A Dutchman by birth, Professor Kolthoff still makes regular trips to his native land, where he stays at the home of his niece, Dr van Leesten (née Kolthoft) and her family in Castricum. It was here, in December of last year, that I had the privilege and pleasure of talking with Professor Kolthoff and took the opportunity to congratulate him on being the recipient of the 1981 Special Award of the Society for Analytical Chemists of Pittsburgh.

He is a most stimulating conversationalist and has an agility of mind which belies his 86 years. In the course of our discussion, Professor Kolthoff revealed the depth of his knowledge and the extent of his interests as a scientist and as a humanitarian. This article, a brief account of my conversation with Professor Kolthoff, is followed by 'The Scientific Career of I. M. Kolthoff', an appreciation of his career by one of his most distinguished former graduate students, Professor H. A. Laitinen of the University of Florida.

'I there is no doubt about it, with modern instrumentation one can get much more detailed analyses than was possible in earlier days, but that does not mean to me that the basic character of analytical chemistry has changed.'

As one who has been actively engaged in research in analytical chemistry since the early years of this century, Professor Kolthoff's views on the scope of analytical chemistry and how this has changed in his lifetime are of great interest. He agrees with the opinion of Abelson, expressed in an editorial in Science last year that 'New instrumentation has had profound effects on analytical chemistry. The most striking one has been the capability of identifying and measuring very tiny amounts of substances. . . . Biochemists have been able to isolate and measure 0.1 picogram of a hormone'. Kolthoff himself went on to say that 'There is no doubt about it, with modern instrumentation one can get much more detailed analyses than was possible in earlier days, but that does not mean to me that the basic character of analytical chemistry has changed.'

Not only has there been a vast improvement in the hardware (and indeed 'software') employed by analytical chemists; Kolthoff thinks that the most profound change in analytical chemistry has been one of approach. He quotes from the editorial 'The Essence of Modern Analytical Chemistry' by H. A. Laitinen, which appeared in Analytical Chemistry in 1979; he concurs with Laitinen's opinion that 'instrumental approaches are merely the means to an end, namely for more detailed information in more complex systems, rather than being the heart of the analytical process'. As well as recognizing the benefits which modern instrumentation has brought, Kolthoff is quick to point out that there are potential drawbacks in an approach to analytical problems in which too much emphasis is placed on apparatus and data processing and not enough on the chemical principles behind the measurement being made. He gives an example from his own recent experience 'There was an occasion recently involving a Ph.D. chemist from outside the U.S.A., who had just spent two years working on crown ethers with me acting as adviser. He had measured a series of equilibrium constants in non-aqueous media, without consulting me as to how he should do the measurements. At the conclusion of the two years he sent me a report with a big section about the computer he had used. But the method he had used to...
make the measurements was dubious and the results unreliable. It is all very well knowing how to programme the computer, but if your measurement is wrong then the answer from the computer will be wrong.

'I was always interested in why things work and not just in empirical observation.'

Kolthoff emphasizes that there are two sides to analytical chemistry, on the one hand it has the task of performing more or less routine analyses, but it is also an area of basic scientific research, and it is this aspect of analytical chemistry which Kolthoff has striven throughout his career to have recognized as a true scientific discipline in its own right. As he said himself 'I was always interested in why things work and not just in empirical observation'. He asserts that modern instrumentation, while invaluable to routine analysis and to the research chemist, used unthinkingly, is not helpful to a scientific approach to the solution of analytical problems. 'Nowadays you don’t have to be much of an analytical chemist to use modern instruments. It does not help the prestige of analytical chemistry when the operator of a machine merely accepts the results it gives him, and cannot think of a way to check them if he suspects they are incorrect.'

The major influence on Kolthoff’s early career and, indeed, on the subsequent course which that career took, was Professor Nicholas Schoorl, of the University of Utrecht. Of Schoorl he says 'I owe him very much. He encouraged me. He had confidence (which he shouldn’t have had) that my work was very good.' It was Schoorl who drew Kolthoff’s attention to early papers in the fields of electroanalytical chemistry and coprecipitation, hence initiating his interest in two fields to which his contributions were to prove so significant.

“The only degree which I ever got which I earned was in pharmacy.”

Kolthoff reminisced about his time in Schoorl’s laboratory. His first degree, in fact, was in pharmacy and Schoorl was Professor of Pharmacy, not of analytical chemistry, which was his main interest. ‘The only degree I ever got which I earned was in pharmacy. At that time there were two schools of pharmacy in Holland, at Amsterdam and Utrecht. Schoorl believed in the expansion of pharmacy. In those days, for example, the Utrecht School of Pharmacy was in charge of investigations into the purity of milk (to determine whether it had been watered down), of foodstuffs, and water analysis. At that time there was no chair of analytical chemistry in Holland, therefore many tasks now within the scope of analytical chemistry fell to the pharmacist. Schoorl, for example, taught a course in toxicology at Utrecht.’

Kolthoff suspects that it was as a punishment for his non-attendance of that toxicology course that Schoorl sent him out on one of the most unusual and unpleasant investigations he has had to carry out in the course of his career. ‘It was 1919. The daughter of Mata Hari had been found dead in bed. She had lived with her step-father, who was the sole beneficiary of a life insurance policy which the girl had held. He went on a binge after her death. Surprisingly, it took the police six weeks to become suspicious, but they did and the girl’s corpse was exhumed for investigation. Schoorl was to perform the analysis of the corpse and I was sent out to the cemetery for the exhumation. Within five minutes of the corpse being rolled out, the court officials and police could stand the assault on their senses no longer, leaving the pathologist and me to do our work. Eventually we got to work and finished bottling various parts of the body in two and a half hours. When I came back to Utrecht my girl-friend had prepared a nice steak for me. I couldn’t eat it. For weeks I couldn’t even stand the sight of meat. Schoorl and I wasted more than six weeks on the contents of the containers, with no conclusive result.’

Soon after his arrival at the University of Minnesota, Kolthoff’s services as an analytical chemist were again called on to find the solution to a crime. ‘In 1928 I learned that the coroner of the State of Minnesota had the right to demand the services of the Head of Analytical Chemistry at the University. I was presented with the jacket of a man, who had been shot, which had one hole in the front and another in the back. Problem – where did the bullet enter? After much thought I got the idea that, since gunpowder is used in firing, some NO₂⁻ might be in the air close to the spot where the bullet was fired, and as a result NO₂⁻ (or NO₃⁻) might be found at the hole where the bullet
entirely. I asked the police to fire a shot through the same jacket and, sure enough, found NO₂ (by the sensitive Gries–Romeyn reaction) where the bullet had entered. Unfortunately no NO₂ was found in either of the original bullet holes." This example, non-academic as it is, serves to illustrate the methodical approach which Kolthoff has taken to the answering of problems in analytical chemistry.

Another major influence on Kolthoff's career was Walther Nernst, the great physical chemist and physicist. 'Nernst's contributions to electrochemistry were great, he was the father of potentiometry, potentiometric titrations, voltammetry and biamperometric titrations, yet in his own time, his work in those fields was hardly recognized, most of his findings went unnoticed and had to be rediscovered early this century.'

The fact that Kolthoff's career has paralleled the employment of a scientific, not purely empirical approach to analytical chemistry, is no coincidence. Throughout his career he has adopted this approach himself (a fact well documented by the account of his career in the article by H. A. Laitinen which follows). But more than that, he has actively campaigned to have analytical chemistry recognized as a truly scientific discipline in its own right, both by his fellow chemists and by the ruling bodies of science, a recognition which he claims today 'is still not 100%.' He talked about the difficulties he has encountered here.

'When I was active in IUPAC, analytical chemistry was scandalously under-represented. For example, in 1949, analytical chemistry was represented by one American, one Dutchman and three other European classical analytical chemists who were involved only in checking qualitative reactions for detection of inorganic cations and anions. I wrote a stiff letter to the President of IUPAC, declaring that this was not modern analytical chemistry. In 1951 I was made an official of IUPAC and was commissioned to establish the Analytical Chemistry Division. I remember I caused a fuss another year at IUPAC, when I was asked to attend the meeting of the Analytical Division in London as part of the American delegation. I was asked to absent myself by the President of the Analytical Division, as I was not an analytical chemist! Of course, I stayed since I had already been delegated to attend the meeting. I also remember that for a long time I was the only analytical chemist who was a member of the National Academy of Sciences (of the U.S.A.).'

Kolthoff thinks it quite evident that in some ways analytical chemistry was more respected in the 19th century than it is even today. 'At that time science as a whole was based more on empirical observation, and the work of the analytical chemists in the 19th century made possible many developments in physical and organic chemistry.'

Kolthoff has always been interested in teaching analytical chemistry as a science. This is reflected in the books he has published. 'In those days the quantitative inorganic textbooks gave a recipe for what to do, but no explanations. But I must say there are still some books which take this approach today.'

His work has brought Professor Kolthoff in contact with many of the great scientists of this century, among them Otto Hahn. It was with some distaste that Kolthoff drove to the station to meet Hahn for the first time in 1933. 'I had been warned not to mention politics and assumed that Hahn was going to be a Nazi.' Kolthoff soon found out otherwise. 'We had not driven for half a minute when he showed me a cable he had received from Max Planck in Germany. It said “Come back and save what you can.” Hitler had just taken power.' Kolthoff and Hahn subsequently became great friends. He also enjoyed a long friendship with Heyrovsky, whom he visited regularly in Prague for a number of years.

Kolthoff's liberal opinions and willingness to express them got him into trouble with Senator Joe McCarthy and the Un-American Activities Committee of Congress, in the early 1950s. As a result of his 'notoriety' he had the unusual experience, for a Professor of Chemistry, of sharing billing in a newspaper article with a Hollywood star. 'The local newspaper called me up at midnight to tell me I had been cited as belonging to 31 subversive organizations and to ask what they should print in the paper. I was a good friend of the owner, so the story was played down a bit. I was mentioned in a few lines at the end of an article on Judy Holliday, the film-star, who had also been cited. The whole thing came to a rather amusing end when the “American Mercury” published an article on “Reds in American Universities”, naming two people in Minnesota, one of them myself, and the other the newly elected President of the American Presbyterian Church.'

Even though he is a pacifist, Kolthoff, with Professor E. J. Meehan and his group of graduate students, participated 100% in war research on synthetic rubber. 'I felt that the defeat of Hitler was essential to maintaining a liveable world.' Since the war he has remained quite involved in the social implications of science and in the defense of human rights.

Professor Kolthoff was and remains a charming man with a delightful sense of humour. His modesty prevents him claiming full credit for the far-reaching contributions he has made, both as a researcher and as a teacher, to the development of analytical chemistry in the present century. However, his fellow analytical chemists are only too ready to give Kolthoff the recognition he deserves, as evidenced by the award he is to receive at the 1981 Pittsburgh Conference and by the appreciation of his scientific career, by H. A. Laitinen, which follows.

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