facts such as these: More herring (102,194,000 lbs.) were caught in the Canadian Passamaquoddy region (Bay of Fundy) in 1941 than ever before, although this region is fished more intensively than any other, with the chief incidence on the yearling fish less than half-way on the road to sexual maturity and with no protection for the spawners. Although Lake Erie is more intensively fished than any other of the Great Lakes, it yielded more whitefish in 1939 than is recorded for any earlier year and the Canadian catch (U. S. figures not available) was 45 per cent. higher in 1941 than in 1939. We have still much to learn.

INTERNATIONALISM IN SCIENCE[1]

By Dr. KARL K. DARROW

BELL TELEPHONE LABORATORIES

I HAVE been asked to speak on internationalism in science, or rather in the particular field of science which happens to be mine, the field of physics. The quickest way to handle this subject would be to reverse it, and speak of *nationalism* in science. This would be a conveniently narrow subject, for in science there is hardly any nationalism. The laws of nature are everywhere the same, and the ways of describing them do not differ from land to land. You may indeed remark that in different lands they are described in different languages. In so far as this is true it is not important, except as an inconvenience; and it is not even entirely true. The laws of nature are described by mathematics, and mathematics is a universal language. You can look at a book of physics in some language of which the very letters may be unfamiliar, and still you can tell what the author is treating by following the train of his equations. If you can read his words or get some one to translate them, you find that there is no imprint of nationality on his ideas, any more than on the laws which he happens to be describing.

So, the journals and the books of science are a cosmopolitan literature, and indeed the most cosmopolitan thing which now remains to us. In the happy days before the other war there were other cosmopolitan things: the gold standard, and the free circulation of art and of artists from country to country, and the worldwide diffusion of travel and trade with limitations so light that they now seem like freedom. These did not survive the other war, or survived it only in a crippled fashion; but the literature of science continued still to pass all boundaries even when its creators could not, a sort of intellectual gold standard by which the worth of every contribution and the standing of every contributor were appraised. Englishmen were not judged by Englishmen exclusively, nor Germans by Germans nor Americans by Americans; the common opinion of the scientific world was the court of first and last resort. No experiment was disregarded, no idea neglected because it came from the opposite side of a frontier. Few if any scientists strove to keep their ideas confined within their own countries. The notion of keeping a discovery undisclosed is repugnant, I can without exaggeration say it is revolting, to nearly every man of science. So few are the exceptions to this rule that we still look with wonder on Newton and on Cavendish, who were exceptions to it, and try to divine what peculiar quirk of personality made them such deviations from the norm. Nearly every one in science spoke to all who would listen, and nearly every one in the entire world of science was ready to listen to a new experiment or a new idea, from whatever part it came.

But even so, were there not some nations which were always the discoverers and the teachers, and others which were always the copyists and the learners? Nothing would seem more natural, and nothing could be further from the truth.

Take the four men whose consecutive labors enabled us to understand the motions of the heavenly bodies: Copernicus the Pole, Galileo the Italian, Kepler the German and Newton the Englishman. They were astronomers, but they were physicists also, for the laws of motion of the heavenly bodies are those of earthly bodies also, exemplified on a grander scale. Take the story of radioactivity. Radioactivity was discovered because x-rays had been discovered. The discoverer of x-rays was a German, but the man whom his work inspired was a Frenchman. Another Frenchman and his Polish wife carried on the study, and for a time it might have been thought that Paris was destined to be the center of all wisdom about radioactivity for ages to come. Not for a very long time, however! Not a decade had elapsed before every one who cared at all about this field was looking eagerly to England, and not because of an Englishman either, but because of a New Zealander whom a fellowship endowed in Britain had brought to Cambridge. The focal point of research in radioactivity traveled with this man to Montreal and then back again to England. It is Rutherford of whom I speak, the very man who later became the first of all men to achieve the transmutation of the elements. So long as he lived, the great Cavendish laboratory at Cambridge was the greatest scene of transmutation

[1] Broadcast, under the auspices of the American Philosophical Society, over Station WRUL on June 24.

in the world. Now the art and science of transmutation are dispersed throughout all countries; they are cultivated in America most of all, largely because Americans invented the two very ingenious devices which are used to produce the very high voltages demanded for transmutation. It was, however, an Italian who first taught the world to use the most variously efficient of all the agents of transmutation, the agent which we call "the slow neutron."

I could tell the same sort of story for almost every achievement in physics, and the lesson would always be the same. Progress in science depends on the spirit of the brilliant man; and in this case above all, the spirit bloweth where it listeth, heedless of national boundaries and heedless of racial groups. There has never been a city which was the capital of physics as Vienna for a century was the capital of music. There has never been a nation which was preeminent in physics as France so many years was preeminent in painting. Metaphorically speaking, if you walk through the galleries of physics you do not find the masterpieces labelled "French School" or "Dutch School" or "Italian School." There is just one school of physics, and from its inception it has been the school of all civilized nations.

Those of my listeners who heard the prior programs of this series are probably expecting something more. You may be waiting now to hear me tell of some great scheme or schemes of formal international cooperation, set up and going on for the benefit of physics. But those who speak for other sciences, astronomy for instance, can give you more striking examples than I can. I might indeed mention the laboratories built and the equipment given by the Rockefeller Foundation for physicists in certain European lands—laboratories now, by tragic irony of fate, ruined by civil war or taken over by the Nazis. It is allowable to hope that soon they may again be serving their intended purpose, and that the example of great donations by private wealth across frontiers may survive to be followed by future generations.

More significant as yet has been the living aid interchanged by the nations—I mean, the students who have gone from their homelands to some other country, not to sit at the feet of a famous master (as the saying used to be) but to stand beside him and work with him upon some problem of his own selection. Few of the leaders of physics have worked entirely by themselves. Normally, the brilliant physicist requires aid, and the skilled intelligent aid of men who are almost his peers, to follow out the ramifications of his thought and to perform the experiments suggested by his ideas. Mostly his fellow-countrymen supply the aid, but not by any means always. Many a Canadian and many an Australian has brought his stone or stones to the edifice reared by a British physicist; many an American has done the like for a German in the days before the other war and in the days of the Weimar republic; many a Chinese and many a Japanese has done it for an American. The graduate schools of many a university were microcosms of a non-embattled world, little groups composed of many strangers working together in a comity and with a mutual understanding such as we all should like to see realized in the world at large. We ought to try to increase their number after this war, and do away with certain formal restrictions which impeded them from arising in certain parts of the world. Yet if there had never been any such group, or if there were never to be any such group again—even in that deplorable and highly unlikely case, science would still be international. It would be inevitably international, so long as the books and the journals were allowed to cross the frontiers. Every physicist sooner or later, and glad or sorry as he may be, finds collaborators springing up all over the world. They are taught by his experiments and by his calculations, and he is taught by theirs. It could not be otherwise. Ideas flow about the world like the life-blood in an organism. If from any part of an organism the flow of blood is withheld, that part decays. The same is true of the organism of science and of thought. If any one doubts this, let him look upon the demonstration which for the past ten years has been presented by the enemy.

OBITUARY

FRANK SCHLESINGER
1871–1943

THE death of Frank Schlesinger deprives American astronomy of its most distinguished authority upon precise astrometric measurement.

Born in New York, the son of Joseph and Mary Wagner Schlesinger, he received the degree of B.S. from the College of the City of New York at the age of nineteen. After five years' experience as a surveyor in his native city he studied for the doctorate at Columbia (Ph.D., 1898).

In the following year he began his astronomical career at the International Latitude Observatory at Ukiah, California, which he established, and operated for four years, as observer-in-charge. The visual observations demanded the highest attainable precision and care, and half of them had to be made in the morning hours. It was a severe introduction to astro-