

A Conversation with Leopold Schmetterer

Hermann Witting

Abstract. Leopold Schmetterer was born on November 8, 1919, in Vienna. He received his doctorate in 1941 and his habilitation in 1949, both from the University of Vienna. Since 1948 he had a permanent lectureship for probability theory, since 1949 for statistics. In 1956 he became full professor at the university of Hamburg. In 1961 he returned to the University of Vienna as a professor of mathematics, since 1971 as a professor of mathematics and statistics. After having been elected an ordinary member of the Austrian Academy of Sciences in 1971, he was elected Secretary General of this Academy in 1975, a position he held until 1983. In 1972 he received an honorary doctorate degree from the University of Clermont-Ferrand. Some further honors: 1961 Fellow of the IMS, 1967-1971 Vice president of the ISI, election into the Deutsche Akademie der Naturforscher Leopoldina and into the Berlin, Saxonian and Bavarian Academies of Sciences. He was visiting professor among others at the University of California at Berkeley, Catholic University in Washington, D.C., Bowling Green State University, Ohio, Technion, Haifa, and the University of Clermont-Ferrand.

The following conversation took place in Freiburg at the beginning of May, 1991.

Witting: As your own example shows there has always been personal and scientific exchange between German and Austrian universities in spite of certain differences and independent developments. This is why many questions will refer to the situation in both countries.

But first of all some questions about yourself and the places of your professional life.

CAREER

Witting: When and through what has your interest in mathematics been aroused?

Schmetterer: My interest in mathematics started as far as I remember when I was 12 or 13 years old. But it was especially aroused when I discovered a little book on analysis where I found formulas for the logarithm of complex numbers. I was so excited that it is possible to define a logarithm for nonpositive real numbers that from then on I tried to read as many mathematical books as possible. At that time this was not so easy for me

because books were expensive and my family was poor, but nevertheless I found opportunities to read mathematical books, especially books which were concerned with algebra and with differential and integral calculus.

Witting: From 1938 you have been studying mathematics, apart from physics and meteorology at the University of Vienna. This was a difficult time for your country because in 1938 Austria had lost its political independence. In which way did these changes have an impact on the mathematical life in Vienna? Which famous mathematicians were at the Viennese university at that time?

Schmetterer: Perhaps I should start with your second question. In the thirties there were three personalities, three mathematicians who had a high reputation in their field. I would like to mention Philipp Furtwängler. He was a well-known expert in number theory, and he retired in 1938. Then Hans Hahn, who was certainly one of the founders of modern functional analysis and who died in 1934. And the third one is Wilhelm Wirtinger. He was very famous in the field of the theory of functions of complex variables. He retired in 1935. As a consequence of the new political situation in Austria, some very important younger mathematicians had to leave Austria and emigrated to the United States. I would like to mention Kurt Gödel, Edmund Helly and Karl Menger who did not return from a visit to

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FIG. 1. *Leopold Schmetterer at the University of Erlangen (near Nuremberg), 1974.*

the United States in 1937 and stayed from then on there. Menger had organized in the thirties the famous Viennese mathematical colloquia. One of the participants was Abraham Wald who had written a Ph.D. thesis on the foundations of geometry. Helly is known to all probabilists and statisticians from his "Auswahltheorem" for sequences of distribution functions. In this connection I would also like to mention the famous mathematician Alfred Tauber. He was a professor at the Technical University of Vienna and had a permanent lectureship at the university. He proved the first "Tauberian theorem": If a series $\sum a_n$ is Abel-summable to s , and if $a_n = o(1/n)$, then the series converges to s . The second "Tauberian theorem" states a necessary and sufficient condition for the convergence of an Abel-summable series: $(a_1 + 2a_2 + \dots + na_n)/n = o(1)$. By the way, he died in 1942 at the age of 76 in a concentration camp.

Witting: Who had the strongest influence on you while you were studying?

Schmetterer: During my studies I was most of all influenced by Nikolaus Hofreiter and Edmund Hlawka, who at that time had a position which perhaps could be named a teaching assistant and

who 10 years later became one of the full professors at the mathematical institute. I frequently had the opportunity to discuss mathematical problems with Hlawka. Even in his early time he was a man who was able to fascinate young students.

Witting: Already in 1941, that means at an age of about 21 years, you received your doctorate. Was one of these two your supervisor?

Schmetterer: Yes, Professor Hofreiter was the supervisor of my thesis. Hofreiter was a student of Furtwängler and was an expert in number theory. By the way, he was an excellent lecturer and attracted many students. My thesis was concerned with diophantic approximations, at that time an important part of number theory. The great influence of Furtwängler remained for a long time in the mathematical institute of Vienna. Even after the Second World War, the spirit of Furtwängler could in some way be recognized in the mathematical institute in Vienna.

Witting: In the thirties Oskar Morgenstern, Gerhard Tintner and Abraham Wald had been working in Vienna, but at the Institut für Konjunkturforschung. When did they leave Vienna?

Schmetterer: Perhaps I should first say a few



FIG. 2. Leopold Schmetterer, about age 9 (right), with his brother, George, at their elementary school during the centennial of the death of the composer Franz Schubert, 1928.

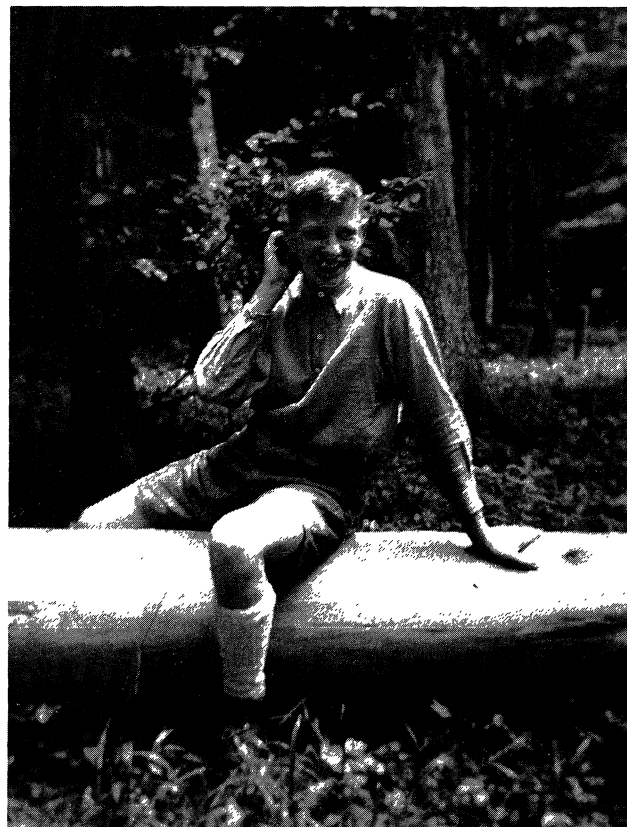


FIG. 3. Leopold Schmetterer, age 15, on a trip to the Vienna Forest, 1934.

words about the situation of Abraham Wald in Austria. At that time it was very difficult to find positions at the university, even for very gifted young people. Since Abraham Wald had lectured in Menger's colloquia in mathematical economics besides other fields, Menger was able to find a position for Wald in this Institut für Konjunkturforschung, which was directed by Oskar Morgenstern. I would like to mention that, after the Second World War, I frequently had the opportunity to see Oskar Morgenstern when he came to Vienna and to discuss problems on game theory and statistics. Morgenstern and Tintner left Austria, as far as I remember, before 1938, while Wald had some difficulties escaping after the occupation by the Nazi troops.

By the way, I should mention that due to the scarceness of positions at the university E. Helly worked at a life insurance company. The same was true for the later on very well known probabilist E. Lukacs. Let me mention in parentheses that Z. W. Birnbaum also since 1934 worked there.

Witting: Where had you been working in the following years until the end of the war?

Schmetterer: From 1941, or let's say the mid-

dle of 1941, to 1943 I had to do military service. After that I was forced to work in Berlin in a factory which was concerned with the construction of airplanes and rockets. There I had to serve as a mathematician and was mostly concerned with differential equations in the field of aerodynamics. While this occupation with differential equations did not really influence my mathematical work, I had the opportunity of becoming acquainted with the theory of Fourier series, certainly on a very low level, but nevertheless this first knowledge of this interesting theory was of great significance for my mathematical career later on.

Witting: What have you been doing after the war?

Schmetterer: Very soon after the end of the Second World War the mathematical institute in Vienna offered me an assistantship which I gladly accepted in the autumn of 1945. In 1946 the very famous mathematician Radon, who is well known for the discovery of the so-called Radon integral and the Radon transform, was appointed full professor at the mathematical institute in Vienna. I attended many of the seminars which he directed and so I got a very good knowledge of modern



FIG. 4. Leopold Schmetterer (standing), with his brother, George, and parents, Leopold and Gisela, in their Viennese home, about age 18.

measure theory and other fields in mathematical analysis.

Witting: When did you get your degree of habilitation and what kind of lecture were you giving after this?

Schmetterer: I got the degree of habilitation in 1949. My habilitation thesis was devoted to a problem in the theory of trigonometrical series. After that I gave a lot of lectures in different fields, among others in the theory of series, potential theory, functional analysis and mathematical logic.

Witting: How did you come to probability theory and statistics?

Schmetterer: In 1948 I was asked by the mathematicians in Vienna to give lectures in probability theory in the framework of a Lehrauftrag [permanent lectureship]. The reason was that an old professor of astronomy retired. He had lectured in the field of probability from a standpoint of the theory of errors. But frankly speaking, I did not know anything about probability at this time. So, I had to work very hard to be able to instruct students in this field. One year later I was asked by the Technical University in Vienna to give lectures in mathematical statistics, also in a Lehrauftrag. Again I must confess that I did not know anything about mathematical statistics and again I had a very hard time to be able to give lectures in this field which was already very well developed in many countries outside Austria.

Witting: It is a little bit surprising that you did not learn about probability and statistics as a student in Vienna because Czuber had been working there for nearly 30 years. [1891–1921]. Furthermore, von Mises, though having professorships in Germany, was an Austrian by birth. He had written his first two books already in 1919 and 1931, respectively.

Schmetterer: As far as I know, Czuber's pro-



FIG. 5. Leopold Schmetterer during his lecture in honor of Radon at the Austrian Mathematicians' Congress, Vienna, 1989.

fessional occupation with probability did not leave traces in the mathematical life in Austria, and I think that in some ways the same should be said for von Mises, although von Mises' interest in probability started later. In my opinion Czuber had some influence in actuarial mathematics, but hardly in probability theory, although in 1894 he was invited by the German Mathematical Society to deliver a survey article about the development of probability.

Witting: In 1956 you had been offered a full professorship in mathematics with special emphasis on mathematical statistics at the university of Hamburg. This was one of the first two chairs to be re-established after all Jewish and many other colleagues had to emigrate in the thirties and mathematical statistics was almost extinct in Germany. How was it that you got this offer? At that time, Hamburg was a mathematical stronghold in West Germany: Blaschke [who in 1956 was already retired], Hasse, Sperner and Witt were there, and Collatz as a representative of applied mathematics.

Schmetterer: I think that was due to the fact that the mathematicians in Hamburg were interested in someone who was able to represent not

only mathematical statistics and probability but also mathematics in a more general context. Hasse was impressed by some of my papers which were concerned with the theory of numbers and which I had written before 1956. As far as mathematical statistics was concerned, I had already written a paper which later gave me some reputation that was concerned with stochastic approximation, and especially my book on this field was published in Vienna exactly at this time. Moreover, the big insurance companies in Hamburg were interested in getting such a professorship concerned with mathematical statistics and insurance mathematics. And that was the reason why I gave a lecture on some stochastic processes which are of interest in risk theory when I was invited to introduce myself in Hamburg, I think early in 1956. By the way, in 1955 I had already published two papers on modern risk theory and insurance mathematics.

Witting: Soon after, Artin also returned from emigration. Did you get into contact with him and have you become interested in modern algebra through him?

Schmetterer: Yes, this is true and I even attended lectures given by Artin. Let me mention in parenthesis that the famous algebraist Hasse did the same. So I improved very much my knowledge of modern algebra and that was also the reason why I started in Hamburg my work on probability on algebraic structures. By the way, my first student in Hamburg who got a Ph.D. wrote his thesis on this field and introduced the important concept of root-compact groups. That was the beginning of establishing a group of young mathematicians in Austria, Germany and Switzerland working under my supervision in this field. These activities finally led to international meetings on this topic at the Mathematical Research Institute in Oberwolfach since 1970.

Witting: As far as I know you liked very much to be in Hamburg. Nevertheless, you returned to Vienna already in 1961. What was the reason for this?

Schmetterer: That is correct what you said. Hamburg at that time was a wonderful place for a mathematician. But already one year after I had left Austria, the Vienna university invited me to succeed Radon who had died in 1956. At that time I refused to return to Vienna although it was a great honor for me to be the successor of Radon. Three years after that when I again got an offer from that university to return to this place I finally decided to leave Hamburg and to come back to Vienna. Among other reasons, this was due to the fact that all my family, or let me say my parents and the parents of my wife, all stayed in Vienna.



FIG. 6. Leopold Schmetterer, (2nd row) seated behind Sperner and Haase, at the Congress of the German Mathematical Society, Dresden, 1957.

Witting: This was a chair for mathematics in general. Did you find time to give classes and seminars in probability and statistics?

Schmetterer: Yes, I gave many lectures in fields which have, so to speak, nothing to do with probability and statistics. But nevertheless some of my lectures during that time in Vienna were also devoted to probability and to mathematical statistics and students who got a Ph.D. under my supervision worked mostly on probability on groups or on mathematical statistics. Starting in 1971 I became a professor of mathematics and statistics at the University of Vienna.

Witting: In 1975 you were elected secretary general of the Austrian Academy of Sciences. Wasn't this a more administrative job?

Schmetterer: Let me first mention that in 1971 I was elected an ordinary member of the Austrian Academy of Sciences. This Academy is not only a learned society but also directs many research institutes in different fields. When I was elected secretary general in 1975 this was to my own surprise. I certainly had to do a lot of administrative work but this work was concerned with science and in particular with mathematics. Although this position was a heavy burden, I did not lose my contact with science in general and especially with mathematical sciences. As a secretary general I had frequently to travel to Academies of Sciences almost in the whole of Europe, and when I was there I always met many colleagues who were concerned with mathematics and especially with probability and mathematical statistics. So I strengthened my contact with these mathematicians whom I had met already before.

Witting: You have been elected into several other academies of sciences, among others the

known Deutsche Akademie der Naturforscher Leopoldina in Halle. Which other academies were there?

Schmetterer: My election to the Leopoldina was in 1970. Later on I was elected to the Academy of Sciences in Berlin, to the Saxonian and to the Bavarian Academy of Sciences.

BOOK

Witting: As you mentioned before, relatively early, you wrote a textbook of mathematical statistics. This was very broadly conceptioned and had a strong influence on its development in both our countries. It appeared in 1956, that is before Fraser's and Lehmann's book came out, and actually it was the first book after Cramér's to be mathematically oriented. Isn't it in fact surprising that such a book came from a German-speaking country at a time when there was no tradition.

Schmetterer: I already mentioned that I had to give lectures in mathematical statistics as early as 1949. And as I also mentioned, frankly speaking, I had not a very good idea at that time of what mathematical statistics was and I did not know the very interesting development of this field before 1949. Therefore, I had to be very careful and I had to try to become acquainted as well as possible with this important field. So my book which appeared in 1956 was really the result of this attempt to become acquainted with modern statistics and to give lectures to my students to show the actual standard of this field.

Witting: In this book you also developed, for instance, the Neyman-Pearson theory in great detail. When did you meet Neyman for the first time?

Schmetterer: As far as I remember, I saw Neyman personally at the beginning of the year 1958 in Hamburg. Shortly after this, I met him in the famous Mathematical Research Institute in Oberwolfach in Germany.

Witting: What did Neyman say about your book or did you get his opinion before this visit?

Schmetterer: Yes, the latter is true. In Hamburg there was a famous professor for shipbuilding mechanics, Professor Weinblum, who was very much interested in many fields of mathematics, among others in mathematical statistics. He had visited Neyman, I think in 1957. When he came back from Berkeley he told me that he had asked Neyman which book at that moment was the best book in mathematical statistics, and Neyman showed him my book. When Weinblum told me that story he congratulated me very heartily. This, of course, made a very deep impression on me.

Witting: Later on you saw Neyman several

times. Can you tell something about him and his personality? What was your relationship to Neyman like later on? You have been invited to Berkeley as visiting professor at least twice.

Schmetterer: In the year 1959 I was appointed visiting professor in the Miller Institute for Basic Research in Science at the University of California, Berkeley. From then on I had always very close relations to Neyman. He instigated for instance a paper I authored on unbiased estimation that appeared in *The Annals of Mathematical Statistics* in 1960. I was always impressed by the personality of Neyman and his pronounced ability to find new applications for statistical methods in many different fields. On a more personal tone, Neyman's long stay in Great Britain undoubtedly had left deep traces. Early in 1959 I accompanied Neyman to one of his lectures in San Francisco. Neyman's talk provoked a long discussion, and when we finally left the auditorium somewhat after 5 p.m. he angrily remarked: "Tea time is over!"

Later I attended at his invitation two of the Berkeley Symposia, which gave me the opportunity to become acquainted personally as early as 1960 with many other leading probabilists and statisticians.

Witting: As far as I know there is a review on your book by Cramér in the *Mathematical Reviews*? Did you get into closer contact with him through your book?

Schmetterer: Yes, I think so, and later on I had many opportunities to see Cramér and to have conversations with him and we also exchanged publications of ours.

Witting: The third edition of this book is published in English. Who invited you to translate it? What, do you think, was the decisive factor for this invitation? Was it the—at least at that time—unusual care in mathematical detail, the wide range of material offered or the stress on the Neyman-Pearson theory?

Schmetterer: I think that all that is correct. The many details given in this book and the extended discussion of the Neyman-Pearson theory aroused interest in a translation into English. And so there were for many years attempts to realize such a translation. Finally, Springer, who had published the first two editions, decided to have this book translated themselves and the third, the English edition, is an enlarged version of the second one. By the way, I would like to mention that this book was also translated into Russian.

Witting: Your book discusses things which have almost not been treated in other textbooks, for example the theory of locally optimal tests or the sampling theory. Does the latter hint that you have



FIG. 7. David Blackwell, Leopold Schmetterer, Joseph Hodges, Jr., and Jerzy Neyman, Berkeley, 1959.

frequently been asked to consult in practical statistical questions?

Schmetterer: I would not say so, although I had some contact with the Austrian Central Office on Statistics as early as 1950, perhaps. I think it was some German tradition to consider sampling theory. In this connection I would like to mention the name of Lexis, who at least in German-speaking countries had some reputation.

Witting: Did you also receive reactions on your book from Egon Pearson or from someone else of the English statistical school? By the way, did you ever become acquainted with Sir Ronald Fisher?

Schmetterer: I would not say I became acquainted with Sir Ronald, but nevertheless, I had the opportunity to see him at several occasions. I had contact with many British statisticians and probabilists, especially due to an invitation to a lecture tour in Great Britain in 1964. Among others, I met H. E. Daniels and in Cambridge I was guest in the house of D. G. Kendall, with whom I discussed statistical applications in archaeology and with whose son I played chess.

PAPERS

Witting: Already in 1953 you wrote an article on stochastic approximation—it must have been one of the first papers following that by Robbins-Munro. What was the fundamental progress of your paper? How did you come to this question?

Schmetterer: I was invited to write a paper for the Festschrift at the 70th anniversary of von Mises' birthday. So at this opportunity I studied some of the papers of von Mises and I found a paper of von Mises and Geiringer which was concerned with the approximative solution of equations. At the same time I found a paper of Robbins and Munro, the

famous paper on stochastic approximation which is somewhat related to the von Mises and Geiringer paper.

My paper was indeed the third one concerned with stochastic approximation, and I think the new element were estimates about the asymptotic variance and the method I used was later on independently used by K. L. Chung in a more general way.

Witting: Did you ever meet von Mises personally? How do you estimate his influence on the development of mathematical statistics in Germany and Austria, I mean statistics in the narrow sense and not in the sense of foundations of probability theory?

Schmetterer: I think it is more correct to say I saw von Mises in 1955, I believe, when he gave a lecture in the mathematical institute in Vienna. And I think I also exchanged a few words with him. But I did not have close contact with him. About the influence of von Mises' important work in statistics in German-speaking countries, I think the answer has already been given by yourself when you said that the interest in modern mathematical statistics in German-speaking countries was almost extinct. Although the important discoveries of von Mises in this field were highly esteemed in the English-speaking countries, they were almost neglected in German-speaking countries at that time. The ideas developed by von Mises as a foundation of probability theory did find a certain resonance in German-speaking countries. Even A. Kolmogorov's "Grundbegriffe der Wahrscheinlichkeitsrechnung" (1933) makes reference to them. However, it is not accidental that the proceedings of the conference in Geneva, Switzerland (1937), about the foundations of probability theory, attended among others by Feller, von Mises and Wald, were published in Paris.

Witting: It is always surprising to me that apart from Frau Geiringer he did not—at least during his Berlin years—have any students in the field of mathematical statistics. This is the more surprising, since nowadays his name is indelibly connected with at least four problems in this field, the extreme value theory, the Cramér-von Mises test, the Bernstein-von Mises theorem and von Mises differentiable functionals.

Schmetterer: I think that I have already partly answered this question in my answer to your former question. Von Mises had to leave Germany in 1933 and as far as I know he first went to Turkey and from there to the United States. Therefore, he even did not have time enough, so to say, to make students of his acquainted with his important discoveries which you mentioned in your question. Let me mention parenthetically that Geiringer got her

Ph.D. from W. Wirtinger in Vienna with a thesis concerned with trigonometric double series.

Witting: Now let us come to nonparametric methods. Relatively early, you wrote a survey paper on this field that gave essential impetus to nonparametric statistics in Germany which was not very much known before. How did you come to this paper? Had you already been working on the theory of unbiased estimation before or did you come to this field only through this article?

Schmetterer: This article was a consequence of an invitation which I got from the German Mathematical Society to speak about problems of mathematical statistics at the occasion of the meeting of this society in 1957 in Dresden. By the way, this was the last common meeting of the German Mathematical Society, that is, of East Germany and West Germany. And this paper was certainly the starting point for my studies of unbiased estimation as witnessed by my later publications in this field.

Witting: You also wrote an often quoted paper on asymptotic estimation theory in which you introduced the concept of continuous convergence for avoiding the so-called superefficiency. Heyde, for instance, wrote that this is one of the most significant contributions to that topic. How do you estimate this paper, and how did you come to this field?

Schmetterer: At that time that was certainly a fascinating problem. And my paper was in connection with investigations by Weiss and Wolfowitz concerning superefficiency, a concept which was discovered first by Hodges Jr.

Witting: While you were an assistant at Vienna university you also worked on trigonometric series. Some of these papers are also quoted in the second edition of Zygmund's fundamental book. Did these papers have an impact on your later work?

Schmetterer: I think so. I wrote a paper in this field also in 1970 and a further paper of 1965 was concerned with the Fourier analysis of characteristic functions, and treated a problem which was raised by Rényi and Lukacs. Moreover my papers concerned with probability on groups had some relation, of course, with harmonic analysis.

THE ZEITSCHRIFT AND CONTACTS

Witting: You were one of the initiators and the first editor of the *Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete*. Can you tell something about how this journal was founded and given its name?

Schmetterer: In the late fifties plans were discussed in the Federal Republic of Germany to found

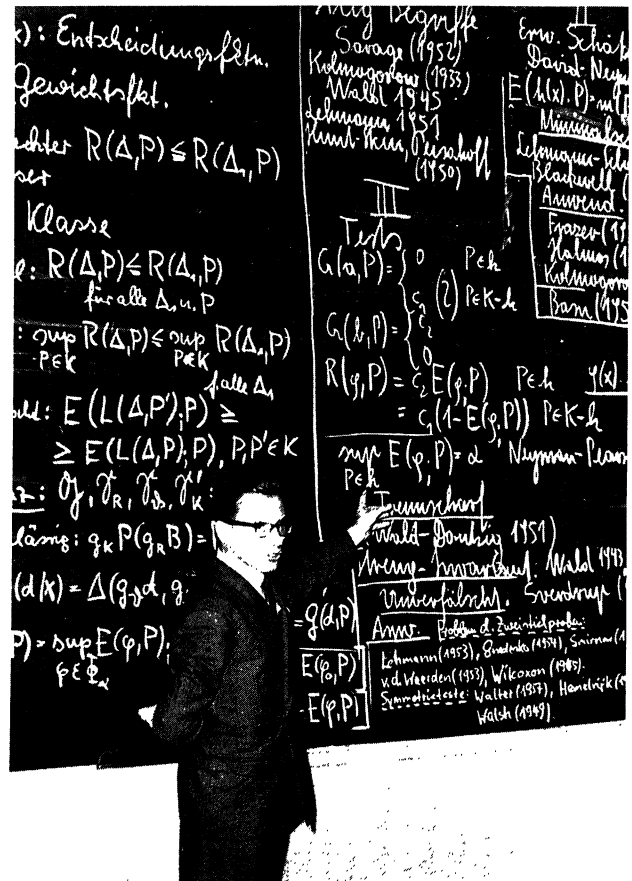


FIG. 8. Leopold Schmetterer, Lecturing at the Congress of the German Mathematical Society, Dresden, 1957.

a journal for operations research. There were even talks with the Springer-Verlag on this subject. I think I remember that, in one such conference in 1958 with representatives of the Springer-Verlag, and in which also H. Richter was present, we discussed the idea of giving the journal a broader scope. Probability theory was to be a major topic, but mathematical statistics and problems of operations research on a high mathematical level should be included. This led to the title *Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete* (Probability Theory and Related Fields). Springer-Verlag also consulted J. Neyman on his opinion. I proposed H. Richter as first editor-in-chief, but finally I was nominated as suggested also by Richter.

Witting: You mentioned the name of Hans Richter. Were you in closer contact with him? He was the person to whom the other of the first two chairs re-established [Munich] has been given. Can you tell something about his personality and his scientific interests?

Schmetterer: I have read with interest Richter's papers on the foundation of probability in the fifties, and my first personal contact with Richter was, I think, in 1955. Later on, I met him

frequently and I had good relations with him. He frequently was also in Oberwolfach and his book on the theory of probability published by the Springer-Verlag was certainly a great help for the German speaking students to learn modern probability theory.

Witting: In 1971 you already passed the editorship to Klaus Krickeberg. What was the reason for this?

Schmetterer: The answer to this is very simple. Some years ago it was discovered that I have a very serious eye disease and the editorship of the *Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete* was a very time-consuming job in which I have read all manuscripts which were submitted for publication, and my doctors told me that I could not go on in this way. Today I have almost lost my eyesight.

Witting: You have also been in good contact with Eugene Lukacs. You visited him in Washington, D.C., and at the Bowling Green State University for longer periods. Is this due to the fact that Lukacs had been working for a Vienna life insurance company in the thirties and so he had some affinity to Vienna?

Schmetterer: In the thirties I had of course not yet any contact with Lukacs because my studies at the University of Vienna, as already mentioned, started in 1938. But after the Second World War, Lukacs frequently came back to Vienna and very soon close relations between him and his wife and my own family were established. Lukacs' origin was the Austro-Hungarian monarchy, and I was always very interested in his work on characteristic functions. It was always interesting to discuss problems in the field of characteristic functions with him. Lukacs was elected a member of the Austrian Academy of Sciences, and at the request of this Academy I wrote an obituary for him which was published in the so-called Almanach of the Austrian Academy of Sciences.

Witting: As we mentioned earlier, many Viennese mathematicians who emigrated to the United States in 1938 have been working there as statisticians. Besides A. Wald, there was H. B. Mann, Z. W. Birnbaum, E. Lukacs; and in the field of econometrics O. Morgenstern and G. Tintner. How do you rate their influence on the development of these fields in the United States.

Schmetterer: I think that this influence should not be underestimated. Let me mention especially Abraham Wald. Wald's sequential analysis and his decision theory have certainly opened a new chapter in mathematical statistics and had a very great influence on the modern development of this branch of mathematics. I already said something about the

importance of Lukacs whose work on characteristic functions provoked further studies in the United States. As to O. Morgenstern, his applications of game theory on economical problems started a new era in economics, although von Neumann had laid the mathematical basis of game theory already in 1928. By the way, von Neumann also came from the Austro-Hungarian monarchy, and his fundamental 1928 paper was his Habilitationsschrift at the University of Göttingen.

Witting: Have you been in closer contact with Tintner, who had worked in Vienna at the beginning of the thirties and who returned from exile, I think, in 1974?

Schmetterer: In 1959 I was invited to lecture at Iowa State University and there I met Tintner personally. I stayed with my family at his home which offered a sophisticated cultural atmosphere due to the paintings of his wife. After their return to Vienna, Mrs. Tintner had several exhibitions of her paintings in art galleries. My contacts with Tintner became even stronger when he was elected an honorary member of the Austrian Academy of Sciences in 1977. As with Lukacs, I also wrote the obituary for Tintner for the Academy.

Witting: I am sure you had also very good relations to mathematicians outside the English-speaking countries. Can you tell a little bit about these?

Schmetterer: I would like to start with France. I had very good relations to French mathematicians, especially of course the probabilists and statisticians, in Paris, in Rennes, in Lyon, in Clermont-Ferrand. I even got an honorary doctor degree from the University of Clermont-Ferrand. I also would like to mention my relations to many of the leading probabilists and statisticians in the Soviet Union, in Poland, in Czechoslovakia and Hungary and also in Israel. I even spent half a year as a visiting professor in Haifa and in Jerusalem and Tel Aviv. Let me also mention that I have been elected as early as 1951 a member of the International Statistical Institute in The Hague, and from 1967 to 1971 I was elected vice president of this institution.

At the occasion of a lecture tour through several universities in the Netherlands in 1970 I got to know closer a number of Dutch statisticians.

Let me also mention the names of four foreign colleagues in connection with their visits to Vienna. A. Rényi visited Vienna several times and, besides talking often about mathematical problems, we enjoyed a close personal friendship. In the *Proceedings of the Sixth Berkeley Symposium* in 1970 I appraised the mathematical life-work of Rényi, and in 1971 I gave an obituary for Rényi at a meeting of the IMS in Denver, Colorado. At

the same occasion J. L. Doob honored W. Feller in an obituary. With J. V. Linnik whom I had met before in Leningrad I talked in Vienna about problems of analytical statistics, as he liked to call it. J. Wolfowitz visited me in Vienna in the seventies. I took him to an excursion on the Kahlenberg, a hill from which one has a beautiful view of Vienna. We talked about mathematical questions, but also had a long discussion about world politics, and discovered that we had mostly concurring opinions. I. Olkin, whom I had already known personally for some time, visited Vienna not quite 10 years ago. He gave a lecture on inequalities and this gave an opportunity to discuss the Bishop-de Leeuw order. I remember that we had dinner at the famous Hotel Sacher.

DEVELOPMENT IN AUSTRIA AND GERMANY

Witting: May I raise a different question? How do you explain the fact that there was more or less a standstill of probability and mathematical statistics in both our countries in the thirties and forties? Was it only an influence of the emigrations because of the political situation during the thirties or do you see any other reason for this?

Schmetterer: I think it was not only the political situation. It was also due to the fascinating development of pure mathematics especially in Germany and the overwhelming position of this branch of mathematics as a consequence. Both the book of von Mises concerned with the foundation of probability, and the most important breakthrough in the foundation of probability due to Kolmogorov, had been published in German. Even so, probability and mathematical statistics were unable to achieve the same status they enjoyed in many countries outside the German-speaking area. In this context it should also be mentioned that in many other countries in continental Europe whose political situation was more favorable than that in Germany after 1933, the development of probability did not reach the same level as in the English-speaking countries with the exception of France, Russia and perhaps Sweden.

Witting: What, in your eyes, were the essential reasons for the revival of our field?

Schmetterer: As I already mentioned, the development of modern probability and mathematical statistics took place mostly outside the German-speaking countries. Especially since 1933 in Germany and then during the Second World War from 1939 to 1945, it was hardly possible to follow the development in these fields in the German-speaking countries. Soon after the Second World War it became possible to learn from foreign literature the advances in probability and mathematical statis-

tics. When the important applications in industry and in fields such as medicine became known in Germany and Austria, interest in probability and mathematical statistics increased until also in those two countries the international level was reached. In parallel, the number of positions in probability and mathematical statistics at the universities was greatly enlarged in the German-speaking countries (but also in many other countries in continental Europe).

Witting: As we have seen, the development of probability and statistics during the middle of this century did not take place in Austria and Germany. This was not the case at the time before. Can you mention some of the German and Austrian people who had some impact on the development of our field?

Schmetterer: I think I have already tried to explain why in the thirties and forties the development of probability and mathematical statistics took place mostly outside the German-speaking countries. But among the forerunners there are very important names. So let me especially mention the name of Gauss and also Helmholtz, Lexis and von Bortkiewicz. Moreover, the work of A. Einstein, L. Boltzmann and M. von Smoluchowski had decisive impact on the development of probability theory. For the framework of mathematical statistics, I would like to mention a name which is perhaps not so well known in the English-speaking countries, that of H. Gebelein. Gebelein has some merits in developing interesting features of correlation theory. Especially his idea of the maximal correlation coefficient, very well known today and also from other sources, was developed in an original manner. He was also the author of a book on statistics written in German which had some relation to modern theories developed outside Germany.

Witting: How do you rate the significance of the journals *Metrika* and the Austrian *Statistische Vierteljahresschrift* for the revival of our field which were the only statistical journals in our countries during the fifties?

Schmetterer: I think that the *Statistische Vierteljahresschrift* and later on *Metrika* had great merits in helping to fill the gap between the levels in probability and mathematical statistics in German-speaking countries and the countries outside this area. And I would not like to miss both these journals which at that time had to fulfill an important task.

Witting: A person who has to be mentioned in this context is the Viennese Professor W. Winkler. If I am not wrong, his field was official and economical statistics.

Schmetterer: Yes, that is true. Winkler was

not a mathematician and he had a chair that was concerned with statistics, perhaps one should say with descriptive statistics. But nevertheless he recognized the importance of mathematical methods in this field unlike many of his colleagues in Germany. Winkler helped very much not only by the foundation of the *Statistische Vierteljahresschrift* but also by institutionalizing lectures on mathematical statistics in Austria. Winkler was even able to organize courses in statistics, both general and mathematical, which later served as a model for a curriculum of statistics.

Witting: In your opinion, which significance did the Mathematisches Forschungsinstitut in Oberwolfach have for the revival of probability and mathematical statistics in both our countries?

Schmetterer: I think that this famous research institute had an influence which should not be underestimated. Many of the probabilists and mathematical statisticians of the younger generation got their first impression of the importance of this field by way of meetings held in Oberwolfach, the first as early as 1955, I think.

Witting: How do you think about the level of industrial statistics nowadays in our countries?

Schmetterer: I think that in a related field, namely in biometrics, the level of research and application has almost reached the level of the English-speaking countries and France. But as far as applications in industry are concerned, I think that more effort is necessary to fill the gap between German-speaking and other industrialized countries. Let me mention that in the early fifties courses on modern quality control were organized in Austria with the help of organizations sponsored by the Austrian industry. These courses were held by Austrian statisticians like Pfanzagl and myself. But today, frankly speaking, I think that in the Austrian industry the interest in mathematical methods in statistics has lost its drive.

Witting: During the time in which you witnessed the development of mathematical statistics it underwent substantial changes. The degree of abstractness has grown, electronic data processing has come about. Are you willing to comment on this development or do you dare to give a prediction for its further development?

Schmetterer: Yes, I am willing to do so. In my

opinion, the further development of mathematical statistics will go in two directions. One will be an even closer connection with other branches of modern mathematics and more abstract ideas will appear in the development of mathematical statistics. A good example is stochastic differential geometry. On the other hand, many problems and tasks of applied statistics will be covered by computer science. I am not quite sure whether these two directions will go together much longer. I think they will separate because analytical statistics in the sense of Linnik will be much more included in the development of modern mathematics while many applications of mathematical statistics will be handled by computer science and the software development.

Witting: I think we should come to an end. Maybe one last question and this of a more private nature. Are you willing to say something about your hobbies?

Schmetterer: Yes, I am. Mathematics was not only my job, but it has been my favorite hobby. I also like music very much and I still attend many concerts in Vienna. I used to be a good piano player. Moreover, I liked hiking very much and still today like to take long walks.

SELECTED WORKS BY L. SCHMETTERER

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Entscheidungsregeln
 Gewichtsfkt.

Wahrscheinlichkeit $R(\Delta, P) \leq R(\Delta', P)$

Klasse
 $R(\Delta, P) \leq R(\Delta', P)$
 für alle Δ, Δ', P

$\sup_{P \in K} R(\Delta, P) \leq \sup_{P \in K} R(\Delta', P)$

$E(L(\Delta, P), P) \geq E(L(\Delta', P), P), P, P' \in K$

$\gamma_j, \gamma_R, \gamma_D, \gamma_K$

$g_K P(g_R B) =$

$\Delta(g, d, g)$

$\sup_{P \in \Phi_x} E(\varphi, P)$

Savage (1952)
 Kolmogorow (1933)
 Wald 1945
 Lehmann 1951
 Hunt-Kim, Pleschoff (1950)

III

$G(a, P) = \begin{cases} 0 & P \in K \\ c_1(z) & P \in K^c \end{cases}$
 $G(b, P) = \begin{cases} c_2 & P \in K \\ 0 & P \in K^c \end{cases}$

$R(g, P) = \begin{cases} c_2 E(g, P) & P \in K \\ c_1 (1 - E(g, P)) & P \in K^c \end{cases}$

$\sup_{P \in K} E(g, P) = \alpha$ Neyman-Pearson

Jensen

Wald-Banking 1951
 Meng-Involutiv: Wald 1943

Unverfälscht: Sverdrup

Anm. Bisher d. Zweifelpunkt:

Lehmann (1953), Gnedenko (1937), Smirnov (1946),
 v.d. Waerden (1933), Wilcoxon (1945),
 Symmetrietest: Walter (1937), Hoeffding (1941),
 Walsh (1949)

Erw. Schätz
 David-Neyman
 $E(h(x), P) = \dots$
 Lehmann-Blackwell
 Anm. Frasco (1941),
 Kalman (1941),
 Kolmogorow
 Barn (1949)

