English translation of the farewell address of Ruth Curtain

The **bold** titles are the Dutch ones you will see on the slides and the translation, where necessary, is in *italic*.

Een Australische blikt terug op 29 jaar RUG

An Australian looks back on 29 years at the RUG

Rector Magnificus, ladies and gentlemen,

It is my pleasure follow the old tradition of this university of delivering a farewell lecture that covers a personal view of one's experiences as professor. As the title indicates, I have spent 29 years at this university. However, to place my experiences here in perspective, I believe it is appropriate to say something about my experiences prior to my arrival here. Where do I come from?

Australië en Nederland *Australia and the Netherlands*

I come from Melbourne, Australia, in 1950 a country with a population of 8 million that has now grown to 20 million. That red smudge, The Netherlands, had a population of 10 million in 1950 and it is now 16 million. The green smudge is Melbourne, then a city of 2 million and now more than 3 million inhabitants.

Mijn ouders 1938 *My parents 1938*

My parents married in 1938 when my mother was almost 18 and my father 28. He was painter an decorator and she was a shop assistent. He was Catholic and she was Presbyterian which at the time was rather controversial, just as in the Netherlands.

geboren 16-7-1941 *Born 16-7-1941*

I was the first born, but within 6 years we were 4 and we remained 4. As was customary at the time my mother stayed home to care for us and she saw to it that we were always identically dressed and not just for photo sessions.

Binnen 6 jaar waren dat er vier *Within 6 years there were four*

Altijd identiek gekleed *Always dressed in identical clothes*

Altijd identiek gekleed *Always dressed in identical clothes*

Perhaps that is the reason that I never minded wearing the school uniform; on the contrary I was proud to do so.

Moreland Central Form 1C

We spent the whole day at school and I have many happy memories of the lunch breaks in the school yard where we amused ourselves with all sorts of games. The school breaks were also used to practise for the school sports

teams. Team sports were an integral part of the school curriculum and here is a photo of our successful third basketball team. Our coach also taught us euclidean geometry. I was not a sport star, but I really enjoyed playing the game. You learned to work together as a team and inter-school sporting competitions created a feeling of team spirit and strengthened the identity of the school.

Basketball, Moreland Central

University High School, Form 3

I had the good fortune to spend my last 4 years of school at one of the top high schools, University High School. Here you see that we had a uniform for summer and one for winter.

University High School, Form 5

What you do not see are the straw hats for summer and the berets and gloves for winter. From all these photo's you might think that I attended a girls' school. That was not the case, but the classes and the school yard were strictly segregated. It was only during the last 2 years of school when we chose our major subjects that the classes were mixed and even then the classrooms were divided by an invisible line. Following the British tradition we had prefects who were supposed to set a good example and to act as communicators between staff and students.

Prefects, University High School

There were also prizes for scholastic achievement and dux (top of the school). Interestingly for 3 consecutive years they were all girls who had followed a science major, but I was the only one who had chosen the physical sciences.

Dux University High School

Sportprijzen *Sports prizes*

But do not be mistaken, the real stars of the school were the sporting stars and there were lots of sports prizes. The top events in the school calender were the interschool swimming and athletic tournaments. They strengthened the school spirit.

Sporttoernooi UHS *Sport tournaments UHS*

Meisjes en "exact": anekdotes *Girls and "exact: anecdotes*

How did society then think of girls and science? That is a very complicated subject and I will just give a few personal anecdotes from my past. In my youth Australians considered education to be very important, but what was considered to be appropriate for girls was different from what was considered appropriate for boys. The main aim for girls was marriage. If the girl came from a middle class background, then an expensive private school followed by university was very suitable, but for a girl from a working class background

this was a waste of money as *girls will only get married* (**meisjes gaan toch trouwen**). More appropriate was a secretarial course or a nursing training, but these also cost money. It was against this background that my father decided that I should leave school at 14 and go to work to earn my living. There was only one person in all the circle of family and friends who was against this; my mother. She also thought that marriage was the ideal, but she also believed that it was important to have *something to fall back on* (**iets om op terug te vallen**) . My mother was a great fighter. Consequently, I was allowed to stay on at school and whenever my father started on the subject of leaving school she told him that in that case we would have to pay back all the scholarship money for books I had won. So I was allowed to complete high school and my sisters followed on.

During the last 2 years of high school there were 2 mathematics subjects; pure and applied mathematics. Students found the latter to be more difficult; it was mainly mechanics. The teacher, Mr. Tyler, discouraged the girls from taking this subject because *most girls would only fail* (**de meeste meisjes zullen voor toegepaste wiskunde zakken**). There was also the rumour that although young girls sometimes excelled at school, when they matured their results would be disappointing. I was actually quite scared of this development, but it only spurred me on to study harder.

Exams were very important and the marks out of 100 were read out and you had to go to the front of the class to collect your exam from the teacher. Mr. Coburn, our teacher for pure mathematics read out our marks and after one boy had collected his exam with 100 there was a long silence. Then Mr. Coburn with a broad grin read out *Ruth Curtain 110 for pure mathematics* (**Ruth Curtain 110 voor zuiver wiskunde**) and he kept on beaming. I tried not to smile too much when I collected my exam, because girls were supposed to be shy and modest. My friends will find this hard to believe, but I kept that up for a very long time, of course, with difficulty.

University of Melbourne

All students in the state of Victoria sat the same final exams that were also entrance exams to the university. There were first and second class honours, pass and fail, and of course rankings and prizes. A fair percentage were exempt from paying university fees, but no living allowance was given. In that time there was a shortage of teachers and the state tried to attract more potential teachers by offering a bursary with a generous living allowance throughout the 4 or 5 years study. This was conditional on the bond of 3 years working as a teacher after completion of the study. In this way I could study and still earn my living. It was a real privilege and a great adventure to be able to go to university. During the first year we had 2 mathematics subjects (pure and applied), chemistry and my favorite subject physics. In the second year you had to drop one subject and I dropped chemistry. The teaching was large scale with up to 300 students in a lecture hall, except for mathematics. There was a separate honours stream for the better students and the honours group diminished rapidly from 50 to 10. Exams were at the end of the year and there

were first and second class honours etc. and prizes for the top marks in a subject. The ranking was published publicly, but it was by number, not by name. In the third year you chose one major subject and I had difficulty choosing between mathematics and physics. I would have liked to have dropped the 16 hours a week of physics lab., but unfortunately that was compulsory. What were the motives behind my choice? Although girls were treated equally as students, it was crystal clear that it would be different in a work situation. Men were to be preferred not only because they were smarter, but because they would be the bread winner in the family. For that reason they received a higher wage than women in most jobs (even teachers) for the same work. Married women were allowed to keep a temporary position with the government, but not a permanent one and they had no pension rights. Of course you should not forget that most women were strong supporters of this policy. That is how it was then.

It was against this background that I chose mathematics in my third year. There were very few positions for theoretical physics and at least there were some women lecturers in mathematics. Not that they were attractive role models for young women; on the contrary. But in the first week I missed the unravelling of the secrets of the world I experienced in physics. I changed my major to Physics. To my amazement I was called for an interview with Professor Cherry, the chairman of mathematics. In those days the distance between student and professor was great. He suggested a compromise; I could take Pure Mathematics 3 as an extra subject in my third year and complete the mathematics honours course in my fourth year. So I did.

Liften rond Australie

Hitch-hiking around Australia

After a heavy 2 years I needed a break and my eyes fell on an ad in the women's locker room. Virginia Sikorskis sought a companion for a 2 month's hitch-hiking trip around Australia. This was not my first hitch-hiking holiday, but with more than 11,00 kilometers it was certainly the longest.

University of Melbourne

Afterwards I followed, rather reluctantly, the one year education course. In retrospect it was a valuable year with general subjects on Psychology, Philosophy, Comparison of education systems in different countries, the history of education in Victoria and of course the teaching rounds in schools. Luckily I was able to do my 3 year bond as a mathematics tutor at the university. This gave me the opportunity to do a masters degree and I chose an algebraic topic. Unfortunately I did not find research in algebra as inspiring as I had hoped. I missed the motivation from the physical world. I perservered, but at the same time looked around for another direction. By chance this came from my boy friend who worked at a government lab. where they applied control theory. His enthousiasm about control theory was contagious and I became hooked too. At that time the thing to do was to get a ph.d. from Oxford or Cambridge. But the USA was where control theory was happening and we chose Brown university USA as the best place to study. It was.

Brown University 1966-69

We both received a scholarship to Brown and a Fullbright grant. The atmosphere at Brown was much more competitive than we were used to and initially we were sure that the other students knew more than us. Fortunately the exam results restored our self confidence. Brown was a great choice as many of the pioneers of optimal control and modern control theory were there: La Salle, Hale, Wonham, Fleming, Falb and Kushner. They attracted other toppers as visitors, in particular, the Russian authors of the famous book on Pontryagin's maximum principle.

Ph. D. Brown University 1969

Now you see where my gown comes from. Under the conditions of the Fullbright grant after my ph.d. I was allowed 18 months work experience before I was supposed to return to my home country.

Purdue University 1969-71

I did this at Purdue in the middle of the corn fields. After 5 1/2 years absence I returned to Australia, but just for a visit. I wanted to see more of the world and I took up a position as research fellow at the new Control Theory Centre at the university of Warwick.

Univ. of Warwick, 1971-1977

Control Theory Centre

Larry Markus was the director and together with Patrick Parks, Tony Pritchard and some postdocs we organized a conference every year on one aspect of control theory.

Control Theory Centre

Onderzoek op Warwick *Research at Warwick*

Our main theme was infinite dimensional systems theory and my collabporation with Tony Pritchard was very fruitful.

Squash in Engeland

Squash was good too.

Rijksuniversiteit Groningen *University of Groningen*

Although after 6 years at Warwick I still enjoyed work and life there immensely, I was ready for promotion. At that time there were no possibilities at Warwick and so I was looking around for possibilities elsewhere in the States, Canada and in Australia. By chance there was a vacant position as lector in Groningen. My CV was up to date and so I thought that in nay case it would be nice to visit Jan Willems there. My interview was on a drizzly day and the dinner was in Salle a Manger then one of *the* restaurants in Groningen. To be

perfectly honest I was not all that impressed with Groningen, but the offer was very attractive and I thought that 5 years here would be a good development in my career.

So why am I still here? Is it because I became to love the city of Groningen?

De charme van Groningen *Charming Groningen*

Is it because I enjoy cycling in the countrside?

Het Groningse Hogeland *The Groningen countryside*

In the first place it was due to the dynamic developments in my subject are Systems and Control Theory in the Netherlands. In Groningen we had about 60 enthousiastic first year maths students and a large number of these chose Systems and Control as their major. We could offer a wide choice of advanced courses on systems and control to classes of 20 to 30 students who created a stimulating atmosphere. A good number did a ph.d. in our area, some in Groningen and more in other Dutch universities. At that time there were openings in mathematics, especially at the Technical universities.

Mijn vakgebied: Mathematische systeem en regeltheorie
My research area: Mathematical systems and control theory

Landelijk Netwerk in 1987 *National network in 1987*

The collegiality among systems theorists was contagious and in 1987 we formed one of the first Dutch networks to offer a national masters course in Systems and Control theory. Through these lecture in which most participated and through the annual Benelux meetings a close- knit community arose that offered both support and inspiration.

Netwerk Boeken *Netwerk Books*

In particular, the lecture notes formed the basis for 6 influential books. We were not only active in NL but we played a strong role on the European stage with participation in 21 European projects and with the organization of several international conferences and with editorships in many top international journals. During this period NL gained the reputation of one of the leading countries in Systems and control theory.

ECC'93 in Groningen

Our group welcomed a stready stream of overseas visitors such as Yutaka in this photo taken during the ECC conference held in Groningen in 1993.

Onderzoeksschool in 1995 *Research school in 1995*

The network formed the basis for the present research school DISC. I enjoyed being part of these great developments.

Regeltechniek: verborgen technologie
Control technology; hidden technology
What is control technology?
I begin with a number of examples of control applications

- a remotely controlled aircraft
- a satellite in a trajectory around the earth
- a ship
- an industrial furnace
- a turbo motor
- robots
- pacemaker
- climate and energy mangement of buildings
- CD's
- control in cars
- irrigation
- temperature controlin glasshouses

There are many more. Control is a hidden technology that is being applied in an increasing number of applications. Unfortunately it is invisible. I attempt to reveal some of its secrets.

How does it work?

The basic principle is feedback. We apply this type of control almost automatically in our daily lives. When we drive a car we are continually observing and this leads to decisions to turn or brake or to accelerate, etc. If we see a red light ahead, we brake and the force with which we press on the brake pedal depends on our estimate of the distance to the lights. We feed this estimate back as the pressure on the brakes. We illustrate this schematically. The car with us inside is the system and the output is our estimate of the distance to the lights and the output is the force with which we brake. The control that we use is a sort of proportional control. The closer we are to the lights the harder we brake. There is a feedback from the output by means of the controller to the input to the system which results in a new extended closed-loop system. The controller can be seen as a rule that determines the input for a given output.

Terugkoppeling = feedback

Proportionele regelaar *Proportional controller*

The simplest controller is the proportional controller,. The input u is a constant K times the output y. If K is positive it is called positive feedback, whereas if K is negative it is called negative feedback. On the motorway we use a similar control law to maintain our distance from the car ahead.

Regeltechniek in luxe auto's *Control technology in luxury cars*

In luxury cars the cruise control does this automatically. There are about 10 control devices in luxury cars that work similarly. In fact, a feedback control scheme behind all these applications lies a feedback control scheme.

Regeltechniek: verborgen technologie

Control technology; hidden technology

Terugkoppeling = feedback

How does one design a controller for a system?

Modellen *Models*

First one makes a mathematical model of the system, but what is a model? Suppose that we are walking in the countryside and in the distance we discern some animals. At first we cannot see clearly what kind of animals they are. If we were in *Australia* (**Australië**) we would assume they were kangaroos, but in *the Netherlands* (**Nederland**) we would take them for deer and in Africa for something else again. In other words, we use models quite often.

Wiskundig model: De baan van een satelliet rond de aarde *Mathematical model: Trajectory of a satellite around the earth*

Mathematical models are of course different and for many applications there already exist good mathematical models, e.g. for the motion of a satellite in space.

Satelliet rond de aarde *Trajectory around the earth*

Using this mathematical model one can calculate how to put a satellite in an elliptical trajectory around the earth. The problem with this is that no model is 100% accurate and it will only be possible to achieve a trajectory that is approximately elliptic.

Satelliet zonder feedback *Trajectory without feedback*

All these little errors add up until you get this. To keep a satellite in an elliptic trajectory one has to control it with little jets and to know how much to control one needs measurements of the output.

Terugkoppeling = feedback

Without feedback it is impossible. For these reasons the models we use are intrinsically different from those used to describe natural phenomena. On the

one hand our models are more more detailed, the outputs, inputs and disturbances are an essential part of the model, while on the other hand our models are often simplified. The reason for this is that the simpler the model, the simpler the control law and complicated control laws are difficult to implement. It is amazing how a simple controller can effectively influence the behaviour of a complex system.

Systeem- en regeltheorie: de verborgen wiskunde achter de regeltechniek *Systems and control theory; the hidden mathematics behind control technology*

What is my part in all this?

This falls under the label System and Control theory with the emphasis on theory replacing technology. The art lies in the relationship between the choice of models of the system, the inputs and outputs and disturbances and of course what behaviour one hopes to achieve. This results in infinitely many different mathematical problems to solve. This is the aspect of the subject that I am involved in and in particular with systems that are described by p.d.e's, e.g. a flexible satellite or robot arm.

Flexibele satelliet *Flexible satellite*

Satellites are very sensitive to vibrations. If we wish to study how we can supress unwanted vibrations we must start with a model of the system. But to analyze the essence of the problem we start with a prototype; a simple system that exhibits most of the characteristics of the original system.

Prototype: Flexibele balk *Prototype: Flexible beam*

For the prototype of the satellite we take a flexible beam consisting of 2 arms attached to a central hub. Suppose we want to suppress the vibrations in the rod by exerting a force in the middle of the beam. Suppose we can measure the velocity of the hub.

Flexibele balk: wiskundig model

Flexible beam: mathematical model

We formulate a mathematical model for the system together with the input and output which looks like this. From this we extract a mathematical problem: find a control law for choosing the force u in terms of the output y.

Negatieve terugkoppeling *Negative feedback*

From the mathematical analysis it turns out that the vibrations can be suppressed in a surprizingly simple manner. This is the simplest possible control law: take the measured output and use this as negative feedback. The engineers already knew this, but what intrigued me and my colleagues was why this works? What characterizes a system for which this works? Can we design systems for which this works? Are there other ways of achieving this? Our way of understanding is through mathematical proofs. There is a fascinating interweaving of the physically motivated questions and the mathematical structures. I will not go into this here, for it is another language.

Mijn onderzoek: *My research*

Those who wish to know more about the hidden mathematics in my research area can thumb through one of my books or go to my home page: google Ruth Curtain, Groningen. The research into passive systems such as this flexible beam has a long history and a number of my colleagues in this room have contributed to this. Research is still going on. This particular example of a flexible beam is a result of recent research into infinite dimensional passive systems that is on the boundary of systems theory and operator theory. But what does this have to do with the satellite?

Flexibele satelliet *Flexible satellite*

I have only outlined the very first step: the suppression of vibrations in a flexible beam. This knowledge can be used to design controllers to suppress vibrations in other flexible systems. But to control a satellite one needs to take into account many other theoretical and practical aspects that due to lack of time I omit. The contribution of mathematical systems and control theory is to analyze idealistic scenarios. The control engineers then have to translate these to implementable control laws in collaboration with other engineers, in this case those specialized in aerospace.

Wisselwerking *Interaction*

There is a strong interaction between my research area *systems and control theory* (**systeem- en regeltheorie**) and *control technology* (**regeltechniek**) and between *systems and control theory* (**systeem- en regeltheorie**) and *pure mathematics* (**zuivere wiskunde**); they nourish and stimulate each other. This interaction is essential for all three areas and it is this interaction that captivates me.

Now back to the title of this lecture.

Een Australische blikt terug op 29 jaar RUG

An Australian looks back on 29 years at the RUG

In the beginning of this lecture I recounted a number of personal anecdotes about my experiences as a young girl in Australia. What about my experiences as an Australian woman in the Netherlands? My feeling is that these are determined by only 10 % by the female component and by 90 % by the anglo-saxon component. Moreover, I think that being a woman in NL has helped rather than hindered, but this probably has more to do with the time than the country. My definition of anglo-saxon is the common denominator of the UK, the states and Australia and against this background I have found it fascinating to learn about the Dutch culture and the changes in it. The differences are many, so I just mention a few that rather surprized me.

- everything should be *fun /nice* (**leuk**).
- In university committees it is not customary to vote, but to discuss things interminably to come finally to a unanimous (often suboptimal) decision.

- Policy and implementation are often separate with the result that a lot of time is wasted discussing policy that cannot be properly implemented.
- There is no other country in which the structure of education and research has changed so often as in The Netherlands
- the word **allochtoon** has no English counterpart
- **team** is borrowed from English.
- In NL the percentage of inhabitants with a job of more dan 10 hours is an important statistic, whereas in anglo-saxon countries the percentage of the population with a full-time job is considered to be more relevant.
- **universteit** and *university* are not the same.

University en universiteit

I shall go further into the last remark. When I arrived at the mathematics department in the WSN building in 1977 I was greeted ironically by Harry Whitfield, the professor of computer science with "welcome to the science ghetto". Indeed it was more like working in an office than at a university as I was used to. Not only did I not come into contact with colleagues from other departments in the Science faculty, let alone colleagues from other Arts faculties, but mathematics was divided up into little kingdoms. In the 4 universities I had previously known I felt in the first place a member of the mathematics department and in the second place a member of the university. You belonged to a team, worked together as a team, just as in an anglo-saxon school. I must admit that I did miss the atmosphere of the anglo-saxon university. Luckily there have been some changes over the years and I welcome the plans to create a mini-science-campus in Zernike complete with staff club. But it will still not be a university in the anglo-saxon sense which is not necessarily a bad thing; it is just different.

A development during the past few years is the avalanche of numbers and statistics that are produced about education and research in the attempt to cut costs. Unfortunately it usually results in spending the money gained from the cuts in education and research on the producing the statistics and the assessments. Statistics and surveys are used to produce academic hit lists such as those by Elsevier. As an example of this phenomenon I consider the ranking of the 200 top universities by the Times Higher Educational Supplement. Here is an extract of the list from 2005.

THES list of World's top 200 universities

1 USA	Harvard university	19 AUS	Melbourne university
2 USA	MIT	23 AUS	Australian National university
3 UK	Cambridge university	33 AUS	Monash university
4 UK	Oxford university	38 AUS	Sydney university
5 USA	Stanford university	40 AUS	University of NSW
6 USA	Univ. Calif, Berkeley	47 AUS	Queensland university
7 USA	Yale university	53 NL	Delft university of Technology
8 USA	CAL TECH	57 NL	Erasmus university
9 USA	Princeton university	58 NL	Amsterdam university
10 Fr	Ecole Polytechnique	70 NL	Eindhoven univ. of Technology

In the left-hand column you can see the top 10 universities most of which are American (in blue) and 9 of the 10 are anglo-saxon ones. With the exception of the university of California at Berkeley they are all elite universities with very elite budgets. In the right-hand column I compare the best Dutch (in green) with the best Australian (in yellow) universities. They are all state universities and I found the results surprizing. De university of Groningen did not make the top 200. But last Monday the rector of this university announced with pride that Groningen is among the top 200 universities. How is that possible? It is possible because there is more than one ranking of the top 200 universities in the world. Here is an extract of the Shanghai list.

Shanghai list of World's top 200 universities

1 USA	Harvard university	41 NL	Utrecht university
2 UK	Cambridge university	56 AUS	Australian National university
3 USA	Stanford university	72 NL	Leiden university
4 USA	Univ. Calif, Berkeley	82 AUS	Melbourne university
5 USA	MIT	102-150 AUS	Sydney, Queensland
6 USA	CALTEC	102-150 AUS	Western Australia
7 USA	Columbia university	102-150 NL	Amsterdam, Groningen
8 USA	Princeton university	151-200 AUS	UNSW
9 USA	Chicago university	151-200 NL	Delft, VU
10 UK	Oxford university	151-200 NL	Wageningen university

You see a good correlation in the top 10, but that is as far as it goes. So what is the meaning of these hit lists? What are the criteria and how do they measure them? For 2005 they used these criteria.

Criteria: wat meten ze?

Criteria; what do they measure?

	THES	Shanghai
Academic peer review	40	0
Recruiter review	10	0
% international staff	5	0
% international students	5	0
Staff-student ratio	20	0
Citations in expanded CSI	20	20
# Nobel prizes & Fields medals alumni	0	10
# Nobel prizes & Fields medals staff	0	20
# highly cited staff	0	20
# articles in Science & Nature	0	20
# normalization for size	0	10

I will not go into details, but the point I wish to make is that their criteria only have a 20 % overlap. I will not discuss the many other top 200 lists either. It is clear that they use different definitions of "top". We mathematicians think that we know something about definitions. First one should determine a significant entity or concept, then give a precise definition and only then prove theorems about it. But with the concept of "top 200 universities" they start with the theorems and only later give a superficial indication of what they mean by the concept. It is a new branch of sport: scientific topsport, but in this branch of sport one can choose the rules. The Australians will choose the THES list while the Dutch will prefer the Shanghai list. But even better, they can choose the list compiled by the national citation guru, Professor Ran Raan of Leiden. He believes in bibliometric indicators because they are objective. However, the choice to restrict oneself to bibliometric indicators is far from objective. In particular, aspects such as scholarship are education are excluded from consideration. Objective or not, scientific topsport has just begun and I quote the THES.

Citaat van de Times Higher Educational Supplement

Citation from the Times Higher Educational Supplement

"While the debate continues on the methodology, ..."

"there has been little argument about the thrust of the world ratings. They strive to be current, rather than historical, and to find proxies for excellence in teaching and research. An international outlook and a global reputation among academics, students and employers are all important aspects of a university that ranks among the world elite..... ..... the search for the world's leading universities is surely unstoppable."

These hit lists have a huge influence on the development of research and teaching in all countries. I predict that in another 29 years that the difference between the cultures of anglosaxon and Dutch universities will be rather small,

for better or for worse. But I hope that some differences remain. In particular, the Dutch ph.d. ceremony [1]

exam is something to be treasured,

Promotie Paula Rocha *Ph.D. ceremony of Paula Rocha*

as well as the after ceremony traditions

Na de promotie 1993 *After the Ph.D. ceremony 1993*

In addition the custom of posing "assertions" [2] is worth keeping. But perhaps it would be more interesting if it were also the custom for emeriti to propose assertions? As an experiment I have done that for this accasion. They will be handed out as you leave the aula.

Finally, some words of appreciation.

There are many people I owe special thanks, too many to mention here. Nethertheless, I would like to take this opportunity to mention a select few.

The person I owe most to is my mother who fought for my chance to pursue my education and who won.

At Melbourne university I was inspired by Professors Cherry and Love who strove to provide us with a training up to the standards of Cambridge, England.

Without John Kriegel I would never have heard of control theory. His enthousiasm for this subject infected me too and was the reason I chose this direction. Thank you John.

During my education at Brown Joseph LaSalle and Jack Hale taught me a less formal, but more creative way of doing mathematics. I thank Peter Falb for an outstanding choice of Ph.D. topic that has led to so much fruitful research.

At the university of Warwick Tony Pritchard and I formed a great team together with several postdocs. That was a marvellous period.

In Groningen I thank Jan Willems for an exciting and thriving period for our System and Control Theory group with many masters and ph.d. students. I would like to specially thank my own masters and especially my ph.d. students. This collaboration was by far the most rewarding part of my work here.

Promovendi *Ph.D. students*

I would also like to thank my System Theory colleagues in the Netherlands and abroad for the fine collaboration and I wish them every success in the future.

[1] Each ph.d. candidate is subjected to a ceremonial public exam during which the committee has a limited time to pose questions. The thesis had already been approved and printed and it is customary that after the defence the superviser delivers a personal speech about the candidate.

[2] The ph.d. candidate must produce at least 6 assertions that range from the subject of the thesis to social statements. During the thesis defence the opponents may ask questions about these assertions. Good ones are often published in the press.

Systeemtheorie *Systems Theory*

When I arrived in Groningen in 1977 it was not just the language I did not understand, but also several other cultural and practical things. I would like to thank those who generously helped me in the very beginning; in particular, thank you Margherita, Jan, Harry Croon and Trudy Klosse. What I greatly appreciated were the invitations to their home by people both inside and outside mathematics, and both inside and outside the university. It goes without saying that most of my colleagues are men, but it goes without saying that it was the wives who prepared the meal and who created a warm, relaxed atmosphere in which the conversation was not limited to work. I thank all these women for their generous hospitality.

Last, but not least, I would like to thank everyone for their presence here today. That means a lot to me.

Thanks for coming!