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Remembering Kloosterman

This is the text of a speech delivered on April 7, 2000 at the Universiteit Leiden, at the occasion of the Kloosterman Centennial Celebration.

Kloosterman was a very calm, even-tempered man. He always spoke slowly, softly, slightly drawling. Never showed emotions by raising his voice or by talking faster. What he said often sounded a bit sad, or very mildly sarcastic.

He had a deep respect for good work of other people, and was always very mild about what he said about others. Yet he had enough sense of humor to make subtle jokes about them.

As an example of the way he talked, I mention what he said about his extensive work on the representation of modular groups by means of theta series (his long paper in the Annals of Mathematics, the work that Springer talked about). He said that he owed it to Adolf Hitler. In 1940 Leiden university was closed by the German occupation, because of the students' protest against the dismissal of jewish professors. Like all the others, Kloosterman kept his salary all the time, without obligations. It was like a research fellowship lasting about 5 years.

He gave the impression of being a quiet, tough worker, not making life easy for himself. Not a kind of man to make many friends easily.

He led a very quiet life ever since he got his job in Leiden in 1930, with a very quiet and even shy wife, and without children. Yet there had been rumours that in the past Kloosterman had led a rather frivolous life and that he was known to have been a heavy drinker. Nobody ever talked about this. People admired him too much to tell anything to his disadvantage.

I mention only one remarkable exception. When enrolling as a student in Leiden in 1936 I was a special case, being over a month late. I had to register with the 'pedel' (the beadle, the man who leads the academic procession, carrying a mace). Imagine this today! The top administrator of a university dealing separately with a single new student. I think his name was Mr. Dee. When he noticed I wanted to do mathematics he began gossiping about Kloosterman's rough reputation. It certainly was not me to bring the name of Kloosterman in the discussion. I was a shy youngster who just wanted to enroll.

Hobbies

He loved sailing and travelling, in particular later in life. He so much enjoyed the car trip he made through most of the states of the U.S. Also loved to read detective stories and to collect stamps. I do not think he was ever seen riding a bicycle. He always came to his classes (in the institute for theoretical physics) by the funny little blue streetcar. It had a stop a small block away from his home, and another one in the Breestraat at an alley leading to the lecture room.

Mathematical opinions and taste

He preferred things that were a bit algebraical. I remember him saying several times that Algebra and Topology are the most important mathematical subjects.

His style was certainly influenced by Hardy. He copied Hardy's claim that mathematics should not to be practical. On the other hand, in the newspaper interview at the occasion of his 60-th anniversary he stated that number theory gave rise to quantum mechanics ('Het Vaderland', 14-4-1960). A slight overstatement, of course.

The leader of Number Theory in Germany was no doubt E. Landau. Kloosterman was not too much impressed by him, saying it was a pity that Landau did not know algebra.

Kloosterman had not been affected by the foundational battle in the 1920's, fought mainly between Hilbert and Brouwer. He never talked about it. In Leiden the question just did not exist. The same disinterest was shown, I believe, by Van der Waerden. The subjects Kloosterman liked, algebra and hard analysis, had little to do with that battle. For him, analysis was precise, explicit, elegant, and by no means a branch of set-theoretical topology. Similarly, he had no interest in Cantor set theory.

He was hardly ever philosophical. But once I asked: why are we doing all this mathematics? I expected a kind of defense, but he looked into the air, and said slowly: that is what I often think myself: why am I doing all this?

Travel

Kloosterman spent a long time abroad (off and on between 1922 and 1930). Göttingen, Copenhagen, Oxford, Münster. Important contacts were Harald Bohr and G.H. Hardy. For a time he had a Rockefeller fellowship, quite a distinction in those days.

In the 1920's it was unusual for Dutch mathematicians to leave the country at all (in the 1930's it was even worse). The standard career of a mathematician was to become a school teacher first, get a PhD, and keep publishing, hoping for a university job.

In an obituary after Kloosterman's death in 1968 I wrote that I suspected that it would have been the famous theoretical physicist Ehrenfest, the successor of Lorentz in Leiden, with all his international contacts, who had stimulated and assisted young Kloosterman in his international enterprises.

Old Van der Woude read this and protested: I was wrong about Ehrenfest. The suggestion was, of course, that it was not Ehrenfest but Van der Woude who did it. On December 31st of that year (1968) Mrs. Kloosterman phoned me to express her gratitude for my obituary (she had postponed it all the time, she said, and did not want to enter another year without having done it). I mentioned Van der Woude's reaction. She said at once: this conceited old Van der Woude always said this, but you were right: it was Ehrenfest indeed.

In spite of his scientific reputation, Kloosterman did not get a job in the Netherlands until 1930, and did not have a professorship until 1947. There just were no opportunities. In Germany, very poor at that time, there were! In the late 1920's, Kloosterman could get a job as an assistant in Münster. Between 1922 and 1930 he was hardly in the Netherlands (apart from his one year military service) and was truly an international mathematician.

In 1930 there was a change of personnel in Leiden. The great J.C. Kluyver retired. Kluyver (1860-1932, professor at Leiden 1892-1930, 38 years) was the man who reshaped the education in analysis. Before Kluyver came to Leiden, the subject was practically 18-th century.

In 1892 Leiden could not find a single specialist to suit the position of professor in analysis. According to Van der Woude, one decided to take the best geometer in the country and to ask him to transform himself into an analyst. That one was Kluyver, and he did it! He worked on analytic number theory. That involved a kind of concrete analysis, very different from the French style, so

much more popular at the time. That kind of French analysis evolved rather in the direction of set-theoretical topology. Kluyver's taste was shaped by the style of Landau and Hardy.

It was under the influence of Kluyver that Kloosterman grew up. Not only Kloosterman, also Van der Corput (1890-1975). Until far into the 20th century all number theory in the Netherlands descended either from Kloosterman or Van der Corput, both descended from Kluyver, and Kluyver came out of the blue. By the way, Kloosterman and Van der Corput were very different in temper and in mathematical style. I don't believe they had any substantial contact. Kloosterman certainly resented Van der Corput's idea that all mathematical research in the Netherlands should be concentrated in his Mathematical Center at Amsterdam (started around 1946).

Coming back to Kluyver's retirement: in 1930 the reader (lector) for introductory courses (Droste) shifted into Kluyver's professorship, and Kloosterman into Droste's readership. That was how Kloosterman was drawn from Germany back to the Netherlands. Around the same time Freudenthal was drawn from Germany into Amsterdam. He got a minor position too, and just like Kloosterman, he had a stimulating modernizing influence on young mathematicians (only, his teaching was far less clear than Kloosterman's). It was through Kloosterman and Freudenthal that the bursting mathematical life of the 1920's was imported from Germany into the Netherlands.

His lecturing

Kloosterman was a very gifted expositor. In particular his mastery of a big blackboard was marvelous. At the beginning of an hour he would start in the upper left corner, writing down everything in an efficient short form, never wiping out anything, reaching the lower right corner exactly at the end of the hour.

In the 1930's he sometimes appeared in his classes dressed in an officer's uniform. He was reserve officer, and in those menacing days before WWII he had to serve now and then.

His Capita Selecta were famous. In the period 1930-1940 he treated a new subject each year. He made it available to all students of all years. Starting from scratch, and leading to quite a high level in a very economic way. There was a wide range of subjects, mainly taken from abstract algebra, functional analysis and number theory.

These courses were not a part of the curriculum. There were no examinations, they were just for scientific interest. He always started with a big audience and kept it. For us it was very stimulating, and opened our eyes for modern subjects, very different from the standard courses we had to pass examinations in. Those standard courses showed no trace of modern mathematics, everything was from the 19th century. No linear algebra, no Galois theory (over a century old already), not even group theory, no Lebesgue integration.

I attended Kloosterman's magnificent course on linear operators in Hilbert space (1937-1938, 60 minutes a week). He started from scratch, with a full introduction into what is now called linear algebra, introduced Stieltjes integrals and applied it to the spectral theory of self-adjoint operators in Hilbert space

I also remember his course (1938-1939, 60 minutes a week) on the work on Winogradoff in analytic number theory, about writing numbers as a sum of three primes, and that kind of thing. It started with very elementary number theory, and became very hard later. He once told me that he had a hard time himself: he had to work the whole week for that 60 minute lecture.

One subject I learned later, in the early 1950's, directly from his own lecture notes: his course on measure theory. He gave it to me to read in the early 1950's. It was just like a book! Beautifully written, no corrections whatsoever. I hope these beautiful notebooks will be preserved somehow.

Being respected

He did not get a professorship in the Netherlands until 1947, since there wasn't any. Yet he was fully recognized and respected, both in the Netherlands and abroad.

Kloosterman was elected member of the Royal Netherlands Academy of Arts and Sciences in 1950. He served a few years as President of the Wiskundig Genootschap. He was an invited speaker at the ICM (International Congress of Mathematicians) at Harvard in 1950. He was chairman of the program committee for the ICM 1954 at Amsterdam. In 1955 he was guest Professor at Ann Arbor, Michigan.

A clear sign of his reputation, when he was still quite young, can be found in Veblen's list. In 1932 Veblen travelled through Europe and North America to find the right people for building up the mathematics division of the Princeton Institute for Advanced Study. In his diary he had a list with 21 names. Kloosterman was on that list (Heyting too). It was mentioned in a recent AMS publication: A century of mathematics in America, part II, p. 213.A very impressive list, containing some of the greatest mathematicians of the century, like Artin, Lefschetz, Alexandroff, Wiener, Kolmogorov, von Neumann, R. Brauer and Gödel.

I never forget meeting Linnik at the International Congress of Mathematicians in 1962 at Stockholm. At a reception Van Lint and I were approached by that famous Linnik (who gave an invited lecture there, using Kloosterman sums). He said that he would like to meet Kloosterman, whom he had never met, and for whom he had great respect. We said: Kloosterman stands talking over there, and we will get him for you. But Linnik replied: out of the question, he is older than me (Linnik was from 1915), and I have to come to him instead. Such a kind of politeness did not exist anymore in our western civilization!

Kloosterman's scientific reputation, even long after his death, can be illustrated by a list provided by MathNet: all publications (as far as reviewed in Math. Reviews) with the name Kloosterman in the title. In total there were 125, and most of them in recent times. (Sums: 93, integrals: 8, zeta function: 6, Dirichlet series: 1, formula: 4, theorem: 4, method: 3, problem: 2, paper by: 1, sets: 1, fractions: 1, codes: 1). A very impressive list indeed. Remarkably, only four of these papers are by Dutch authors!

My own relation to Kloosterman

In my student days, there was hardly any social life for mathematics at the Dutch universities. Apart from the University of Amsterdam, there was nowhere a mathematics building. The only contact that students had with the professors and readers was at their prelims (tentamens), almost always at their homes. Certainly in the great depression of 1930's, most students were poor, and could not afford to rent a room in Leiden. So if they did not happen to live with their parents in Leiden itself they had to travel up and down by train, tram, bus or even bicycle.

In spite of the fact that contacts between students and their teachers were quite rare, Kloosterman had a personal interest in students, and was very kind to them.

Until 1946 (the year we became colleagues), my personal contacts with Kloosterman were so rare that I still remember them one by one. When I first came to him at Lei-

den, he turned out to know my name and my face! He had been on an examination committee in 1935 where I had been a candidate, and I arrived in Leiden a year later. He still remembered me!

This is why I came to him. I had looked through recent problem journals and had seen a problem by Kloosterman on the representation of the Riemann zeta function as an integral. I solved it, and found several similar results. I went to him and showed what I had done. He at once stimulated me to write an article about it and to submit it to an educational mathematics journal he was an editor of. This became my first publication, at the age of 18. At the same occasion he took a quarter of an hour to tell me a lot about the Riemann zeta function and about Dirichlet series in general, and stimulated me to work through Titchmarsh's book. For years I spent at least part of the summers to try to prove that simple Riemann hypothesis, and failed. Well, you learn a lot from failures too.

Around 1942 he gave me his copy of Hecke's Algebraic Number Theory to read. It had quite an influence on my later PhD thesis.

I got my PhD in 1943 at the Free University of Amsterdam, and Koksma acted as my official PhD supervisor. Things went very fast in those days. I can show a letter from Kloosterman who had studied my manuscript in a single week (he was free from other academic duties, after all), dated 26 January 1943, with comments and suggestions for improvements. The PhD ceremony took place exactly two months later, March 26, 1943. Meanwhile, the thesis had to be nicely typeset, printed and sent around, arrangements had to be made for the PhD ceremony, et cetera. Times were grim, but some things were so much easier than in our modern affluent society. Yet there were inconveniences. When trying to enroll at the administration of the Free University in Amsterdam there happened to

Kloosterman-lied
(op de melodie van 'De kleine man')

Als je in je eerste jaar college loopt bij Kloosterman
zijn er dingen die je machtig imponeren.
Met verbazing en bewondering zegt iedereen ervan:
tjonge-jonge wat kan die vent integreren.
We zijn nog veel te dom
en snappen nooit waarom,
maar wie gaf d'eerste schatting van een Kloostermanse som?

Dat was die knappe man, die hele knappe man,
die alles wat mathesis heet direct begrijpen kan.
Met integralen, idealen pakt ie alles an.
Hij is de trots van Leiden, hij is onze Kloosterman.

Lineaire op'ratoren zijn voor hem een peulenschil
en met thetareeksen werkt hij als de besten.
Als hij groepenringen restkarakters adjungeren wil
zoekt hij Klassenkörper na op Normenresten.
Wie steekt er met gemak
elk lichaam in zijn zak,
wie kan zo smeuïg lachen om die 'functies' van Dirac?

Dat is die knappe man, die hele knappe man,
die even zit te lezen en hij weet er alles van.
Met integralen, idealen pakt ie alles an.
Hij is de trots van Leiden, hij is onze Kloosterman.

Op zijn Capita Selecta is hij in zijn element
want daar kan hij ieder jaar iets nieuws voor kiezen.
Arithmetica en algebra ja alles kent die vent
om maar niets te zeggen over analyse.
Want weet je wie begon
met maten van Radon,
terwijl in heel Europa maar een enkeling het kon?

Dat was die knappe man, die hele knappe man,
die't werk van Winogradow zit te lezen als roman.
Met integralen, idealen pakt ie alles an.
Hij is de trots van Leiden, hij is onze Kloosterman.

Op het bord schept hij met krijt in welgekozen symboliek
transformatiegroepen en dat soort van dingen.
Uit de woorden die hij spreekt klinkt mathematische muziek,
zijn formules staan er zachtjes bij te zingen.
Hij heeft de grootste pret
met 'n reeks van Dirichlet,
hij maakt daarvan een dubbelsom, die convergeert nog net.

Dat is die knappe man, die hele knappe man,
die spreekt in O-symbolen en in dan-en-alleen-dan.
Met integralen, idealen pakt ie alles an.
Hij is de trots van Leiden, hij is onze Kloosterman.

Als je zin hebt om nog wetenschap te plegen beste vrind,
en je wel een knappe vent zou willen worden,
als je graag het geniale in het triviale vindt,
praat met Kloosterman en alles komt in orde.
Al doe je 't vaak verkeerd,
hij is het die 't je leert,
en zal er wel voor zorgen dat je eind'lijk promoveert!

Daar bij die knappe man, die hele knappe man,
zo knap als Gauss en Hilbert en de hele rataplan.
Met integralen, idealen pakt ie alles an.
Hij is de trots van Leiden, hij is onze Kloosterman.

be a raid of the German Sicherheitspolizei. I was arrested and taken to a notorious building as a first stage for being sent to a camp, but by sheer luck I was set free again the same day.

Although I left the areas of Kloosterman's interests almost entirely after my PhD, I have been influenced substantially by him. Many decades later, in the 1980's I published on Fourier transforms of quasicrystals: very close to working with theta series, with all the groups and transformations involved. All centered around the Poisson summation formula. I really felt as in my Kloosterman period. That whole area of Penrose patterns and quasicrystals was a mixture of combinatorics, geometry, number theory, algebra and analysis, a kind of mixture that Kloosterman had liked so much.

And, of course, from Kloosterman I inherited his love for precision in presentation and his love for correct mathematical language. Things need not be vague in order to be interesting. It was his style to be careful, precise, clear, patient, right to the goal, never a single superfluous word.

Kloosterman always accentuated the unity of mathematics. I once heard him say: in mathematics I know many things, but not more than a little bit of everything. I took the same attitude. Unfortunately, I never penetrated far in the subjects Kloosterman was such an expert in.

For a long time Kloosterman was the managing editor of the Nieuw Archief voor Wiskunde, in which I published quite a few papers. He had the habit to print at the end of each paper: Received, followed by the date in abbreviated form. One of my papers in 1944 I delayed a bit since I wanted to have it marked as Received 4-4-'44. It worked indeed, but it had been a fake! The mail had been extremely fast that time, and Kloosterman received the paper on 3-4-'44. But independently, he liked to have a paper with 4-4-'44 too, and he cheated one day! A quiet sense of humor, without even mentioning it to anybody. He told it to me 20 years later!

For years (1946 to 1960) Kloosterman and I often did oral examinations together in The Hague, where we both came from. The examinations were for teacher's certificates: the diploma's K1 and K5. These were the diploma's we had both started from ourselves. Kloosterman had done the first one, K1, already as a schoolboy! I very much enjoyed this renewed contact with Kloosterman. And we often met at the monthly meetings of the Wiskundig Genootschap at Amsterdam. After 1957 also at the Royal Academy of Sciences. But my mathematical interests had drifted away from his, by so many other stimuli and obligations.

In the period 1952-1954 Kloosterman was chairman of the program committee for the ICM Amsterdam 1954, and I was the secretary. His influence on the congress was substantial.

Only two social occasions I remember. My wife and I were once invited by him to a one-day sailing trip in the wonderful scenery around Leiden. He liked sailing. Of course he did: he was born in Friesland.

And once he had dinner with us in Nuenen, at the occasion of his colloquium talk on groups of linear transformations in the early 1960's at Eindhoven.

His health was rather delicate during the sixties, and he often was ill. He died in 1968, at the age of 68. I am glad that I was privileged to have known him in his better days.

Respected by students

He had a stimulating influence on students, without trying to force them in the direction of his own work. He had a feeling for the importance of other regions too. And he knew that one cannot enforce creativity anyway.

In later years he tried to promote the study of algebraic geometry and topology without having any roots in it himself. He felt it was important that the country should not become backward in such areas.

His ability to get fast to the essentials of a region made it possible for him to give guidance to PhD students in various areas. In the time he was reader at Leiden (1930-1947) he attracted quite some research-minded mathematics students. Several got their PhD under his direction. Or, rather, we should say that these students were inspired, not directed by him. And being a reader, not having the rank of a professor, he could not be PhD supervisor. For the official PhD ceremony one of the professors (Droste or Van der Woude) had to be appointed formally in that role. In my own case it was Koksma, of the Free University at Amsterdam, since Leiden university was closed at that time.

The large influence Kloosterman had on younger people was mainly caused by his scientific and educational talents, not so much by social talents. He did not have that much personal contacts with colleagues or students.

In analysis, Kloosterman loved Tauberian Theorems. He probably developed taste for that area during his stay with G.H. Hardy in Oxford. He stimulated Korevaar around 1945: try to find an elementary proof of the Prime Number Theorem, by means of elementary Tauberian theorems. It had quite some influence on Korevaar, who just told me that even now he is planning a book on Tauberian theorems.

On me too, I loved it. In my book on Asymptotics I devoted a chapter to it, under the heading "Indirect Asymptotics".

As students we really worshipped Kloosterman. He was our hero. The others (Van der Woude and Droste) were older and much less active (they were in their sixties and fifties, Kloosterman was not yet 40).

The mathematics and physics students club (the 'Leidse Fles' at the University of Leiden) had a kind of cabaret evening each year. I belonged to a small singing group calling themselves the Epsilon Boys. We sang at two occasions. Both times one of our songs was a tribute to Kloosterman, and both times he was present himself. He enjoyed it.

The song of the second occasion (1939) was more informative than the first one. I repeated it in 1960 at the meeting in honor of his 60-th birthday, in the stately old university building on the Rapenburg. I was no trained singer, and had no support of musical instruments, but I had brought a tuning fork along. There were scientific lectures (I believe by Visser and Van der Blij), and my only contribution was that I sang.

I will try to do it again here! The text is Dutch, of course, and the melody is taken from a song that was extremely popular in the 1930's, featured by the famous Louis Davids, under the title "De kleine man".

So I end my memories of Kloosterman by expressing our admiration in this song.

Acknowledgements

The drawing of Kloosterman on page 131 was kindly provided by Ferry Rondagh, who graduated in mathematics at the Universiteit Leiden. He made the drawing in the sixties.