

Eugene Wigner—a tribute on his seventieth birthday

Next month marks the seventieth birthday of this mathematical physicist who has contributed to so many aspects of our science. A former student of his talks of Wigner and of the significance of his work.

Frederick Seitz

It was in 1930 that Eugene Wigner joined the staff of Princeton on a half-time basis, at the age of 27, sharing a professorship with John von Neumann. Both were members of that remarkably illustrious group of students who had emerged almost as a team in Budapest and then accepted employment in Germany in the last great days of German science. Leo Szilard once confided to me that the group was really not composed of Hungarians but of Martians in disguise.

Foresight and insight

Wigner's half-time appointment became full-time in 1933, for well known historical reasons. I well recall the morning in February 1933, in the depths of the world depression, when the newspapers carried the information that President Hindenburg of the Weimar Republic, after failing several times to form a stable government along other lines, had selected Hitler as his Chancellor. Eugene's response was a solemn and prescient "Ah Weh!" We had just completed the first semester in which I had been privileged to work with him, and he was about to return to the half-year in Europe. His route led to his home in Budapest rather than to the Technische Hochschule in Berlin, where he knew that the new government would no longer welcome him. He commented afterwards that when, later that year, he

saw Professor Richard Becker, who had once been his sponsor in Berlin, Becker, in addition to wishing him well in his new life in America, stated that perhaps he was fortunate in the sense that by the time it would become obvious to other scientists in Germany that they too should leave, the doors to migration would be closed.

It was characteristic of Wigner's insight into human, as well as scientific, affairs that he appreciated almost immediately the full significance of the changes that were taking place in the world. To many, myself included, his forebodings concerning the worldwide implications of events seemed overly pessimistic. The simple truth was that most of us, not least of all a relatively naïve lad from the West Coast such as I was, could not really comprehend the magnitude of the forces at work in the world at large and were too willing to look upon events as localized, in much too simplistic terms. It may be true that Eugene did overrate the ultimate capacity of the new German leaders to achieve their goals, but he never underestimated their ambitions. Moreover, if we are willing to grant that the forces of totalitarian repression are far from dead in the world in our day, his concern about the end result of the antidemocratic trends that have arisen in our century was neither overrated nor, in fact, as yet resolved. I was in Prague on 22 August 1968, the day that the Soviet Army invaded that country to reassert the principle that it is to be a satellite.

The parallel with the events of 1938 was all too close to be missed by one of my generation.

In these days in which the concept of a generation gap has become a commonplace, it is worth commenting on the generation gap of those long past days. I will readily confess that I felt a genuine sense of dislocation relative to the order established by the older generation during my student days. To this extent I have more than a measure of sympathy with the students of today. For reasons too complex to analyze here, however, the sense of alienation I had then, and which was rather widely shared, never encompassed the short-range destructive impulse that we see in our day. No one I knew would have damaged a blade of grass on the campus, let alone contemplated burning down Nassau Hall. The wish for change was directed at a more cosmic and abstract level. We never bore resentment to those who surrounded us and worked with us in the everyday world, as seems so common today. In retrospect I am inclined to believe that Wigner, however, without being conservatively rigid, probably never suffered the throes of such dislocation, and as a result was able to maintain a far more balanced and rational view toward the forces at work in society than most of us could. His mother commented that once, when Wigner was a teenager, he was asked what he wanted for Christmas and he remarked that he had need for nothing, because he was contented with things

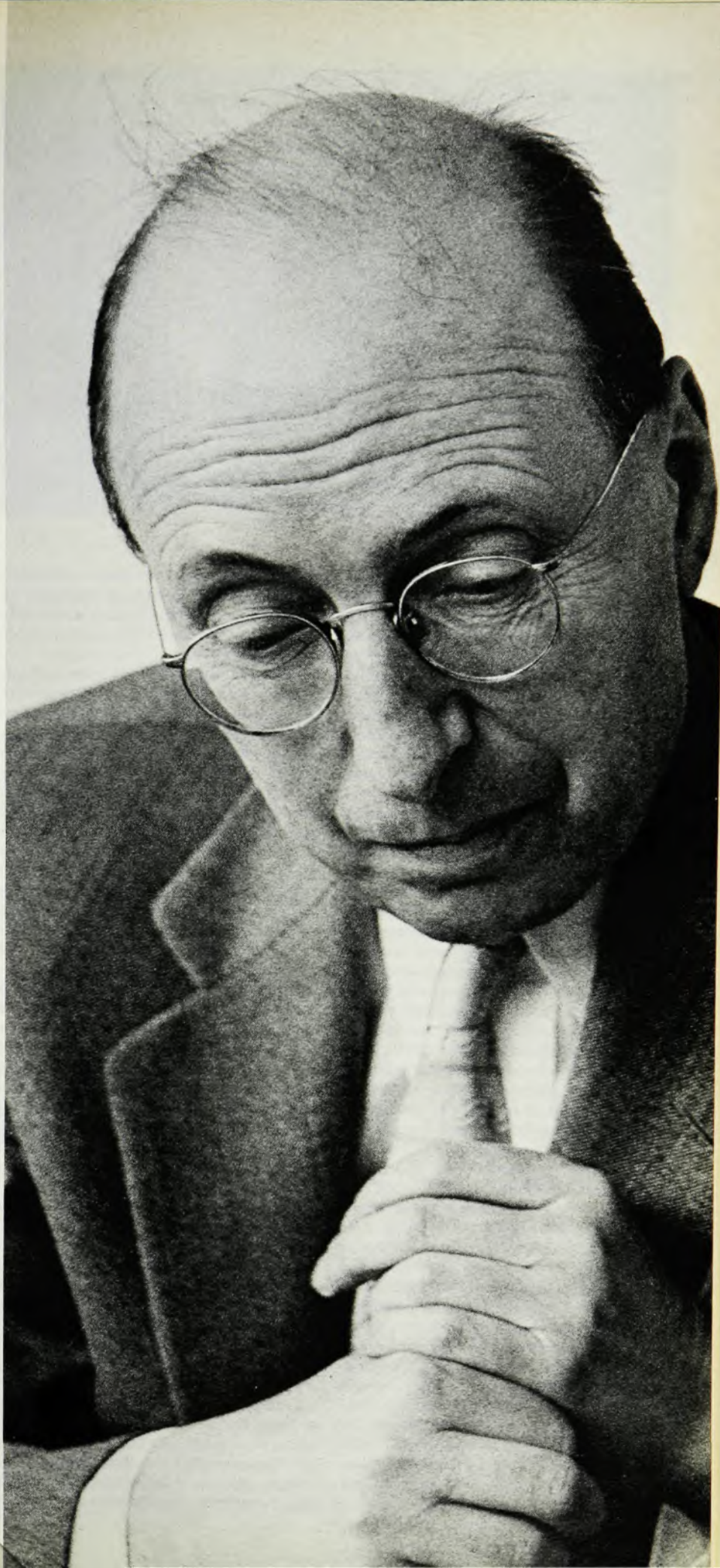
Frederick Seitz is President of The Rockefeller University, New York.

as they were and with what he had.

In January 1932 I had the good fortune to be accepted as a beginning graduate student at Princeton. Within a matter of a few hours after arriving in town in what was turning out to be mild January weather, the small contingent of graduate students from northern California took me in tow, partly to help, partly out of curiosity, and partly to make certain that the Golden Gate was still swinging on its hinges. Three of the group, namely Arthur Frost, Everitt Gorin and Albert Sherman, were in chemistry. These and a fourth, Joe Hirschfelder, who was somewhat of a Leonardo of geographical and scientific areas, quickly bundled me up and took me off to the final lecture of Wigner's course in elementary quantum mechanics. He was lecturing on the Zeeman effect in the hydrogen atom. I was sufficiently impressed with the elegance and clarity of his presentation that, when I saw a copy of a book he had written on group theory and quantum mechanics (while prowling about the Princeton bookstore the next day) I bought it with the hope that it might be a more understandable approximation of Herman Weyl's book on the same subject, with which I had been struggling. It was.

Scientific diversity

It is perhaps worth noting that by the time Wigner severed his European professional links he had thoroughly established the groundwork in a large number of areas in which he would be-





At Wisconsin. Posing with the physics department of Wisconsin's Madison campus during the spring of 1938, Wigner is flanked by Gregory Breit (on his right) and Raymond G. Herb (on his left).

come distinguished. For example, he had already evolved the principles involved in applying group theory to quantum mechanics, and created many of the basic concepts upon which the theory of reaction rates was based—concepts that Henry Eyring and his colleagues at Princeton exploited so effectively. Still further, Pascual Jordan and he had published a basic paper in field theory, and his definitive work with Victor Weisskopf on the relationships between line shape and transition probabilities was becoming a normal part of the discipline of theoretical physics.

In this connection I recall an interesting incident that occurred in the fall of 1932. George Shortley, whose undergraduate training had been in electrical engineering, prided himself on being a very able draftsman and would frequently make inked copies of the figures for journals as a favor to individuals in Palmer or Fine Halls who had great need of such service. In the fall of 1932, Eugene arrived in the office with a set of figures, which George and I mused over and which appeared soon after in an article in *The Physical Review* bearing the title "On the Mass Defect of Helium." This was, of course, the paper in which the concept of short-range nuclear forces was presented and exploited quantitatively. It represented a giant stride in the process of increasing our understanding of the constitution of nuclei. Perhaps I should add that it was during those same months—following Eugene's observation that some of the wave functions of electrons in metals should have lower energies than the ground-state valence electrons in the free atom, because of relaxation of boundary conditions—that we learned how to determine such functions in at least a rudimentary way. I might also add that

during that same autumn semester, Eugene gave a series of lectures on solid-state physics that eventually found their way into the book I wrote later in the decade.

During the mid-30's, Wigner extended his interest in the application of group theory into three major areas: first, in relation to the crystallographic groups in a set of papers written with J. Bouckaert and Roman Smoluchowski; second, in connection with the classification of nuclei, using the fact that, apart from Coulomb forces, there is close symmetry between neutrons and protons, and finally, he explored in greater depth the representations of the Lorentz group. At about this time he once remarked that although group-theoretical methods were exceedingly powerful, very few individuals appeared interested in them. The truth is that the line of reasoning he had devised was, on the whole, ten or twenty years before its time. In fact, it now appears likely to me that a century or so from now Wigner will be remembered most in the circles of mathematical physics for his pioneering work in the application of group theory—the subject for which he presumably was awarded the Nobel prize.

In 1936 Eugene decided to broaden his understanding of the US and accepted a post at the University of Wisconsin, where he remained for two years. Among other things, this gave him an opportunity to work in very close association with Gregory Breit and to extend his creative interests in the field of nuclear physics, partly in cooperation with Breit.

I was invited to Wisconsin to give a colloquium talk on crystal luminescence in the late winter of 1938 and arrived precisely at the time Eugene was in the process of making up his mind about returning to Princeton. I recall

walking with him to Western Union when he sent the telegram of acceptance that characterized such decisions in those days. My visit included a Saturday, which was especially memorable because it encompassed a Saturday-afternoon picnic in which the entire physics department went for a walk along the lake through the winter landscape to the place where we could have what in the Midwest is called a "cook-out." Eugene was an enthusiastic participant in the group.

About the same time, I joined the staff of the physics department at the University of Pennsylvania and made frequent trips to Princeton. By this time the experimental nuclear-physics group was growing; for example, Edward Creutz and L. A. Delsasso had joined the staff and Bob Wilson would follow somewhat later. Actually, a substantial part of our everyday thoughts were dominated by the rapid pace of political events in Europe, Eugene becoming more and more anxious about the outcome.

Paradoxically enough, it was in the midst of this very turbulent and uncertain period that he and Mary Wheeler were married—a marriage that has added much to the completeness of their lives and has given the various communities in which they have lived a happy home in which countless friends have been welcomed. It also added to those communities two very interesting new members, namely David and Martha Wigner.

Work on nuclear fission

The war years need no detailed repetition here. From the start Eugene worked in intimate association with the group at Columbia University that began exploration of the possibility of producing a fission chain reaction. Harry Smyth took an active role in

At Trieste. During the International Symposium in Contemporary Physics, held in June 1968, Wigner accepts one of his numerous awards—an alarm clock recognizing the participant most often late to meetings.



the formation of the National Defense Research Committee and relatively early in events asked me to cooperate with the group at Princeton. It was led in substantial part by Walker Bleakney and H. P. Robertson and formed the nucleus of what eventually became Division Two of NDRC.

Once the work at Columbia University with Szilard and Enrico Fermi made it appear likely that a chain reaction could be sustained, Eugene moved to Chicago with a substantial group from various parts of the country. Well before the first self-sustaining chain reaction was achieved, Eugene and a small group, consisting in the main of Alvin Weinberg, Gale Young, Edward Creutz, Sidney Dancoff and Francis Friedman, fully appreciated the shape of things to come and began exploring the best methods of achieving reactors that would operate in the hundred-megawatt range. Marvin Goldberger presently joined this group as a member of the Army Corps of Engineers' Special Engineering Detachment (SED) and there met Mrs. Goldberger. Although the group's proposal of the water-cooled reactor was rejected at first as too fantastic, the engineering construction leaders of the project eventually caught up with Wigner's group and followed its advice even in minute detail. Eugene once commented to me during this period that he would willingly work on the bomb if it became necessary to do so, because he felt it was very important that the free world maintain leadership in such developments. However, he was rather glad on the whole that it was not necessary for him to do so, as he would rather think about the ultimate peaceful uses of reactors. In fact, once the Hanford reactors came into operation, Wigner and Fermi spent several months with a small

group attempting to chart the various avenues along which reactors could develop. Looking back to this stimulating experience, I would say that the only shortcoming of the study lay in the fact that no one quite appreciated just how abundant uranium would really turn out to be.

Although the work of the wartime period was necessarily of an applied nature, it gave Eugene an opportunity, at the height of his career, to unbridle the full range of his creative powers. He was at once the brilliant engineer, the brilliant chemist and the brilliant theoretical physicist. Fortunately, the essence of this period of creativity is preserved, at least in part, in his book on reactor theory, which he wrote with Weinberg.

In the summer of 1946, following a loose agreement some of us had made in the last year or so of the war, the core of Eugene's group at Chicago reassembled at Oak Ridge to explore the peaceful uses of nuclear energy. In that period Wigner laid much of the groundwork for what has happened in the development of reactors since. Unfortunately, large-scale developments have gone much more slowly than we would have guessed initially, partly because of overclassification in the early days, but principally because the work has necessarily fallen into more conventional hands as it becomes disseminated. One of the consequences of the Oak Ridge period was the training of a substantial group in the field of reactor science—a group that provided a great deal of leadership in the ensuing years.

In the intervening quarter of a century, Eugene has kept alive along a very broad and active front practically all of the interests he had before. To these he has added two major ones. The first is the matter of civil de-

fense, which he feels quite deeply should be treated in a much more urgent and practical way in our country if we are not to leave the free world open to blackmail or worse. The second topic, in which he actually was interested in in his youth, centers on the question of whether the life processes can be understood in terms of the physical laws of nature as we now know them. I think we have closely similar understanding of the first of these issues, because I am also inclined to believe that the free world is destined to be in for some rude shocks, sooner rather than later, if present trends continue. On the second matter, concerning the science of living systems, I have never been able to tell whether Eugene's views stem directly from the rational components of his mind or whether they are tied to the more mystical roots of the subconscious that exist in all of us in some form. Perhaps he can render a service to all of us who admire him so much by spending some of the period ahead expounding further on these issues.

In scanning my memory I have come up with one of Wigner's quotations that I believe is relevant to this time of his life. It was actually from his father, who visited Chicago frequently during the War. His father said, in effect, that it seemed to be the lot of the involved man to rush about like mad in the course of his various occupations and then wake up one morning to find that he is seventy years old. I suspect that Eugene will continue to admit wistfully that his father was a wise and discerning man.

* * *

This article is adapted from a talk given at Princeton in May 1971 on the occasion of Wigner's retirement. □