Letters

Studies of Fallout

The article relative to radiation hazards and Government [*Science* **129**, 1210 (1959)] impressed me as a fair, sound, and useful statement of the problem. I am sorry, however, that Project Sunshine was written up in such a negative way. This was probably more a matter of public relations on the part of the Division of Biology and Medicine than anything else.

As the United States Representative to the United Nations Scientific Committee on the Effects of Atomic Radiation, I was impressed to learn that the United States had been able to make available a wealth of material as a result of Sunshine and related projects without which the development of our report to the General Assembly of last August would have been difficult. The material provided this committee by the United States was greater than that provided by all other countries.

It would be helpful if one thing could be made clear—the tremendous difficulty of making these analyses of almost infinitesimal amounts of material. One of the great achievements of Libby and the radiochemists, both those who are associated with him and radiochemists in general, has been the development of reliable analytical methods that have made the studies of fallout meaningful. Determinations of total beta activity as made by the Public Health Service are meaningful only in light of the ability to compare them with the more exact determinations that are made.

The Atomic Energy Commission has been active since its inception in stimulating interest and competence in the Public Health Service in the field of radiation and radiobiology. The activities of the Public Health Service mentioned in the article—operations at the Columbia River and the Robert A. Taft Sanitary Engineering Center, offsite monitoring, and the research program in radiobiology—were all stimulated by the AEC or its predecessor, the Manhattan Project.

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Basic Research

Definitions of basic research [for example, C. V. Kidd, *Science* **129**, 368 (1959)] remind me of the fat and lean physicians who were asked to classify a couple of hundred patients as obese, normal, or underweight. It should come as no surprise to find that the lean physicians classified many more patients as obese than did the fat ones.

Similarly, definitions of basic research are not made by engineers, physicists, research managers, and so on—they are made by people, each with his personal packet of professional training and biases. Each such person tends, I believe, to define basic research from his own personal place in the scientific spectrum —everything on his left is basic, everything on his right, applied. Research an engineer calls basic may well be regarded as applied by a physicist.

This approach is, of course, practical nominalism, as opposed to the attitude of those who believe that if they can find the "lost chord" of magic words they can unmask a universal, essence, or concept of "basic research" good for the ages, or at least good till the next administration.

The working scientist could relegate this discussion to the metaphysicians of the philosophy department or to the front office and proceed with his business if it were not for one practical consequence. Good research proposals may find themselves wandering in a limbo between fund-granting agencies—too basic for the hard-bitten practical men of one, too applied for the purists of another. Good will on both sides can, and does, solve such problems, but beware of Aristotelian classifications in the non-Aristotelian world of science.

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Basic Research in Europe

In the interesting survey article entitled "Basic research in Europe" [*Science* **128**, 227 (1958)], written by David M. Gates, the author refers to the state of North Westphalia, which at the present time does not exist. Probably the author had the state of North Rhin-Westphalia in mind instead.

It is also stated that research funds in Spain "are controlled largely through the Superior Council for Scientific Research, under the Ministry of Education, and are distributed to academic institutes in all fields of science, *except agriculture*" (italics mine). This statement shows unfortunate misinformation on the part of the author. The "Misión-Biológica de Galicia" has been engaged in agricultural research since 1921. That institution has been absorbed by the Superior Council for Scientific Research, which at the same time supports agricultural research in institutes and experimental stations in localities such as Madrid, Sevilla, Granada, Murcia, Salamanca, and Santiago de Compostela, among others.

Another obvious piece of misinforma-

tion given in the article is that "in Portugal [there is] far greater freedom and communication with the outside than will ever be possible under the present regime in Spain." The international activities of the Superior Council for Scientific Research are summarized in a booklet entitled "Actividades Internacionales del Consejo Superior de Investigaciones Cientificas," and the catalog of the research staff of that organization clearly shows that most members have had extensive research experience in other countries. At present a number of private firms also have technical and scientific exchange with foreign countries.

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My attention has been called to the following statement in an article by David M. Gates on basic research in Europe: "Eire is an overpopulated, tragically poor agricultural country with a total lack of organization for research. In the shadow of Great Britain it is a little surprising that more cross fertilization and inspiration have not taken place."

The factual statements in the foregoing paragraph are, I regret to say, seriously at variance with reality. Not only is Ireland not "overpopulated" in the normal sense of the term but the reverse is the case, as a glance at the table on population density in the *U.N. Statistical Year Book* of 1956 (pages 32–34) will amply demonstrate. That table shows that in 1955, whereas the density of population per square kilometer was of the order of 331 in the Netherlands, 291 in Belgium, 121 in Switzerland, and 103 in Denmark, it was only 41 in Ireland.

To speak of Ireland as a "tragically poor agricultural country" is likewise a serious exaggeration. For many reasons, some of which derive from historical causes, Ireland is not as prosperous as it might have been under different circumstances. However, since the establishment of an independent state a generation ago, considerable effort has been made both to raise the general level of prosperity and to correct the disequilibrium in the economy which resulted from the enforced subservience over a long period of time of the Irish economy to that of Britain. Although the process is inevitably a slow one, these efforts have already achieved some success; the value of the contribution of nonagricultural activities to the national income rose from $337 million in 1938 to $924 million in 1957. During this period the number of persons engaged in industry rose by 30 percent, while at the same time output per head in the agricultural sector increased by 65 percent. In 1930 we produced 60 million units of electricity; last year we produced 1860 million units and distributed it not only in urban areas but to 240,000 rural homes and workshops.

Furthermore, Ireland cannot be held to be a poor country in the ordinary connotation of the term. It is true that, by comparison with other countries of Western Europe (one of the most highly developed economic areas of the world), the standard of living—as judged, for instance, by income per head—is not very high. However, it is certainly not low, either, by comparison with the countries of the world generally, or even by comparison with the countries of Western Europe. The *U.N. Statistical Papers* series E, No. 4, for instance, which show net national product per head at factor cost in U.S. dollars as averages for the years 1952–54, give for Britain a figure of 780; Germany, 510; the Netherlands, 500; Ireland, 410; Austria, 370; Italy, 310; Greece, 220; and Portugal, 200. Furthermore, food consumption per head in Ireland is among the highest in the world. The *OEEC General Statistics* (1958, No. 6) show that in terms of calories per day such consumption in Ireland for the year July 1956–July 1957 stood at 3550 as compared with 3240 in Britain, 3220 in the United States, 3010 in Germany, and 2930 in the Netherlands.

It is likewise not true to say that there is in Ireland "a total lack of organization for research." The university system in Ireland, as will I am sure be known to most of your readers, is good and provides reasonable facilities for research. The country does not, of course, command the same financial resources in this field as bigger countries which have had time to develop their economic resources. But to give the impression, as Gates does, that Ireland is, in this field, in an entirely backward situation is a gross misrepresentation.

JOHN J. HEARNE, *Ambassador Embassy of Ireland, Washington, D.C.*

The article entitled "Basic research in Europe," by D. M. Gates, assistant division chief of the Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado, who was attached to the London branch of the Office of Naval Research from 1955 to 1957, contains the following reference to my country: "Eire is an overpopulated, tragically poor agricultural country with a total lack of organization for research. In the shadow of Great Britain it is a little surprising that more cross fertilization and inspiration have not taken place."

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Letters

(*Continued from page 128*)

When Gates wrote this paragraph he was not writing as a scientist, for he is demonstrably wrong about ascertainable facts, nor was your journal in printing it contributing to the advancement of science by the pursuit of truth.

The Republic of Ireland (*Eire* is Gaelic for the whole country) is not overpopulated in the normal meaning of the word. Its population density (41 per square kilometer) is one-eighth that of the Netherlands, one-third that of Switzerland, and less than half that of Denmark. It is about equal to that of overpopulated (?) Indiana or Michigan.

If the Republic of Ireland, with a per capita net income of 410 U.S. dollars per annum, is "tragically poor," how must we designate Italy ($310), Portugal ($200), India ($60)? "Hypertragically" might be employed. And what of the Netherlands, of which your contributor rightly speaks well? Is it "hypotragically poor," with an income but some 20 percent higher than that of Ireland?

Again, our figure for motor vehicles per thousand of the population (85) is not greatly below that of Great Britain (110), and our per capita annual consumption of energy (1.8 tons of coal equivalent) is 80 percent that of the Netherlands or Denmark. We have 50,000 television sets in the area (population 1 million) in which reception is at present available.

Had Gates visited Ireland (I presume he must not have done so) he might, I admit, have concluded that we lived with the belief that, having only one life, some part of it should be devoted to play. We have, possibly, too many race meetings and golf courses. But he would not have seen much evidence of "tragic poverty" among the best-fed people in the world (3550 calories per head per day, as compared with 3220 in the United States). We rather like our well-fed poverty; our suicide rate is among the lowest in the world (this includes the Western Hemisphere). "Poor"—perhaps more than slightly; "tragically poor"—to princes and millionaires only.

I now turn to Gates' remark that we are "totally lacking in organization for research." He should take a lesson from the politicians and beware of categorical statements unless he knows they are true. They are so easy to refute, while the difficulty of contradiction increases with the degree of qualification. Perhaps I had better list our more important organizations, though to mention one would be sufficient to knock out the "totally."

We have two universities, the National University of Ireland, with constituent colleges in Dublin, Cork, and Galway, and Dublin University, which has Trinity College. The degree examinations, graduate and research, are conducted in collaboration with external examiners from other (mainly British) universities, and the degrees themselves are recognized by the British as equivalent to their own degrees. Our graduates are recruited by foreign firms on the same conditions as British graduates.

Research is actively pursued in our university departments of science. It is supported by the Government and the local authorities, and by the Medical Research Council of Ireland (that of Britain also makes grants), by the Rockefeller Foundation, by United States agencies—for example, the European Research Office of the U.S. Army—and by Irish and foreign industry. Some of our professors have world-wide reputations in their fields of work; E. J. Conway, head of our department of biochemistry, is outstandingly distinguished. They find demand for their services as visiting lecturers at universities and before learned societies outside the country. About 150 scientific papers emanate each year from the Republic.

A number of Irish students go to the United States to hold postdoctoral fellowships. We do not hear complaints about their lack of research training; indeed, they seem to do quite well.

Many scientific organizations have thought it worth while to hold international gatherings in Dublin. The universities were hosts to the 1957 annual meeting of the British Association for the Advancement of Science. The International Astronomical Union met in Dublin in 1955; in the same year an International Symposium on Plant Products was organized in this college. The British Faraday Society assembled here for a discussion on "Ions of the Transition Elements" in September 1958. This autumn there is to be an International Conference on Humic Acids. I could readily extend this list.

Our scientific roots run deep; the Chemical Laboratory at Trinity College, Dublin, was established in 1711 and our chair of chemistry in this college, in 1796. The latter is one of the oldest in Great Britain and Ireland formed outside a medical school.

The science library facilities in Dublin are of a high order. Trinity College Library was established in 1591. It receives by law a copy of every book published in Ireland and in the United Kingdom. The library of the Royal Dublin Society dates back to 1731, and that of the Royal Irish Academy to 1786. Our own College Science Library was started in 1845. There are few important scientific journals of which complete runs are not available here, bought as issued and not later as photocopies or in sets.

The National Observatory at Dunsink, near Dublin, was founded in 1785.

It has had distinguished directors, among them Sir William Hamilton (1805–65), whose work was of great importance in the development of quantum mechanics.

The Dublin Institute for Advanced Studies, which trains postgraduate students, was set up in 1940. It contains departments of theoretical and cosmic physics and has had rather distinguished people on its staff—Ernest Schrödinger and Walter Heitler, for example. We get numerous applications from abroad for scholarships to be held in the institute. The Dublin climate can scarcely be the attraction.

The Royal Dublin Society was organized in 1731 to promote the study of agriculture and science in Ireland. Its School of Applied Science (1796) was one of the earliest developed in the then United Kingdom. This School eventually became the Royal College of Science for Ireland, the courses of which were modeled on those of the Imperial College of Science in London. The Royal College was amalgamated with University College in 1926.

The society has published for many years its *Scientific Proceedings of the Royal Dublin Society* and has journal exchanges with institutions all over the world. It gives grants to promote research and each year brings two or three distinguished scientists from England to lecture here.

The Royal Irish Academy was chartered in 1786. Its functions here parallel those of the Royal Society in London. It publishes scientific and literary proceedings and has exchanges with academies in many countries. It is responsible for the Irish National Committees which are linked with the International Scientific Unions. For example, it organizes the work of the Irish National Committee on Chemistry, which is affiliated with the International Union of Pure and Applied Chemistry. The academy has, for one of its duties, the screening of applications for awards that are offered by the U.S. National Academy of Sciences.

The Medical Research Council controls research into medical problems of importance to Ireland. The work of Vincent Barry and his team on the chemotherapy of tuberculosis is internationally distinguished. Barry has lectured in Britain, Europe, India, and the United States; he has, I know, spoken in Denver. His work, while mainly financed by the Irish Government through the Medical Research Council, has also been supported by a large European firm and by the Lasdon Foundation of New York. An International Colloquium on the Chemotherapy of Tuberculosis was held in Dublin in 1951. It was attended by distinguished workers from many countries.

The Irish Department of Agriculture has subsidized research in a number of branches of agriculture for many years.

Its research journal is well known—even though Gates never heard of it. Recently, many of these functions have been taken over by a new Institute of Agricultural Research, founded with the aid of grants from the United States (Counterpart Fund). The Soil Research Centre at Johnstown Castle, Wexford, which has been working for a number of years, has a high reputation. The Agricultural College attached to University College, Dublin, was established in 1838 and is one of the oldest in these islands.

The Institute for Industrial Research was founded in 1946. It developed from an Industrial Research Council which goes back to 1934. The institute works on problems of interest to Irish industry. Its testing facilities are being extended with the aid of grants from the Counterpart Fund. In addition, industrial research is carried out by the bigger agencies, such as Messrs. Guinness, the Irish Peat Board, and the Irish Sugar Company. A very famous statistician (who wrote under the pseudonym of "Student") was attached to the scientific staff of Messrs. Guinness.

There is quite a lot of "cross fertilization" from abroad. I have referred to the work of the Royal Dublin Society in bringing over British lecturers. This is but a small part of what is done in the way of arranging lectures by distinguished foreigners.

The Chemical Society (of London), the Royal Institute of Chemistry and the (British) Society of Chemical Industry have flourishing local sections in Dublin. They, with the Institute of Chemistry of Ireland, have a Conjoint Chemical Council which arranges lectures in Dublin. The current program shows 11 lectures by foreigners.

In addition, the universities arrange many addresses by professors from abroad. In this department we had ten last session. We also had R. Bognár of Debrecen, Hungary, as visiting professor for a term.

I hope I have cited facts to show that Ireland is not "overpopulated," is not "tragically poor," is not "totally lacking in organization for research" and is not without "cross fertilization" from abroad.

Apart from putting Gates's statement in the proper perspective, this letter may provide new facts for your readers. I was surprised, when in the United States, to find that some of your countrymen seemed to think I should express amazement at the sight of electric light.

In taking issue with Gates I do not, of course, claim that we are underpopulated like your Western states, or that we are not poor by United States standards, or that we are not underorganized in research. I merely state that we are not as totally backward as Gates implies.

T. S. WHEELER

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I am pleased to be corrected for my ill-chosen words concerning the Republic of Ireland, and I hope that these were not taken as any lack of appreciation for the wonderful hospitality extended to me during my visit to that beautiful, romantic country. Apparently, the economy of Ireland is stronger than the impression of it a visitor receives; however, the fact still remains that due to economic necessity many people (especially students) find it necessary to find employment elsewhere. Many countries or states throughout the world can list numerous universities, institutions, societies, libraries, and traditions which, by themselves, do not imply good organization for scientific research. However, their very existence should provide the basic environment from which a broad spectrum of knowledge, stemming from research, should flow.

In my article it was impossible for me to describe in detail the scientific activity of every European country, and for this reason I wish to thank Hearne and Wheeler for their informative letters.

DAVID M. GATES
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Subcool and Supercool

The recent exchange of views [*Science* **129**, 1296 (1959)] between meteorologists Braham and Appleman relative to *super-* and *subcooling* intrigues me. It might be of interest that chemical process engineers, who have intimate contact with related physical phenomena, have no problem with these words. They are not used interchangeably. Each has a distinct and separate meaning.

The engineer's definition of *supercool* coincides with that of Webster: "to cool below the freezing point without solidification." For example: Liquid glycerine can be supercooled many degrees without crystal formation.

Subcool in the engineer's parlance is defined as "to cool a liquid below the equilibrium temperature at which condensation takes place." For example: The alcohol condenser in this process is designed for 20°F subcooling. In actual practice, condenser calculations are made with separate consideration of heat transfer surface "for condensation" and "for subcooling."

Since it appears that meteorologists have not made up their minds concerning usage of these two words, may I have the pleasure of inviting them to join with the engineers? Consistency of terms throughout the scientific fraternity is worthy of attainment.

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