

3 September 1963

## HOW SHOULD ONE GO ABOUT DEVELOPING THE FIELD OF QUANTITATIVE BIOLOGY IN EUROPE?

by

Leo Szilard  
The University of Chicago: *Chicago, Ill.*

1.) America is way ahead of Europe in modern biology, particularly in molecular biology, ~~both~~ in the number of people moving into this field *as well as* and in the facilities that are made available to them, and the gap that exists in this regard is not narrowing but widening at present.

The development of modern biology began to proceed in America on a *fast pace* fairly ~~large scale~~ right after the second World War, less than 20 years ago *and* ~~a~~ *in the post-war years a* number of young physicists, physical chemists *chemists* and medical doctors made ~~in the post-war period~~ major contributions *in* this field. Most of these *young* men discovered what molecular biology was about by attending Summer ~~classes~~ *courses* during ~~the~~ *their* vacations and frequently they acquired the special techniques which they needed *(also)* through such Summer ~~classes~~ *courses*. Of those who spent several of their vacations ~~taking~~ *in* such Summer ~~classes~~ *courses*, quite a number decided that biology was not for them and they returned to physics, physical chemistry, chemistry or medicine - depending on the field ~~which they had studied and~~ in which they ~~held~~ *held* a degree. A minority of those who attended such Summer classes decided that they liked biology enough to invest a few years in ~~doing~~ biological experiments and in trying to discover whether they were good enough at it to pursue an academic career in this field.

Even those who made the grade did not at first find it easy to obtain a staff position at one of the universities. *because* ~~the~~ senior members of most departments of zoology or botany were not eager to open the doors of their departments to them. *MS* Some of the ~~the~~ *MS* younger men who happened to be physicists obtained staff positions at some ~~university~~ *university* ~~in~~ *is* the department of



physics, where they taught physics, <sup>They did</sup> ~~but~~ their research work <sup>however</sup> (in modern biology, so to speak under the protection of their physicist colleagues who recognised that modern biology <sup>appeared</sup> ~~is~~ a ~~promising~~ <sup>promising</sup> field <sup>for</sup> research.

After conspicuous success <sup>is done</sup> ~~had been~~ achieved in the field of molecular biology, it did not take very long until the situation changed. The <sup>senior</sup> ~~classical~~ <sup>staff members</sup> biologists who controlled appointments in departments of zoology and botany of the leading universities gave in, and they opened the doors of their departments to molecular biologists. Many departments of bacteriology changed their name to microbiology and created new positions for <sup>molecular biologists</sup> ~~microbiologists~~.

" " A number of leading institutes of technology which had no departments of biology up until then, created <sup>such</sup> a department of biology. ~~Other~~ <sup>such</sup> institutes which had a department of biology expanded this department and <sup>as the result of</sup> ~~tried~~ <sup>to fill</sup> the newly created positions with molecular biologists. <sup>as the result of</sup> ~~just a~~ <sup>development</sup>

<sup>by 1960</sup> ~~few years ago~~ there were more positions available for molecular biologists in the US than there were good men to fill these positions. <sup>Whenever</sup> there is a major break-through in a branch of science such as there <sup>has recently</sup> ~~is reason to~~ <sup>be</sup>

<sup>been</sup> in molecular biology, it does not take much originality for a man to obtain publishable and frequently <sup>quote</sup> ~~interesting~~ <sup>results.</sup> ~~to read~~ research. Whenever this happens, a large number of men moves into the <sup>open</sup> ~~breach~~; even the least gifted among them <sup>may</sup> attain a certain measure of success and it is frequently quite difficult to tell who of them <sup>ought to be encouraged</sup> ~~is good enough in science to deserve to be~~ encouraged to pursue an academic career.

<sup>In America</sup> ~~In the last three years in America~~ there are a <sup>new</sup> large number of young men <sup>in America</sup> who have moved into the field of molecular biology. <sup>in the last three years</sup> ~~Their~~ number is so large that even those who ~~will~~ make the grade would find it difficult to successfully pursue an academic career, were it not for the fact that <sup>recently</sup> the medical schools in America have adopted a <sup>new</sup> ~~most~~ enlightened attitude towards the promotion of the development of modern biology. In increasing numbers the medical schools in America are ~~taking~~ the position that, in choosing a head for their



department of anatomy, ~~haematology~~ <sup>Pathology</sup>, pharmacology, bacteriology and biochemistry, one ought to disregard the field of specialization of a candidate. It is argued that anyone with a general knowledge of biology can assume the responsibility for the teaching of any one of these subjects and that the school ~~is~~ <sup>may</sup> therefore ~~free~~ <sup>be</sup> to fill any of these positions independently of the field of specialization of the candidate. What holds for the head of the department, holds also for both senior and junior positions ~~under the head of the department, and it may be seen that on this~~ <sup>within</sup> basis, the number of positions in ~~medical schools~~ <sup>American</sup> ~~which are~~ <sup>which are</sup> open to those who make the grade in any field of modern biology, ~~is going to~~ <sup>must be expected to</sup> be very large ~~in~~ <sup>in</sup> the years to come.

2.) In America, as well as in Europe, of the students who graduate in physics, physical chemistry, chemistry or in medicine, a substantial number may try their hands in basic research in these fields, but, of those who do, in the end only about 1 in 20, or perhaps 1 in 10, make the grade and ~~decide to~~ pursue an academic career thereafter. The remainder who do not make the grade take a technical or an administrative job in industry or government or, if they have a medical degree, they may take up the practice of medicine. This is just as it should be for no-one can predict who of those who feel attracted to basic research and are inclined to try their hand at it, will in fact make good. If those who ~~do~~ <sup>do</sup> not make good did not have an opportunity to earn a satisfactory living outside of an academic career, they would either be forced to earn a living in some field which they did not study, or else they would clutter up the universities, perhaps working at a low pay as technicians - and unsatisfactory technicians at that. ~~In these circumstances,~~

3.) ~~there is a tendency in America to advise students~~ <sup>In America students</sup> who feel attracted to biology, ~~to get a degree in physics, physical chemistry, chemistry or~~ <sup>are currently advised</sup> medicine so that if they try their hands at ~~research in biology and do not~~ <sup>basic</sup> make the grade, they may be able to earn a satisfactory living in the field



in which they have obtained their degree. While in the years to come there  
~~might be an~~ <sup>they</sup> expansion of industrial positions for biologists, ~~it is not~~ <sup>is likely to continue</sup>  
~~likely that this expansion~~ <sup>may not</sup> keep pace with the rapid increase  
~~of the~~ numbers of those who <sup>are</sup> attracted by modern biology, <sup>and</sup> are going ~~to~~ to try  
their hands at ~~the~~ basic research in ~~biology~~.

1122

0.57.21  
1.00.2  
-----  
1.57.41

1122



in which they have obtained their degree. While in the years to come there  
 will be an extension of industrial positions for biologists, it is  
 likely that this expansion will keep pace with the rapid increase  
 in the number of those who are attracted by modern biology, and going to the  
 their hands at the same time as in the past.

15.176	1885
5.591	200
9.585	200
	300
	400
	400
	400
	400
	400
	906
	5,591



The development of modern biology went in America through three stages. At first, the young men who moved into this field, and who were offered staff positions at one university or another, were badly dispersed, working in geographic isolation from each other. Later on, there developed a few rather highly specialised centres where a number of young biologists were able to find employment and work in daily contact with each other and, still later, there developed research centres which were attractive to those who were interested in the basic problems of biology and which are large enough to reach the critical size at which it becomes possible for a member of the staff to free himself from any one speciality and to change his speciality as some problems get solved and other problems come to the fore. Even today, the number of those centres which are large enough to be broad-minded and to give young scientists both the independence which they need and the freedom from social pressures which confine them to one or another of the specialities, is quite limited.

4.) In the light of the cause of the development of modern biology in America, I now propose to examine the problem which faces Europe.

There are two aspects of the problem in which Europe differs from America. It will be even more difficult in Europe than in America for a young biologist to find a position where he will enjoy the independence which will be offered to him at a number of major research centres in the US. It will take in Europe 25 years, if not more, before the medical schools adopt a similar attitude towards modern biology that many medical schools have adopted, or are in the process of adopting, in America and therefore the volume of modern biology cannot expand in the next 25 years to the same extent that it is going to expand in America. Nor will there arise in Europe in the foreseeable future within any one nation, the kind of major research centres where young men moving into this field can find the congenial atmosphere that would enable



them to have the independence which they need in order to try their wings and, with luck, to establish themselves in the field, and where some advanced research workers are not subjected to the kind of social pressures which make it difficult for them to leave a field in which they are becoming unproductive in order to attack problems that may prove to be refractory for a number of years but offer reasonable chance of greater ultimate rewards.



Memorandum on the development of modern (quantitative) biology in Europe

Because modern biology, particularly molecular biology, has had conspicuous success in the last 10 years there is a great interest in the developing this field in Europe on the part of various national governments

and it also represents a tempting field of work for those who are attracted. ~~Because of the conspicuous successes in this field in the past years and~~ *Because of the conspicuous successes in this field in the past years and*

~~because this field is rapidly expanding, it is very tempting for all those~~ *because this field is rapidly expanding, it is very tempting for all those*  
~~scientists and would be interested~~ *scientists and would be interested*  
who are attracted to branches of science which are rapidly growing *fields of science*

~~The field has also attracted the attention of those who are responsible~~ *The field has also attracted the attention of those who are responsible*  
for the administration of science on a national level and it is comparatively easy to obtain funds for the development of this field in a number of nations in Europe.

The development of modern biology in Europe faces, however, just because of this strong new interest, a number of dangerous pitfalls. There is a temptation to encourage students to get their

degree in modern biology. ~~For a limited period of time those who get~~ *For a limited period of time those who get*  
their degree in modern biology ~~will~~ *might be able to get Academic's* be able to get jobs in industry if they do not make the grade in ~~academic research~~.

It is a foregone conclusion, however, that very soon the supply of graduates in modern biology ~~will~~ *would* greatly exceed the ~~demand in industry, and it is obvious that even though~~ *job opportunities* demand in industry, and it is obvious that even though a number of professorships at universities for modern biology may be created at various European universities, these would be a best, sufficient to accommodate those who make the grade in academic research.

*especially*  
*and biology*  
*fields of science*  
*problems*  
*if they*  
*might be*  
*made of*  
*would*



This situation is very different from the one which prevails in physics, physical chemistry, chemistry, or medicine. Of the students who graduate in this field, an increasing percentage will try its hand in basic research. Perhaps one in ten of those ~~x~~ who do might make the grade and pursue thereafter an academic career. The remaining nine out of ten take an industrial or administrative job or if they are MDs take up medical practice. This is as it should be for ~~anyone~~ no-one can predict who, among those who feel attracted by basic research, will make the grade and if those who do not did not have an opportunity to earn a living outside of an academic career, they would either be forced out of the profession or they would clutter up the scientific laboratories, working some low grade job, perhaps as technicians - and very unsatisfactory technicians, at that.

What, in my opinion, needs to be done in Europe<sup>is</sup> is to encourage students ~~to~~ who are attracted by modern biology to get a degree in physics, physical chemistry, chemistry or medicine and after they have their degree, to try their hands at basic research in modern biology. If they make the grade and if they have an opportunity to do so, they could then pursue an academic career in this field, otherwise they could earn a living in the field for which they are qualified by their degree. If this philosophy is adopted, then it is obvious that a successful development of modern biology in Europe would require action along two different lines:



(a) It would be necessary to provide for summer courses both in specialized techniques of modern biology and in such more general fields as biochemistry, which would afford an opportunity to students both to learn these techniques and to find out what modern biology is about during their summer vacations. Such summer courses could be held, for instance in France, Germany, England or Italy and could be mainly aimed at students of the country where the laboratory giving the course is located or one could aim at setting up at an international laboratory located in Europe, summer courses which are open to students of all the nations of Europe, or even better, to students from all nations. Assuming that the volume of quantitative biology in Europe might in the years to come, equal the volume of this field in the United States - and it would be unreasonable to believe that it would be greater, one international laboratory giving such summer courses could easily serve the needs of the whole of Europe. Just as one summer course in each of the special fields of quantitative biology has proved to be sufficient for the US

In as much as one summer course given in each specialized field of modern biology has proved to be sufficient for the needs of the US, <sup>it</sup> ~~which~~ seems reasonable to assume that one single international laboratory which assumes <sup>the</sup> the responsibility of holding/summer courses which are required, would be sufficient for the needs of the whole of Europe.



In particular the international laboratory of Genetics and Biophysics at Naples, ~~would~~, if it assumed this responsibility and if it were adequately financed, could well provide all the summer courses that Europe would need. If one of 10 or 20 students who spent several of his summer vacations attending these summer courses were ultimately pursuing an academic career in the field of basic biology ~~these~~ this could be regarded as a healthy development. If there were a mushrooming of summer courses all over Europe with a result that only one in 100 or one in 1000 of the students who spent their vacations attending these summer courses would find the opportunity to pursue an academic career in basic biology, this would have to be considered as a rather unhappy state of affairs.

(b) Having created adequate summer courses it will be also necessary to create one international laboratory in Europe where the most gifted students could spend 5 or 6 years after having graduated in physics, physical chemistry, chemistry or medicine or some other related subject, in post graduate research work, and where they could discover whether ~~their~~ they are suited to an academic career in basic biology and whether some of them could, with luck, establish themselves in the field of modern biology, to the point where they may receive an offer from some university or a position where they could continue their work with ~~a~~ the required degree of independence. In the absence of such a European laboratory it would be very difficult for those who want to engage in post-graduate research in the field of modern biology to find a place in any of the national



laboratories where they would have the independence that they would need to try out their wings and with luck to establish themselves as an authority in some field of specialization. It is ~~ve~~ much easier for a post-graduate student to find an academic position in America, ~~which provides him~~ As an assistant professor, a position that he can hold for 6 years in the independence that he would need to be able to try his wings. Even in America laboratories outside of universities such as the National Institutes of Health

In America laboratories which are not embedded in the setting of a university such as the NIH are able to provide more freedom for young graduates than are universities. This is illustrated by the success of such young men working at the NIH as Dr Niernberg who would have found it rather difficult to have the independence which he enjoyed at the NIH when he made his contribution to the coding problem and ~~in and~~ any of the universitites which would have been willing to give him comparative facilities.

It would perhaps be possible ~~that~~ with the help of the the National Research Council in England, the Centre de la Recherche Scientifique in France, to create scattered throughout Germany, France, England, units at which young graduates could pursue their research in basic biology with sufficient independence. The trouble with such scatt~~er~~ed small units is, however, that they are of necessity rather small and that they thus remain



well below what may be called the critical size. Young men who join them would feel isolated. They could not have an exchange of views on a daily informal basis ~~that~~ <sup>with</sup> other people ~~should~~ who are interested in the same problems as they are, and such an exchange of views on a daily basis is particularly important for young people who have not as yet found their bearings and who have not as yet established themselves as authorities in any special field. This problem of the critical size of the unit, which is more important for the younger people than for those who have established themselves already ~~would be best~~ be best solved by setting up an international laboratory in some suitable place in Europe. In order to have the critical size, the institute would have to have about 50 000 sq. ft. of laboratory space and a budget of between one and a half million and two million dollars a year. The initial expense of setting up such a laboratory is estimated at between four and five million dollars.