to follow will not be along classical lines, but certain strands of argument will be picked up and followed solely because they appear to come into conjunction with some hitherto little known aspects of science and technology which may now be used for problem-solving.

Facing the Malthusian Dilemma

The number of persons for which to plan is a fundamental and inescapable factor in world development. At present it is apparent that there is more manpower available than can be successfully mobilized for developing the available resources. Thus we have the phenomenon of widespread underemployment in areas which are "underdeveloped". There are also more people living in many of these areas than can be supported at a decent level of living by applying techniques already known. This was demonstrated in Section One. However such a condition of population surplus need not be permanent -- since the means for increasing food, energy, and raw materials production are already on the horizon.

How many persons should populate the Earth? One approach to determining maximum population is to complete a calculation begun earlier. It was demonstrated in Section Two that the technology of microbiological food production should stretch sunlight and soil resources to the point where it is probable that they would be sufficient to feed 50 billions of persons. This would imply virtually continuous urbanization stretching over most of the flat portions of the world. A subsequent analysis of the minimum energy costs of comfortable urban living suggested that they could not fall far below an average of 10^7 Cal. per person per year. If this quantity were to be drawn from sunlight at reasonable efficiencies it turns out that one needs

flat surface roughly the size of the Pacific Ocean to accomodate energy demands for 50 billion people. All the other requirements that can be put into physical terms are equally stupendous, but cannot be proven impossible (the investment required, for instance, would be 10^2-10^3 times that of the U.S. today). It is barely credible then that 50 billions can live moderately well on the planet, and that this number represents a practical saturation level.

At the current rate of growth it would not take long for the Earth to become saturated with humanity. If the present 0.8-1.0% annual overall increase were to be maintained, the elapsed period would only be three to four centuries. This assumes that the annual increase could be maintained in the face of regional shortages of materials and raw materials which now seem overwhelming.

Actually it is not the threat of 50 billions of persons which is so serious, because people would probably get used to the idea and its implications within a few generations, but the present rates at which various populations are growing. The demands of the new persons require virtually all the savings the growing society is able to muster, if even the minimum wants are to be met. Meeting these needs will bring most programs of economic improvement to a standstill, with net per capita increases in income remaining uncertain. There are likely to be many counterparts to the current Five Year Plan for India which only claims that conditions will be no worse at the end of the period than they were in the beginning.

The present world population increase of 20-25 millions per year is fantastically expensive. In order to feed and clothe them we have to clear new land for crops, or improve the existing fields, and accelerate the depletion of resources. The capital required each year just to maintain these

people at the subsistence level is estimated at close to $10 billions per year. Later it will be possible to judge what it would cost to maintain them at a minimum adequate standard of comfort and convenience, but it is already apparent that this sum is likely to exceed the total annual investment in the world today.

What these rough measures emphasize is that world development cannot proceed in an orderly fashion unless there is some social control over population increase. There are places in the world where this has occurred in recent times. Some societies have arrived at a population equilibrium with low birth rate and low death rate which has been maintained over several decades. Most of these are in Northwestern Europe, or of that stock, so that the records of the social processes by which this social stability came about have been accessible to researchers. From the investigations it is possible to draw some general conclusions about how they achieved this condition and have been able to continue it, despite much local opposition stemming from religion and nationalism.

The improvement of public health and safety in these countries during the 19th century was accompanied by an acceleration of trade and manufacturing. Under these circumstances the population grew steadily, due mainly to a decline in the death rate while the birth rate remained virtually constant. The excess population, forced to migrate from overcrowded villages, went to the city or to new territory overseas. In the city new opportunities existed. The age of marriage, for many logical reasons, was postponed. Also children were an inconvenience in the cities of that period, so primitive methods of contraception were brought into widespread use. Shortly after a social class became predominately literate a gradual decrease in its birth rate was observable. This was even true of the agricultural areas which were

brought into steady commercial contact with the cities. Another important factor tended to be the increasing independence, within the family unit, of the wife. It appears that wives have, almost everywhere in the world, quite consistently preferred fewer children than their husbands. Once they achieved literacy, and were permitted to hold down a responsible job, child-bearing was often postponed. The depression of the '30's, with its loss of income and threat to social status, brought still more postponement of marriage and more carefully planned families.

Thus, in all cases where the new population stabilization was achieved, it was required that there be

knowledge of some means of contraception
at least one means available to each income level
the method was used diligently
a high level of literacy
opportunity existed for improving comfort
a decline in the authority of the male in the family
an urban, or urbanized, environment

These are circumstances which can only exist if economic development has already proceeded a long way in that society. The world does not yet have an instance where a rural people with low levels of literacy, and with consumption at subsistence standards, has voluntarily taken up birth control and made a success of it.

The mass populations in Asia have expanded their villages to the saturation point without generating simultaneously a wave of education and economic opportunity in the cities with the vitality of the movements in Western Europe. One suspects that this was because they started later, the transition was more rapid, and the political dominance of the West delayed

indigenous responses. However, whatever the reasons, these societies are now in a position where, in order for investment and resource development to accelerate, the drain on resources caused by population growth must be markedly reduced. Thus we are faced with a prerequisite for development which has no relevant precedent; unlike Europeans, these people need birth control before migration, before literacy, and before economic opportunity -- while they are still absorbed in the tradition-directed routines of village life. China, India, Pakistan, Indonesia, Egypt and the others cannot follow in the footsteps of Japan because the latter's population has already exceeded the capacity of the local soils, fisheries, and mines by at least 25%. The rest of the world does not have that much surplus to spare.

It appears, from this line of argument, that the most useful research which would contribute to the solution of the population problem relates to the functioning of the family in various village cultures. Is there some simple inexpensive means whereby both the concept and practise of birth control can be introduced into such an imperturbable ritual-oriented institution as the rural family?

Sociologists and demographers have begun such studies (Tacuber, 1951) in recent years. They find that the two or three child family is an ideal held by most women, and often by the men as well. These views are held privately, often in contradiction to the established mores of the culture, but they are operative only as wishes which exist without mode of fulfillment. By the time their families are complete twice this number are likely to survive; under such conditions the overall numbers will increase by more than 2% per annum. Investigators have found that idea of birth control is almost everywhere present, even in the most primitive societies. It may take the form of an herb concoction, a charm, or a vaginal plug, or lead to abortion and infanti

and infanticide. None of those means is sufficiently effective in agricultural communities, indeed they are seldom applied at all until the size of the family has become impossible to support. Thus the scattered evidence available suggests that there is hope of introducing a truly worthwhile contraceptive into the rural family, once it became available and convenient.

Among demographers and sociologists faced with this problem there has been some wishful speculation too. The ideal solution, they felt, was a small pill which produced temporary sterility in the female. It must be non-toxic, have no undesirable side effects, and have only trifling cost. It must not lose its potency through age, heat, humidity, or exposure to air. In other words, it should be as simple in its application as taking aspirin. Such a drug, most of them feel confident, could be rather quickly (that is, over the span of one generation) introduced into rural villages, if it were the object of a carefully planned campaign.

Surprisingly enough, after years of neglect, the minor leads suggesting the specific chemical and physiological nature of such a drug are now being taken up. In the latter half of 1952 two preliminary reports on such possibilities were published. The first of these was an herb used by Shoshone women (Lithospermum ruderale -- but the officinale species also has this activity), commonly called gromwell. An aqueous infusion of the carefully dried herb appeared to stop ovulation in mice with no other ill effects (Wiesner and Yudkin, 1952). Very limited experiments upon humans suggest that there are no immediate side reactions or toxicities to deal with, but the dosage required (around 20 g. of dried herb per day) is too large to be economical. Somehow the delicate active ingredient must be isolated, identified, synergized, and produced by some more efficient means. Larger scale long term testing is necessary, and detailed cost estimates must be prepared, before

the drug will be ready for introduction. With ordinary luck and liberal financing this procedure may take five to fifteen years.

Shortly after gromwell was announced, Sieve (1952) reported a material which seemed to be much further advanced. Phosphorylated hesperidin is a compound which has hitherto been used in small dosages to reinforce the small blood vessels of aviators and as an aid in recovering from radiation sickness, so its toxicities are well understood and a matter of record. In large dosages (0.3-.4 g. per day) Sieve claimed that it was completely effective as an oral contraceptive in the case of 300 couples with a total of 317 exposed woman years. He also pointed out an advantage to oral contraceptives capable of inducing temporary sterility which demographers had not dreamed of ..." A comparative study was made of the incidence of coitus before and during therapy. On questioning the female (of the couple), one significant fact was revealed. Many of those who had been using mechanical devices showed a definite increase in total orgasm when the oral therapy was used. From this observation it may be deduced that mechanical methods had produced a state of anxiety causing varying degrees of frigidity, which resulted in a loss of total orgasm. A significant increase in the frequency of coitus was found in this group. Interestingly enough it was found that the frequency pattern now practised by these couples now correspond essentially to the frequency pattern practiced in the early months of their marriage." Since phosphorylated hesperidin can be made from hesperidin, a chemical compound found in fair concentrations in practically all citrus fruits and quite easily isolated from waste orange pulp and peel, by what should eventually be a simple chemical process, the cost of manufacture should be low. It would seem that here, in the first real try, the goals set for the oral contraceptive had not only been reached but surpassed! However the initial attempts

at verifying Sieve's claims seem to throw it open to question. Chang and Pincus (1953) tested the presumed mode of action of the drug and found that it did not hold for rabbits. From the laboratories of the manufacturers of phosphorylated hesperidin it is reported that various batches of the product yield inconsistent, even negative, results (Martin, 1953). It is apparent already that it will take some years of active laboratory research and possibly extensive field tests to settle the controversies which have already.

The first hint of the possible existence of a product which acts exclusively upon males is even more recent. It has been found that furacin, a relatively simple chemical compound used in salves for combatting superficial infections, will cause temporary sterility in rats. Since the drug seems to be quite specific in the inhibition of the growth of sperm, there is an excellent chance that it will have similar effects in humans. However large overdoses seem to be toxic, thus making self-medication possibly harmful, so it appears that furacin itself may not be the solution, but some related compound may serve. Development in the general direction of a sterility pill for males now appears much more promising than ever before, but it too will take time.

To this potential battery of pills might be added one or two more which would absolutely assure that the desired size of family was actually obtained, and unwanted children did not arrive on the scene. Drugs for bringing about early abortions are already fairly well-known. Previous objections of the medical profession to the use of abortion -- based upon the possibility of infection -- have recently been shown to be largely without foundation (Tietze, 1951). Abortion is safer than childbirth, both in primitive and developed areas. In Japan and Russia, and even in some Christian societies

where it would on the surface appear ideologically reprehensible, abortion has been and may easily remain a preferred method of family limitation, at least as a line of secondary defense against surplus progeny. It is certainly no more drastic than permanent sterilization of the wife, which has become a very popular method in Puerto Rico.

The perfection of these drugs and the methods of their manufacture is only the first step toward achieving the desired control over population growth. Their introduction into a relatively agrarian society would require a program much more intensive and ingenious than has been applied to public health activities in these same areas. Indeed it seems logical that it be assigned to the agencies responsible for public health as a primary responsibility. Thus those professional workers that interfere with the equilibrium of births and deaths are encouraged to develop a professional skill in combining alternative techniques of life-saving and life-prevention in such a fashion that only moderate population disturbances occur in the course of transition, rather than the three-fold to eight-fold expansions which have hitherto been experienced.

In order to acquire this knowledge and skill some rather large scale social experiments will have to be carried out. Initially these experiments would be rather simple, and would probably be organized along the lines set forth by Ogburn (1953) for introducing the rhythm method of birth control. As the early information is accumulated it will be apparent that the a successful introduction will need to be either more rapid, or less demanding of scarce man-power and money -- quite possibly all of these at once. Then still more elaborate experiments will have to be designed and conducted which will perhaps bring the methods of disseminating effective information about birth control up to the standards required for population stabilization

in backward rural areas. This process of experimentation must be repeated for each culture desiring to embark upon a program of economic improvement, just as each public health program has to be adopted to the biologic environment and cultural pattern of the region being covered.

On the whole the outlook for birth control is more cloudy and uncertain than any other element of science and technology which appears to be necessary to improving levels of living. It deserves much more attention than is being accorded it in the allocation of funds for research. The need for scientific and clinical investigations on the subject is rapidly coming to be understood, but it is seldom realised that the social researches must be on a much larger and more expensive scale than those falling within the scope of biology and medicine.

References

P. K. Hatt, ed. World Population and Future Resources, 1952, American Book Co., New York.

I. B. Taeuber, "Family, Migration, and Industrialization in Japan," American Sociological Rev. 16, 149 (1951); "Approaches to the Problems of High Fertility in Agrarian Societies," Milbank Memorial Fund, 1952, 171

C. Tietze, "Theraputic Abortions in New York City," Amer. J. of Obstet. and Gynec. 60, 146 (1950

B. Ryan, "Institutional Factors in Sinhalese Fertility," Milbank Mem. Fund Quart. 30, 359 (1953)

C. Tietze, S. R. Poliakoff, and R. Rock, "The Clinical Effectiveness of the Rhythm Method of Contraception" Fertility & Sterility 2, 444 (1951)

B. F. Sieve, "A New Anti-Fertility Factor," Science 116, 373 (1952)

M. C. Chang and G. Pincus, "Does Phosphorylated Hesperidin Affect Fertility?" Science 117, 274 (1953)

G. J. Martin, "Phosphorylated Hesperidin," Science 117, 363 (1953)

W. C. Nelson and E. Steinberger, "Effects of Nitrofuran Compounds on the testis of the Rat," Fed. Proc. Biology 12, 103 (March 1953)

W. F. Ogburn, "A Design for Some Experiments in the Limitation of Population Growth in India," Econ. Dev. & Cult. Change 5, 376 (1953)