

# A Century of Doctorates at Delft



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## A Century of Doctorates at Delft

Extract from the Register of Doctorates  
at Delft University of Technology  
1905 through 2001



J.M. Aarts et al.

Delft University of Technology, Delft, the Netherlands

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## About this book and the CD-ROM

This book is an extract from the register of doctorates at Delft University of Technology. The extract covers the period from the first doctorate in 1906 through the year 2001.

The doctorates have been enumerated in chronological order. Each item mentions the full name of the doctor, the title of the thesis, a subject classification code, the date of the thesis defence, the name(s) of the promotor(s) and concludes with the predicate "cum laude", whenever conferred. Following the extract from the register, a complete list of the honorary doctorates is included.

A few articles about the Delft doctorate precede the extract.

The CD-ROM offers a searchable version of the Register of Doctorates and a gallery of photographs taken during the ceremonies.

The book and the CD-ROM have been composed by the doctores J.M. Aarts, J.M. Dirken, A.T. de Hoop and J.J. van Loef. Dr. J.E. Mooij kindly gave permission to include some of his quatrains as captions for images of thesis defences. The doctores P.J. French and K.P. Hart assisted in linguistic matters. Technical support was provided by X.W. Wu.

Delft,  
Die ante diem natalem,  
January 6, 2002

J.M. Aarts

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## Introduction

'A Century of Doctorates at Delft' gives an overview of the 3804 doctorates awarded between 1905 and the end of 2001 at the *Technische Hoogeschool Delft*, later renamed *Technische Hogeschool Delft* and finally Delft University of Technology. Doctorates constitute one of the most important products provided by an institution of higher education. A doctorate is, after all, the highest academic degree that such an institution can award. This has been the case ever since the first universities were founded some 800 years ago.

Nowadays, a doctorate is the result of a study of three to five years, during which the student receives tuition while at the same time carries out independently pioneering research. This research leads to a doctoral thesis or proof design, which has to be defended in public. The doctoral examination committee, chaired by the *Rector Magnificus* and consisting of the thesis supervisor, professors and guest experts, assesses the manuscript or proof design. In case all the members of this committee have granted their permission to the candidate to defend the thesis or proof design in public, it means that in their opinion the manuscript or technical design is of adequate level and quality to confer the doctor's degree. During the public graduation ceremony, the candidate's defense of his or her thesis or design will be assessed. If the doctoral examination committee judges this defense also positively, the candidate will receive the doctor's degree diploma, which is signed by the *Rector Magnificus* and the thesis supervisor.

The preparations for an academic doctorate and the way the doctorate examination takes place have not always been as described above. For that reason, it might be interesting to take a short look back at how the first universities came into existence, how degrees were conferred in the Middle Ages, and how various developments led to the award of the first doctorate at Delft. This last topic will be considered more in detail elsewhere in this volume.

The founding of the first universities, like the ones in Bologna, Paris, Oxford, Montpellier, Cambridge and Salamanca, at the end of the 12th and the beginning of the 13th century, was the result of a number of political, social-economic and cultural developments in medieval Europe. For a small part of the population the standard of living increased, and that part of the society became more and more interested in structuring knowledge in a systematic way, and so the need was felt to create centers of higher education. In these institutions, the cultural elite, which had the capacity to fill socially important positions, was trained. The objectives of the students were to acquire fundamental knowledge and to obtain practical skills.

The universities were of great importance, not only to the students and teachers, but also to religious and worldly leaders. They all hoped that the knowledge and skills disseminated at the universities would reinforce their position. For students and scholars,

a study at a university also implicated that they were protected largely against a number of threats from medieval society. They were recognized as a separate class and were protected by both religious and worldly leaders.

The diplomas granted by the universities gave the right to use the title of *baccalaureus*, *magister* or *doctor*, although it should be noted that the degrees of magister and doctor were often used indifferently at many universities. In arts, the degree of magister was usually awarded and in law the degree of doctor was used; in theology and medicine a great variety of degrees existed. The *baccalaureus* degree was seen as the completion of the first phase of university education. The diploma qualified the holder to become a 'junior-teacher' at the university in a certain discipline under the supervision of a magister or doctor. The degrees of *magister* and *doctor* gave their holders the formal right to teach independently.

Obtaining an academic degree was a complex process. Before a candidate could enter the *baccalaureus* examination, he had to prove that all conditions for obtaining this degree were fulfilled. Did he study long enough, had he accomplished all academic exercises, had he read all the specified documents, and had he actively taken part in all the disputationes? If so, an oral examination followed, which - as a rule - consisted of a discourse in which the candidate had to give his view on a particular problem. A *baccalaureus* had the possibility to continue his study for a number of years in order to acquire his *licentia*. For the *licentia*, an examination was held in the presence of a jury that consisted of *magistri* and *doctores* and was chaired by the *rector*. Usually, this examination consisted of a disputation, in which the candidate had to defend a certain view on a particular question, a 'point', which was drawn by lot the previous evening or morning. If the candidate won the disputation, he became a *licentiatus*, i.e. a 'graduate'. Paradoxically, the *licentia* was no license to teach at the university. To obtain the right to teach, the candidate had to take a public examination, which normally took place soon after receiving the *licentia*. This examination, which was the actual solemn inauguration into a university teaching position, led to the award of the degree of *magister* or *doctor*. It was a ceremonial examination - one that the candidate could not fail - and normally took place in a church. After that examination, the candidate received the attributes belonging to a magister and doctor, namely the *birerra*, gloves and 'doctor's book'. After that, he performed his first act as a *magister* or doctor, usually consisting of a disputation with students on a topic of his choice. This disputation had to demonstrate that he was able to teach, and marked his entrance into the body of doctors.

It should be mentioned that many *licentiati* never obtained a teaching position at the university of their doctorate. In that case, they did not appeal for the degree of *magister* or *doctor*. The reasons were that the procedure was very expensive and that - although a *doctor's* degree was very prestigious - it gave no further rights outside the university. It was indispensable only for those who wanted to teach, because they had to be member of the *collegium doctorum*. The question remains whether all those who did obtain the highest

academic degree, being *magister* or *doctor*, actually had a teaching position. Originally, this was a requirement formulated in the academic statute. According to that statute, every new magister or doctor had to serve the university as a *necessarius* with a teaching period of two years within his own faculty. This rule ensured that the university teaching staff was renewed regularly. However, the *necessarii* viewed the rule as a restriction of their professional development, while the established staff viewed it as a threat to their position, because it was in their own interest to restrict the number of teaching positions. For these reasons, the rule was applied less and less, and from around 1450 it was dropped from the academic statute of most universities.

Outside the university, an academic degree was not required for practicing a profession. In many professions, a person with an academic degree did not necessarily have a higher status than a person without a degree. However, a university education was often required for many public service positions, as there were no specific education and training facilities for such positions.

In the first centuries after the founding of the universities, a stay at a university was considered to be a valuable element of education, both for children of aristocracy and of the middle classes. However, many of them did not complete their study and never graduated. Gradually, this situation changed, and from the 15th century on an academic degree began to be a significant qualification for an appointment in ecclesiastical and worldly positions. In this way, a university education, first without and later with a degree, became characteristic of the professional and social elite employed in religious profession, legal practice, civil service, medical care and education.

In the Northern Netherlands, the first *Hoogescholen* (later called ‘universities’) were founded in the period 1575 to 1640: Leyden (1575), Franeker (1585), Harderwijk (1600), Groningen (1614) and Utrecht (1636). These institutions held the *ius promovendi*. In the same period also the first *Athenaeae*, also called *Illustere Scholen*, came into existence. These were institutions for semi-higher education; they did not hold the *ius promovandi*.

In the Northern Netherlands, scientific technical education started in Leyden, where Prince Maurits announced an education programme ‘*Duytsche Mathematique*’, designed by Simon Stevin, on January 9, 1600. The very next day, the mathematician Ludolf van Ceulen got the assignment to take care of the education in mathematics and surveying of students in engineering science<sup>1</sup>. This school of engineering associated with Leyden University was basically an institution of higher professional training. The stipulation that the lessons had to be taught in Dutch and not in Latin, as was customary in academic education, stressed the difference between students of the new engineering education program and those of the traditional academic programmes. In Leyden, the graduated engineers were consequently often characterized as ‘rather ordinary service providers with a

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<sup>1</sup> *Ludolf van Ceulen was instructed “voor hen, die zich in het ingenieurschap zullen willen begeven lezingen te houden over arithmetique of te tellen ende het landmeten, met demonstratie op papier en in 't veld.”*

fairly modest level of education'. Gradually, engineering education also developed at other universities. However, none of the universities realized a good integration in their academic education programmes, although one gets the impression that, for example, in Franeker and Groningen the relations between the engineering faculty and the traditional academic faculty were better than in Leyden.

In 1842, the *Koninklijke Akademie* (Royal Academy) was founded in Delft. In that way, the engineering education for industry and trade<sup>2</sup> in The Netherlands was accommodated in a separate institution. This institution fell under the regime of secondary education and consequently it did not hold the *ius promovendi*. When Mr. J.R. Thorbecke, Prime Minister and Minister of the Interior, began planning a general revision of the legislation on education around 1862, he already foresaw the founding of a *Polytechnische School* as a successor to the *Koninklijke Akademie*. Many tried to persuade Thorbecke that a *Polytechnische School* should be placed under the regime of higher education. Thorbecke was not really in favour of this idea, as can be learned from his reply to Parliament. He stated that education at the *Polytechnische School* should not be regarded as academic education, but as advanced professional education in preparation for positions in trade and industry<sup>3</sup>. The Parliament agreed and in 1864 the *Koninklijke Akademie* became the *Polytechnische School*, once again under the regime of secondary education.

Nevertheless, many persons continued to press for the *Polytechnische School* to become part of the higher education system. At the beginning of 1902, an opportunity presented itself. Prime Minister Dr. A. Kuyper held the opinion that the industrial developments in The Netherlands made it necessary to establish a *technische hogeschool*. He intended to incorporate that new institution in his new act on higher education, and he wished to give the *Polytechnische School* at Delft the status of a *technische hogeschool*. However, this required an adaptation of the education programme, the form of administration and the internal structure of the *Polytechnische School*. This was realized and on July 10, 1905, Her Majesty Queen Wilhelmina officially opened the *Technische Hogeschool Delft*. Due to the fact that this *hogeneschool* was an institute of higher education, it obtained the *ius promovendi*, which enabled the graduates of this institute to continue their study to obtain a degree of doctor of technical science. It is notable that there was no

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<sup>2</sup> The Royal Decree reads: "Een Akademie ter opleiding van burgerlijke ingenieurs, zoo voor 's lands dienst als voor de nijverheid en van kweekelingen voor den handel."

<sup>3</sup> Thorbecke stated: "De Polytechnische School is hooger onderwijs, zegt men. Zoo als men het verstaan wil. Het is hooger onderwijs vergeleken met de burgerscholen, maar het is niet universitair onderwijs. Het is onderwijs op een geheel ander terrein. Professioneel onderwijs is niet strijdig met mijn systeem: het middelbaar onderwijs moet een grond van algemeene beschaving leggen. Daartoe dienen vooral de burgerscholen. Doch aan de uiteinden van die reeks vindt men, beneden, de burgerscholen voor ambachtlieden en kleine landbouwers, bovenaan de Polytechnische School: deze is een samenstel van speciale scholen; voorbereiding voor bepaalde bedrijven in de maatschappij. Zij zet de kroon op het organisme van onderwijs, dat het onderwerp van dit voorstel uitmaakt."

serious opposition to the founding of the *Technische Hoogeschool*. From the minutes of the relevant debate in Parliament, we learn that the general opinion was that in the case of technical education - even more so than in university education - one had to take account of strong foreign competition and of the importance of such education for the Dutch economy<sup>4</sup>. However, the establishment of doctorates at the *Technische Hoogeschool* encountered some resistance. In the same minutes, it is stated that this constitutes a clear break with the tradition whereby a grounding in the classics was considered a necessary qualification for academic education<sup>5</sup>. The point of discussion was that for students of the *Technische Hoogeschool* such a classical training was not required. The Prime Minister countered this argument by saying that a doctorate from the hogeschool was not the same as one from a university. He emphasized that at a university the doctorate is a natural *terminus ad quem* to be distinguished with respect to the faculty, whereas at the hogeschool a doctorate will only be strived after by a limited number of graduates who aim at further scientific qualifications<sup>6</sup>. In accordance with this view, the parliamentary bill refers to the degree of 'doctor of technical science'. It was only in 1964 that the plural term 'doctor of technical sciences' was introduced.

The first Delft doctorate was conferred on July 6, 1906, and it took almost three years before the tenth doctorate was conferred. By December 31, 2001, about 96 years after the founding of the *Technische Hoogeschool*, 3804 doctorates have been conferred by the *Technische Hoogeschool Delft*, later on by the *Technische Hogeschool Delft* and Delft University of Technology. The present book, published on the occasion of the 32nd lustrum of Delft University of Technology, gives an overview of those doctorates and a survey of the development of graduating in Delft. It can be seen as a successor to the book '*2000 Delftse dissertaties, een bibliografie*' published in 1992 by the Library of Delft University of Technology on the occasion of the 150th anniversary of the university. As a matter of fact, that book was a successor to previous bibliographies of Delft dissertations published in 1955 and 1966 on the occasion of the 50th and 60th anniversary of the *Technische Hogeschool Delft*.

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<sup>4</sup> The minutes state: "Sterker nog dan bij universitair onderwijs is op technisch gebied te rekenen én met de sterke concurrentie van het buitenland, én met den onmiddellijken invloed van dit onderwijs op onzen volkstoestand en 's lands welvaart."

<sup>5</sup> The minutes state: "Eene te krasse inbreuk met de traditie, waar tot dusverre de klassieke studiën als noodzakelijke voorbereiding voor het universitaire onderwijs op den voorgond hebben gestaan."

<sup>6</sup> Kuyper answered: "Aan eene universiteit is het de natuurlijke *terminus ad quem* en is daarom naar de faculteiten onderscheiden; bij de hogeschool daarentegen is het een uitzondering ten behoeve van hen, die na hun einddiploma verworven te hebben, zich als candidaat-geleerde voor een hogerent titel aanmelden."

The initiative to publish this book was taken by the Board for Doctorates in June 2000. This Board appointed an editorial committee, consisting of prof.dr. J.M. Aarts, prof.dr. J.M. Dirken Eur Ing, prof.dr.ir. A.T. de Hoop and prof.dr. J.J. van Loef. We trust that this book will provide valuable information on the many doctorates conferred at Delft and on the development of 'graduating at Delft'. The book pays a tribute to all those young scientists whose research has made the name of our institution known throughout the world.

Prof.ir. K.F. Wakker  
Delft, January 6, 2002  
**Rector Magnificus**  
Chairman of the Board for Doctorates

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## **Some images of thesis defences**

### **Intocht**

Wij schrijden binnen in een stijve stoet,  
pedel met staf, rector en professoren,  
bijna zo hanig als de drie tenoren.  
  
Weet, promovendus, wat gjij weten moet.

### **Grand entrance**

We solemnly enter in a formal procession  
beadle with mace, rector and professors,  
almost as cocky as The Three Tenors.  
  
Knowest, promovendus, what thou should know.



**Titulatuur**

Zeer- dan wel hooggeleerde opponent?  
De vraag rijst of in de promotie-uren  
aan wetenschap of puur de procedure  
meest dan wel hoogst belang wordt toegekend.

**Addressing in form**

This opponent, is he very or highly learned?  
One wonders whether during the defence  
Science or purely the protocol  
is esteemed to be prevailing.



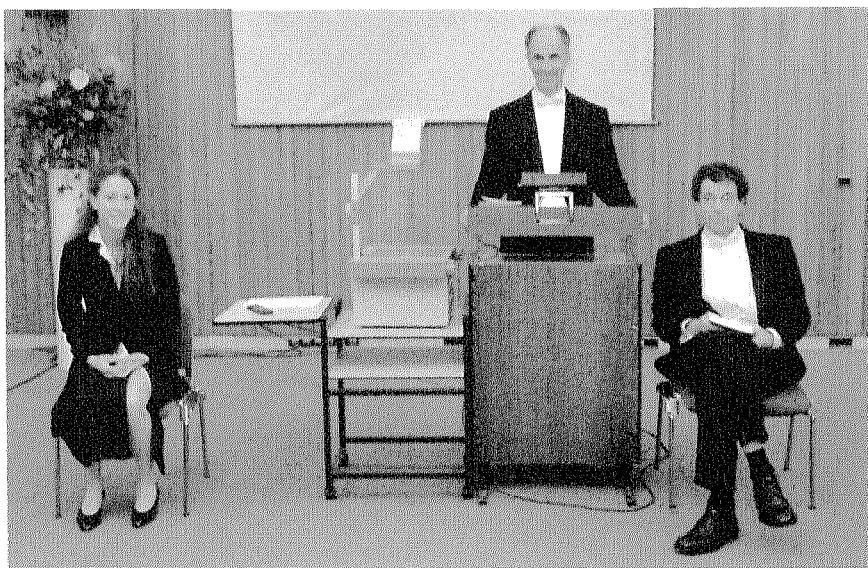
**Paranimf uit 't vak**

De vragen worden niet aan haar gesteld,  
ze hoort waarschijnlijk bij de goede vrienden.

Maar als wie wél praat 't antwoord niet kan vinden  
zie je het door haar ogen uitgespeld.

**Paranymph, a second in expertise**

The questions are not posed to her,  
a close friend-in-support this hour.  
  
But, when who does talk cannot find the answer,  
one sees it spelled out by her eyes.



**Oud&nieuw**

De toegevoegd promotor: lang verhaal,  
met als conclusie drie, vier kleine vragen  
die in het stellen al hun antwoord dragen.  
De promovendus snapt het allemaal.

**Old&new generation**

The adjunct promotor: long exposition,  
concluding with three or four minor questions  
that encompass their answers in the formulation.  
The promovendus grasps it all.



### **Hemelse gerecht**

De lange zitting lijkt op puur gepest.

Het roodvlekhalsje fladdert in een hoekje,

zes zwarte kraaien pikken aan haar boekje.

Dan daalt de engel neder. Hora est.

### **Celestial intervention**

The dragging session feels like sheer bullying.

The little redspotneck flaps around in a corner,

six crows in black are pecking at her booklet.

Then: the angel cometh down. Hora est.



**Slinger van de tijd**

Het rokkostuum, ooit kleding op bevel  
en met de tijdgeest amper te verzoenen.  
Vandaag opeens zes hooggelakte schoenen.  
Twee blauw met witte sokken, dat nog wel.

**Pendulum of time**

The white tie dress, once costume by ordinance  
and hardly reconcilable with the spirit of the time.  
Today we see six patent leather shoes.  
Two blue and white socks do remain.



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## **Doctorates at Delft in the twentieth century**

## A start with uncertainties

### *The first of many*

On July 6, 1906, less than a year after the opening of the Technical High School Delft (TH), the first doctoral ceremony took place. The technologist (chemical engineer) N.L. Söhngen, received his Doctor's degree. The subject of the thesis was: *The origin and vanishing of hydrogen and methane under the influence of the organic life.*) The supervisor, called 'promotor' in the Netherlands, was professor dr.ir. M.W. Beijerinck of the Department of Chemical Technology and Mining. Söhngen was not the first person with the title Doctor Engineer (dr.ir.). Those with an engineering degree from the former Polytechnical School, the predecessor of the TH, had been able to obtain a doctorate at German Technical High Schools since 1884, although this road had rarely been followed. Now in 2002, 96 years later, in the Netherlands thousands of academic engineers have obtained, since, the doctor's degree. In "Delft" more than 3800 doctorates have been bestowed, in eight out of ten cases to persons with an M.Sc. degree in Engineering (since 1917 also persons with a different Master's degree were permitted to enter the doctoral study at Delft). Also many academic engineers later received the doctor's degree at other Dutch Universities and High Schools.

### *Doubts over the Doctor in Engineering*

Many discussions and deliberations had preceded this first doctorate at Delft. The Polytechnical School, the 'PS' (1864-1905), had been promoted by law of May 22, 1905, to a Technical High School. In The Netherlands this meant a step upwards from secondary to higher education and concerned seven different engineering curricula comprising five years, each with a Bachelor's and Master's degree (in the Netherlands the B.Sc. degree has always been regarded as a intermediate degree of study and not as a professional start for some or many of them). The newly acquired academic position also implied being on a par with the universities, including the 'ius promovendi': the right to bestow doctorates. This prerogative, however, was not being regarded everywhere as a matter of course. Doubts were expressed by academics and politicians, and also by engineers themselves. Mr. Thorbecke, the Prime Minister, had established in 1863 for the middle-class in society a type of secondary school: the Hoogere Burger School (Higher Burgher School) or HBS. The engineering education at the above-named PS was consecutive to this HBS. It was part of an educational stream designed for trade and industry, which was considered to have a nature different from the education for the learned professions through the Latin School (Gymnasium), followed by University. In the 19th century the Dutch universities, it is true, mainly prepared for professions: jurist, clergyman, physician, teacher, but this implied a certain knowledge of the classics –especially Latin– as a mark of civilization and traditional background. Recognition that engineering ought to be based on something as 'technological science', was far from general and had been recently imported from abroad. Many held the opinion that it was improper and exaggerated

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*\*) Dutch titles of theses have been translated as closely as possible.*

to open for technicians with a HBS background and thus without knowledge of Latin the possibility to become a doctor.

### *Doctorates in Engineering exceptional?*

Dutch universities had already some time earlier protested against the appointment of 'professors' at the PS, even at a lower salary. The universities had also rejected the idea of taking up themselves an academic engineering education. (Ultimately, this idea was accepted by Groningen University in 1971, be it on a moderate scale.) Finally, in 1905 the political debate about the ius promovendi of Delft led to a positive outcome. One expected that the doctorate in engineering was to be rather exceptional, principally meant for training new professors for this single High School. This rarity proved itself and lasted for a long time. In the first half of the 20th century only a relatively low percentage (five per cent) of the academic engineers received the doctor's degree. Compared to most other branches of science the percentage nowadays is still a modest one. The second aim, the nurturing of professors, was only realized to a limited extent. Within the group of the first fifty doctorates at Delft nine persons became professor at the TH. In contrast to the general universities in the country, however, during most of the century the majority of the body of the Delft professors bore no doctor's title \*). This adds to the idea that combining technology and the doctorate is not a matter of course.

### *Politics around 1905*

The legislation of 1905 concerning higher education was also based on the consideration that the country could strengthen its prosperity and international competitive position by increased technological knowledge. Foreign examples were also of some influence. In Germany and France, higher technical education could be found much earlier, although in their beginnings without the ius promovendi. Debates in the Dutch Parliament amended Delft's request for the right of granting doctor's degrees in "Technological Sciences" to the more modest singular "Technological Science". Only in 1964 the plural became legally recognized. In 1905 the 'ius promovendi' for Delft implied an addition in the law of a sixth Faculty (Technological Science) next to the existing five: Divinity, Law, Medicine, Literature & Philosophy, Mathematics & the Natural Sciences. The elevation of the PS to Technical High School was, however, not the only matter. It was part of a political package deal, by which the Prime Minister, being Minister of the Interior as well, dr. A. Kuyper, realized at the same time the legal recognition of the

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\*) The Annual Catalogue 2001-2002 of the Delft University of Technology presents a list of the 418 living professors, retired since 1975. More than half of these prove not to possess a doctor's title. The picture is, however, shifting, because in the same source can also be found that, of the then actual body of 318 professors, almost ¾ is doctor. Of this professorial staff more than 30 per cent had another degree than in engineering. At the start of the TH in 1905 out of the 39 professors 9 had a doctor's title and 23 were engineer (title: ir.); only three of them were dr.ir. Out of the 49 persons that in the period 1905-2000 held the position of Rector Magnificus (Vice-Chancellor), 28 had a doctor's title and 35 were academic engineer.

Calvinistic "Free University" at Amsterdam that he himself had founded in 1880. Now the road was paved for other special universities too, such as the Catholic University at Nijmegen (1923), but also for other High Schools such as the High School for Commerce (Handelshoogeschool) at Rotterdam (1913) and the one for Agriculture at Wageningen (1917).

### ***A real engineer does not want the doctor's title'***

As said before, doubts on the value of the doctor's degree for engineers were also expressed within the technology sector itself. The equivalence with universities was felt as a deserved recognition, but did this also imply the incorporation within 'elitist traditions and doctrinaire theorizing'? Pursuing academic titles would rather be characteristic for commoners and upstarts, wouldn't it? The dissertations that were then usual for a doctorate could hardly accommodate the problem solving by engineers, being skilled but in the first place practical and pragmatic. Until the second half of the 20th century the engineer with a doctorate was by many looked upon with some suspicion. In several technical sectors it was even reputed to be a counter indication for employment. For instance, with Rijkswaterstaat, the influential and prestigious governmental Department of Public Works and Water Management, the semi-official saying went: "a real civil engineer refrains from a doctor's title". The Dutch M.Sc. title for engineer is it, as opposed to drs.(doctorandus) for the Master's degree of most other academic disciplines, and -some maintained- this exceptional, official abbreviation again underlines the 'different' position of engineers.

### ***Dissertation or Design?***

For several of the aforementioned reasons the doctorate in Technological Science(s) was cared for by special regulations. In the Royal Decree of July 4, 1905 a special paragraph 3 was included: "On the Doctorate in Technological Science". Here it was decreed that entrance to doctoral studies was allowed only to those with an M.Sc. degree in Engineering. Furthermore, if desired, additional proof of practical performance could be required. The requirement is remarkable that for the doctorate either a dissertation had to be written or a design had to be shown, or both. Also a set of additional propositions was required. The legal text continued that the dissertation or the practical design, and the additional propositions, should be related to technological science. Under the present law, the WHW: Law on Higher Education and Science of 1997, several of these elements have been notably changed, if only because technical higher education has been legally integrated with general higher education and is no longer subject of a separate legislation. The admittance to doctoral studies has been broadened. As mentioned the candidates should have successfully passed the final examination of at least a four-year course in higher education (university or higher vocational schools, the latter now being called High Schools, whereas the former High Schools, such as Delft, became special Universities). Factually, this delegated the admittance mainly to the professor at the university who takes up the

responsibility of 'promotor', being the thesis supervisor. In 1917 an M.Sc. degree from a Faculty of Mathematics and the Natural Sciences also became recognized as an adequate starting point for a Delft doctorate. In 1964 this was broadened again to any Master's degree, and since 1985 admittance was even possible on the basis of a Bachelor's degree from one of these new (Vocational) High Schools. Many of the doctoral students, also traditionally called 'promovendi', are, however, having Master's degrees from foreign universities\*). In the aforementioned WHW law the possibility of requiring a proof of past practical performance has disappeared –actually this happened long before– and also propositions were no longer a requirement. Whether or not propositions are required depends on the Doctoral Regulations of each University separately. What did remain, however, is that the proof of competency can be either a dissertation or a 'proof design'. The latter, initially only meant for Technological Science, can now in principle be applied to any scientific discipline. This proof design was since 1905 –and still is– subject of discussion and uncertainty in interpretation. The question arises whether a doctor's degree could be bestowed by a University of Technology on the basis of a technical design only\*\*). For example, in the form of a material object, drawings, software or a manual for a technical method; and all this without a written, thorough treatment of theoretical backgrounds and scientific developments. Such a 'proof design' also relates to the coming into being in 1986 in The Netherlands of so-called "Advanced Design Courses", taking up two years after an M.Sc. degree in Engineering. Since a few years these courses led to the new title Master of Technological Design (MTD), registered by the Royal Institution of Engineers in the Netherlands. Later on, this field of tension between dissertation and design will again be mentioned. Firstly, there follows as a background a short historical outline of higher technical education.

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\**) In the five-year period since 1-1-1997 more than 900 persons became doctor at Delft. Of these, 17 per cent had a Master's degree from a foreign university, for ¼ this was from: the EU, Eastern Europe, USA, Canada or Australia. As a background figure may serve that of the about 13,000 students in the Delft engineering curricula about 1100 come from abroad. In this five-year period only one per cent of the new doctors had as a pre-doctoral degree merely a Bachelor's from a Higher Vocational School.*

\*\*) *Imagine a doctoral ceremony the core of which consists of the switching on of a designed machine, as ultimate proof that 'it does work' and as principal evidence of technological-scientific aptitude. Then there follow questions, explanations and discussions on workings and on the considerations during the design process. This takes place without published journal articles or book chapters; possibly patents come to the fore. Such a solemn protocol, as far as we know, has never been followed.*

## The road towards scientific engineering education

### *Simon Stevin AD 1600*

During the solemn opening of the Technical High School at Delft, in the presence of two queens: Her Majesty Queen Wilhelmina and the Queen Mother Emma, on July 10, 1905, the new Rector Magnificus professor ir. J. Kraus commemorated in a festive speech how in Holland already in 1600 engineering education was started. Prince Maurits of Orange had requested Simon Stevin (Brughes 1548 – The Hague 1620) to design an educational programme, especially with a view of fortifications, land reclamation and shipbuilding. This became the "School voor Duytsche Mathematique", narrowly related with the first and only University in the country, at Leyden. At this school ambitious craftsmen, e.g., brick and stone masons and carpenters, were instructed in 'proper Dutch language'. The first two professors were Ludolph van Ceulen\*) , the mathematician and fencing instructor (was this the reason that the school was situated in the former fencing school of the Leyden university?) and Simon Franz van der Merwe, the surveyor. In seven other towns in the Republic of the Seven United Provinces this example was soon followed. During the 17th and 18th centuries several Dutch universities provided some technical courses, be it on a modest scale and as a peripheral activity. The mere fact that the language of instruction was the local one and not Latin, was seen as ample proof that this did not concern science or higher professions.

### *First higher Schools of Engineering*

The year 1600 was indeed an early start. The 'enghien-maker', or engineer of mediaeval implements, mainly military, and also other technicians were educated in practice by a Master of the Guild, from apprentice to journeyman or fellow, and finally to master. In the course of the 18th century engineering lessons acquire a place in separate military and maritime academies. Soon there followed in central Europe and France non-military - consequently called 'civil' - Engineering Schools. In 1717 emerged the Prague Technical College, in 1735 the Hungarian Mining Academy at Selmecbanya and in 1745 began at Braunschweig the Collegium Carolinum. Initially for military purposes, in France the Grandes Écoles (Schools of Greatness): in 1744 the École des Ponts et Chaussées (Bridges and Roads) and the École des Mines in 1747 were created. Later, in 1794 the École Polytechnique was founded as their preparatory course of two years. In these countries the education of engineers did not become incorporated in the existing universities; it remained in a separate stream of education. For example, in Freiburg in 1760 a 'Technische Hochschule' is founded and in Berlin the Prussian Mining Academy. The German speaking Technical High Schools became recognized in the second half of the 19th century as belonging to the level of universities. Nevertheless the ius promovendi was granted later.

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\*) Hildesheim 1540 – Leyden 1610, famous for his calculating the first 35 decimal places of the number Pi, which are also shown on his tombstone, now on a plaque, in the Pieters Church at Leyden.

This occurred after 1880 and it was, worldwide for the first time. It is remarkable that in the United Kingdom higher engineering education only appeared late in the 19th century. There, confidence in the old Guild system probably remained longer. In most cases the engineering education was finally incorporated as a Faculty or School within the existing universities.

### ***Dutch Military Schools***

In Delft in 1814 a School for Artillery and Engineering was founded, which also educated the engineers for the governmental Department of Public Works and Water Management and for the shipbuilding. This school continued from 1826 as the Military Academy at Breda. In parallel, there was the Royal Institute for the Navy at Medemblik. It took much personal initiative and perseverance to establish in the Netherlands a real 'civil' school of engineering. Trade and agriculture were considered higher than the industry, even after the "loss" in 1830 of Belgium that, after having formed with the Netherlands a unity for about fifteen years, had seceded to become a separate nation.

### ***The Delft Academy from 1842 onwards***

Finally, a Royal Decree of January 8, 1842 decided to establish an "Academy for the education of Civil Engineers, for the service of the country and of industry, and of Apprentices in Trading". The date of January 8, 1842 is considered as the date of birth, 'Dies Natalis', of the Delft institute. Its inauguration took place at January 4, 1843 and the next day lessons for the 48 students started. In the meantime, a Royal Decree of July 18, 1842 had added the task of educating the Civil Servants for the colonies in the East Indies. During the 22 years of its existence the school produced 260 engineers and 318 colonial civil servants, but not a single apprentice in trading. The 'Royal Academy at Delft' provided for five engineering curricula: for civil engineers, inspectors of weights and measures, mining engineers, shipbuilders and for chemical/mechanical engineers. It was recognized as Higher Education, although definitely not on the level of universities. Nevertheless, this engineering school remained small, budgetary critical and with little national recognition. This led in 1864 to a rather radical closing of the Delft Engineering Academy, through the dismissal of everyone and the re-appointment of a few only.

### ***The Polytechnical School from 1864 onwards***

The Government had deliberated whether the different engineering educations should better be housed in the Faculties of the existing universities: maybe Civil engineering in Leyden and Mechanical engineering in Amsterdam University. These alternatives were rejected and September 26 saw a fresh start in Delft: the Polytechnical School became the next national School of Engineering. The institute, however, was reckoned to belong to the secondary education; its system of governance was changed, as also its financing. Curricula of four years were established for Civil, Architectural, Mechanical and Mining engineering and, as a fifth one, a three year curriculum for "Technology" (Chemical engineering). The

'PS', as the historical intermediate between the Academy and TH, has been very successful. It produced more than 2000 engineers in its forty years of existence until 1905. Its curricula were in level not equal to those of Faculties in the universities. It did not offer the possibility for the graduated engineers to continue for a doctorate. They could only attain a higher degree by going to a German speaking Technical High School (after 1884) or passing a State examination for a Gymnasium diploma (for Latin) plus a fast-track study at a Faculty of Mathematics and the Natural Sciences. These were all lengthy and cumbersome trajectories and, consequently, only rarely trodden.

## Preparing for the engineering professions

### *Post-university Guild training*

Technology emerged as a late comer. It was not recognized as a subject of science and as a higher profession before the period of Enlightenment. Even some remnants of today can be explained by this late development. It is clear that already in the beginning phase of European universities in the 13th century several higher professions could trust their education to 'Academia': theologians, jurists and medical doctors. Often, a doctorate in the corresponding Faculty was required for becoming an independent professional, although sometimes the Master's degree was sufficient. The requirements for becoming a doctor varied considerably in the long history of the universities. Higher professions/Guild organizations sometimes considered the level of the academic education and the duration of studies as being too low and too short, respectively. Later on, systems came about to add, after the university formation, practical studies and training on-the-job, supervised by the Guild. An evident example is the model of medical education: after one or more medical degrees at the university (in the Netherlands medical doctorandus), several years of study and practice in hospitals follow, before the recognition as a qualified physician. Studying for a doctorate and writing a dissertation then becomes an optional road, again within university jurisdiction. If the recognition of technical science had historically appeared earlier and with less hesitation, it is conceivable that such a model would also have been applicable for engineers. Does this also explain why the engineers themselves in 1905 had second thoughts on the *ius promovendi*? Being satisfied that both the number of engineering curricula and their duration had been enlarged by the transition from PS to TH \*), the engineers may have regarded the years for a doctoral study as a waste of time.

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*\*) The Technical High School Delft began in 1905 with the following seven curricula, each of which consisted of five years and included the Bachelor's- and the Master's degree: Civil engineering, Architecture, Mechanical engineering, Shipbuilding, Electrical engineering, Mining and Chemical engineering. Around 2002 in the Netherlands the number of academic engineering curricula at the three Universities of Technology has been more than tripled.*

And if it became possible to stretch the period of training even further, was it not then preferable to devote the extra time to training on-the-job, supervised by the Royal Institution of Engineers in the Netherlands? This latter way became the appropriate one for most British engineers. The doctorate in technology had a slow start, but a period of supervised engineering practice after the M.Sc. degree in the Netherlands never materialized. Recently, the same ideas played a role, when the Dutch Government decided to shorten every curriculum at the universities to four years, from 1982 onwards. Not so much educational ideals, but rather national economizing was the reason. The risk, however, was obvious that in international comparison those four years would be judged to come short for encompassing both the Bachelor's plus the Master's study. The three Technical High Schools (since 1984 called universities) and the Royal Institute of Engineers in the Netherlands fiercely protested against this government decision. They argued that educating academic engineers required both a scientific training and a design training, and that these together demanded more than four years. Some years later the Government indeed made it possible to establish, to a limited extent, curricula for engineering design, taking two years after the M.Sc. in Engineering.

### *The graduate courses in Engineering Design*

The three Universities of Technology in the Netherlands (at Delft, Eindhoven and Twente) have, during a long period, utilized this opportunity of teaching two year courses in Engineering Design mainly for research training. This did not conform to the original goal of design training, but the production of scientific publications was becoming very urgent at the same time, because of governmental budget reductions for other research personnel. It is odd that the official reduction of the curriculum to four years had no effect whatsoever on the factual duration of studies in engineering. This was and remained on the average six years plus a few months. In 1995 the exceptional position of having programmes of five years was again granted to most of the engineering curricula; whereupon their average duration of study continued to be six years plus a few months! The existence of design courses and the duration of the master's study seemed to be unrelated. Several of these post-M.Sc. courses still exist at the three Universities of Technology, be it with moderate numbers of students and with less acclaim than they probably deserve. Some of these courses, especially those at Eindhoven, have also become a 'stepping stone' for a quick doctorate on basis of a dissertation annex proof design. The combination of ir. and MTD (Master of Technological Design) shows some resemblance to the aforementioned model of medical education. Proposals to entitle the graduates of the Engineering Design courses to a "Professional Doctor" in stead of an MTD, were rejected earlier. The medical model for professional preparation has been copied in the Netherlands for several judicial specializations and accountancy, but have not become the common path to qualify engineers.

*The aio's and oio's (research assistants in training)*

In 1976 legislation once again appeared to restructure the universities. This time this also had a substantial effect on the numbers and ranks of personnel. After much delay this finally resulted in the introduction in 1984 of the system of research assistants in training. When paid by the university their acronym was "aio" and when paid out of national research funds\*) or by a third party the name was "oio". It was problematic how to combine several principles. The first principle was the increase and improvement of the university research. The second was economizing on the tenured university personnel. The third principle was more delicate and typically Dutch: it was not politically correct to select students at the entrance of a study, even a doctoral study; in contrast, it is correct to select new personnel. The outcome was that the students continuing their studies for a doctorate (or MTD) were selected and became junior, temporary members of the university staff. Since then most of the doctoral students, together constituting about 1/4 to 1/3 of the research capacity of universities, received a modest salary and had to spend at least 70 per cent of their hours for a doctoral study, to be completed within four years. This solution was a remarkable one, because universities abroad usually charge fees for the doctoral studies, although there are several systems of scholarships with fierce competition and sharp selection. The net result of the new Dutch system was a considerable increase of doctoral students and doctors, also in fields where these were less common, such as in engineering sciences. The system also meant that a diminishing percentage of the university teaching staff acquired the doctorate during their university career. This may, probably, be attributed to the increase of their teaching load. The relative number of persons outside university and preparing a dissertation next to a regular job, evidently, decreased. Not surprisingly, this vast body of research assistants became a considerable factor in the scientific production of the Faculties. Their contribution is usually not restricted to the publication of the dissertation, but also consists of several scientific articles published elsewhere and also serving as chapters of the doctor's thesis. The emphasis on "publish or perish" also favours situations where well geared research groups incorporate the young assistants as members, to continue ongoing lines of projects and to learn and contribute in team work. This way of participating can be a very efficient preparation for research jobs later. The training on-the-job of the medical model again comes to mind, be it in this case for the job of research engineer. The effects of this system of research assistants-in-training are clearly demonstrated by several statistics. From 1985 to 1998 the national, annual production of new doctor's titles grew from around 1000 to 2600 (for Delft's annual production see Figure 1). In the same period the annual production of scientific publications by the Dutch universities increased from 38,000 to 51,000. The percentage of drop-outs of the doctoral studies is between 25 and 30, and it usually takes five years till the doctor's degree is received. The one year in excess of the four-year appointment

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\*)Generally speaking, in Delft the number of aio's and oio's were equal. Among the national research funds an important and stimulating role was played by the STW, the Foundation for Technical Sciences.

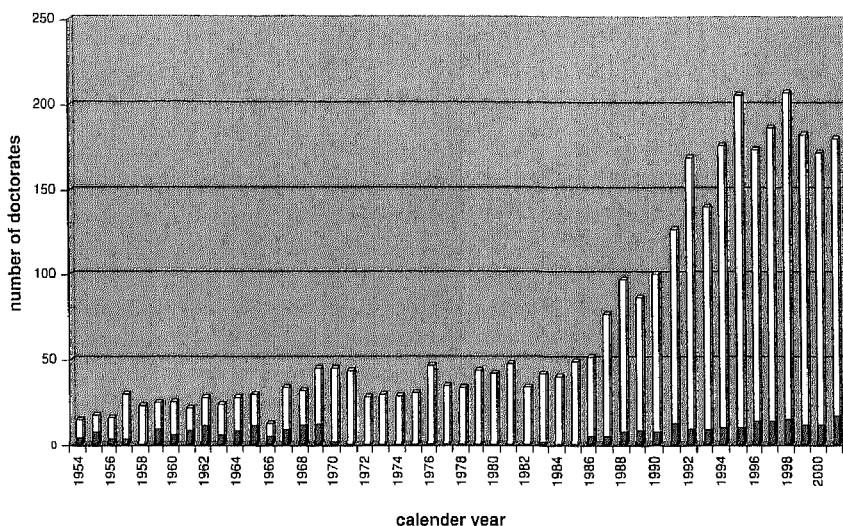


Figure 1: Number of doctorates per annum (period 1954-2001): ■ is number of doctorates cum laude

sometimes goes without a salary. At Delft the system is changing in several respects. Since 1999 the assistant's position is different and his salary has been raised. In the years 2000 and 2001 approximately one-third of the doctoral assistants possesses a Master's degree from a foreign university, indicating an important aspect of further internationalization.

### *Fundamentals / Principles / Designs?*

Uncertainty continues to hover over the engineering field: what type of doctorate in technology is most useful, and what type of jobs to prepare for? Jobs as researchers of the mathematical and natural scientific fundamentals of technology, jobs as researchers/developers of applicable technical principles and methods, or jobs of science-based innovative design of technical products and systems? Should there be an equal mixture of these three types or should one type dominate? The historical evolution of engineering into scientific technology could go further than only emulating physics, but should also advance beyond merely realizing new practical tools and systems. Similar questions can be addressed to many other applied disciplines, such as business administration, accountancy or marketing. These questions even apply to the older, 'higher' professions such as Law and Medicine and their many practical specializations. The answers, obviously, depend on many assumptions. For instance, the assumption that doctoral studies are principally meant to mould a generalistic scientific attitude, in contrast to the vision that they are essentially for contributing to a specific field of study. Even more ideas about this may prevail. The legislator c.q. government (whether or not financing the

doctorates), a university, a professor promotor and a 'promovendus', may have different preferences and goals. A variety of viewpoints can be expected when comparing different historical periods, scientific sectors and countries.

## In the course of the twentieth century

### *First flow of (honorary) doctorates*

The Technical High School Delft modestly started to 'produce' doctor's titles (see Figure 2). In the first academic year, 1905-1906, there was only one doctorate, during the next year four and in the following year two. Understandably, first of all new academic engineers had to be sown and harvested, in more and longer curricula. Till 1925 the annual doctor production oscillated around six and in the next twenty years it was about eleven per year. In the academic years 1943-1944 and 1944-1945, the last years of the German occupation during World War II, no dissertations appeared at Delft. The first one hundred was reached in 1925. In contrast, nowadays it takes only seven months to attain the next hundred doctorates. It is interesting to note that- in an overtaking manoeuvre, probably out of enthusiasm of finally belonging to higher education- at the Dies Natalis of 1907 the Technical High School awarded not less than seven honorary doctorates, whereas until then only two 'normal' doctor's titles had been granted. Among the new 'doctores honoris causa' were several prominent persons: the aforementioned dr. Kuyper, who had just resigned from the Cabinet, and the first Delft Rector Magnificus ir. Kraus, then being Minister of Public Works. Since this 'Pleiade' of seven honoured persons in 1907, Delft has been more restrictive in honorary doctorates. During the 96 years since 1905, a total of 94 have been given (in 41 years no honorary doctorate was bestowed and in 1947, 1955 and 1992 five). Five doctores honoris causa were Nobel laureates.

### *The ceremony*

Belonging to the company of Dutch institutions of scientific education -although this was perceived differently for a long time by the older universities- also meant an adoption of the rules and protocol of the ceremony of the doctorate, as far as these were not already prescribed by Dutch law. The Diploma had and still has a text not in Latin but in Dutch, and as long as 'Delft' was a Technical High School and not a University, the public ceremony of defending the dissertation and additional propositions was ended by the Beadle's call: "The hour is over", which was later changed into: "Hora est." Comparatively speaking, the protocol of defence and handing over of the Bulla at Delft is rather strict and traditional. This often leads to surprise and appreciation of foreign guests in the Doctoral Committee. Up to 1925 the solemn occasions took place in the 'Prinsenkamer' in the building where the Academy started in 1842 (at 95 Oude Delft). Thereafter, during

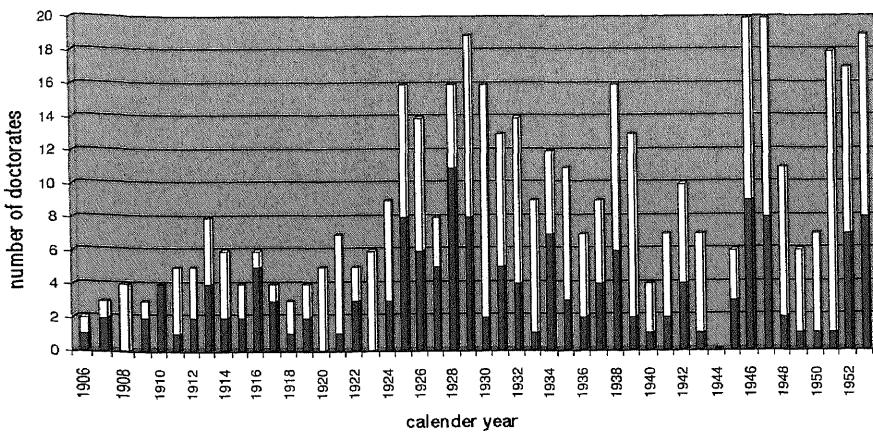


Figure 2: Number of doctorates per annum: ■ is number of doctorates cum laude

forty years, the doctoral ceremonies were held in the Senate Hall, 118 Oude Delft, the former Chapel of the Nuns of the Holy Ghost. From 1956 (with the doctor with serial number 708) they were held in the Senate Hall of the Aula building at the Mekelweg.

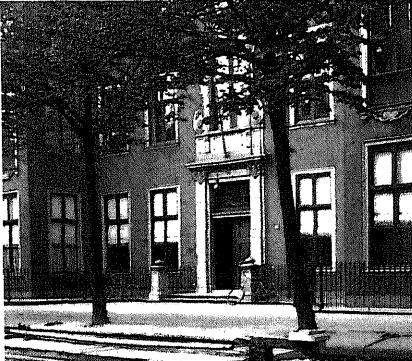
The Princen Room



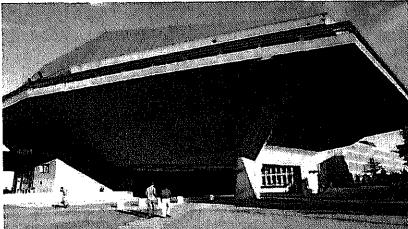
Senate Hall, 118 Oude Delft



95 Oude Delft



Aula, Mekelweg



### ***Applicability and Direction of the Dissertations***

On inspection of the titles of the first row of hundred dissertations from Delft, the impression arises that an important part typically belongs to a technical institute. Direct reference is sometimes given to machinery or vehicles (e.g., locomotive, cable net, bridge) or to commercial processes of manufacturing (e.g., vulcanisation, butter production). With a majority, however, it seems that the study could also have fitted in a Faculty of Mathematics and the Natural Sciences. During the first score of years subjects of study can also be found that are more of a historical, juridical or economic nature. Characteristic is the case in 1914 of the doctoral student H.J. Kiewiet de Jonge, M.Sc. in Architecture, who aspired for the doctorate through a study on "*Building Societies*", a study of a predominantly historical and policy nature. The intended supervisor was professor mr.dr. J.H. Valckenier Kips, the Delft professor of Constitutional Law (!). The Delft Senate (convention of all professors) judged the subject as being not of a technological nature. After ample discussion the dissertation was rejected and the reason given was that the promovendus could not give a convincing proof of past practical (architectural) performance. As was discussed above, there was no legal obligation for this proof. The tricky question in the background concerned, of course, not only the technological identity of Delft, but also the dispute whether some professors could be excluded from acting as a doctoral supervisor. This dispute pointed at all those with a non-technical or less technical professorial assignment and could even involve the mathematicians and the theoreticians of technology. This doctor-to-be did not receive his doctor's title, but a remarkable letter stating that his study would have made an excellent dissertation at a university! Nevertheless, later on professor Valckenier Kips supervised seven other doctorates (on housing shortage, relations between employers and employees, on the history of societies for the control of water works, etc., topics which would not have been to the standard of the Senate in 1914). In more recent days the professorial assignments cover much more breadth, including some on Humanities, Arts and Social Sciences, in pure form or as an aspect of a specific technical sector. Therefore, the overlapping with general universities has become quite acceptable for doctoral studies at Delft. The habit of forming the doctoral committee in such a way that also experts from outside Delft are present, could also guarantee the appropriate quality of dissertations of a less technical nature. Some justification can also be derived from the legislation, since 1986 prescribing that a Dutch doctorate is "undifferentiated", implying that also Universities of Technology do not give anymore a doctorate in Technological Sciences, but just the title "Doctor" without any further specification.

### ***Background Statistics***

For the sake of surveying and comparing, the editorial committee for this book decided upon a subject classification of the contents of dissertations at Delft. In total 19 fields of

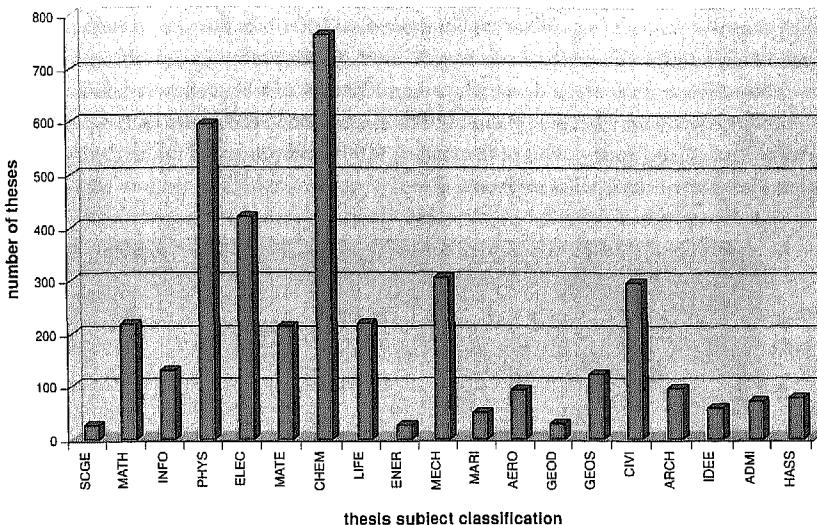


Figure 3: Classification of the total number of theses according to subject. For subject classification scheme see p. 57

scientific areas, mainly derived from the Central Library of Delft University, were distinguished (see p. 57). All, nearly four thousand, dissertations were classified accordingly, resulting into the frequency histogram of Figure 3. Almost 20 per cent of the theses deals with chemical (technological) topics and 16 per cent of the theses deals with subjects in physics. Two-thirds of the dissertations are to be found in six classes and 80 per cent is covered by nine classes. Subjects such as energy, but also subjects from engineering curricula with very high numbers of students for the Bachelor's- and Master's degrees, like Architecture, Industrial Design engineering, Aerospace engineering, turn out to be numerically negligible subjects (less than 2½ per cent). It should be emphasized that the subject classification is no indication of degree of scholarship, applicability or importance. The presence of the class HASS (humanities, arts and social sciences) being only two per cent could indeed confirm the repeatedly made statement that the Delft engineering education devotes very little attention to these approaches, in comparison with some other institutes, like, for instance, the MIT at Cambridge, MA. Indeed, the doctorates of Delft University of Technology have a profile that is characterized by natural and technological sciences. The Delft annual output of around 180 dissertations is part of a Dutch national output of about 2500 and of an annual output of 45000 in the European Union. The Dutch annual contribution to science is estimated about two per cent of the global output. A few more statistical data follow. In the period 1906-2001 in Delft over 3800 doctor's degrees were granted. In 982 doctorates, a quarter of the total number, more than

one promotor professor supervised and in more than 100 times this was an extra promotor from outside Delft University. There were more than 800 professors at Delft who took the promotorship once or several times. More than 130 of the Delft professors fulfilled a promotorship at least ten times. Professors Waterman and Van Bekkum each did this over seventy times! See Figure 4. Out of the total of 1100 Delft professors in the 20th century more than 300 never acted as promotor.

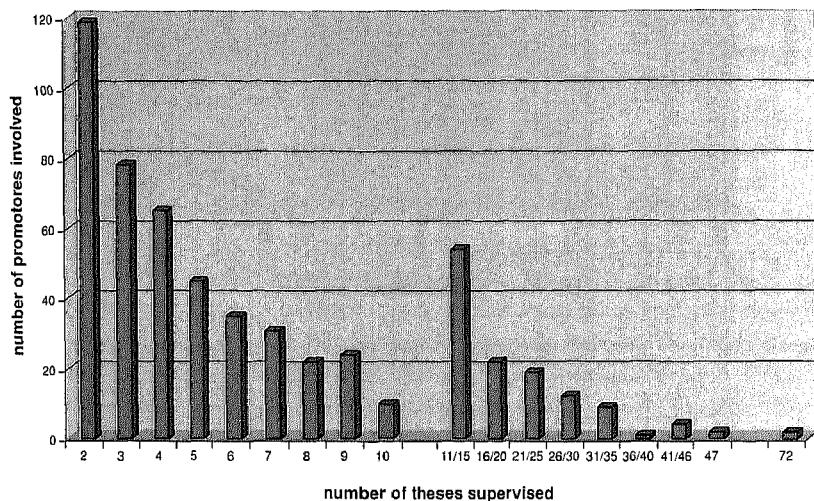


Figure 4: Promotor involvement in thesis supervision. Note: 2 promotores have supervised 72 theses each

### *Actual Issues*

The Delft scientific output (of which the doctorates constitute a substantial part) is the product of a mature and efficient organization. In the course of a century several constants and variables can be distinguished. As we have observed, in Delft the question lingers, whether the doctorate is reconcilable with applications of technological sciences. The dissertation on a purely scientific, fundamental subject and a proof design are the poles between which preferences fluctuate. The modal tendency, however, is nearer to the first pole. Several other issues often receive attention in academical discussions and university policies concerning the doctorate. What value for professional practice can be attributed to a doctorate, also taking into account that after four to six years on the job the doctor engineer tends to work less at the frontier of science and is shifting his attention towards managerial responsibilities? Is the specific subject of the dissertation of any importance for the further career, often in a completely different field? Is five years of doctoral studies too long a period, also in view of the deceleration in the learning curve? Is the drop-out percentage during doctoral studies too large or to be seen as acceptably selective, or even

inevitable? Should doctoral studies, at least partly, be devoted to general scientific insights or exclusively to training in the research methods relevant to a specific subject? Should the result of a doctorate be an essential contribution to a selected and limited problem field or does active participation in the laboratory team sufficiently guarantee the training for a full-fledged scientist? Is the number of new doctorates too high in view of the costs or in relation to the number of academic vacancies; or is it too low, taking into consideration the growing role of science in a society of rapidly increasing complexity? It is proper that 'Academia' sometimes reflects on these issues and now and then endeavours to adjust its general policy. The personal, societal and universitarian values of doctorates are, however, that much convincing, that major changes in policy concerning the doctorate, let alone its abolition, are not to be expected. Also in Delft the doctoral tradition will be upheld in the 21st century, in a dignified manner and for innovating many qualities of engineering.

## Changes after a century

### *In Conclusion*

During the twentieth century, the evolution of the doctorates at the Delft institute for engineering education reflects the trends of technique and technological sciences at national and international level. In the period directly after 1906 a dissertation in Technology was a rarity, usually written in Dutch, dealing with a theoretical or practical problem, in national or colonial context and often preparing for a career at a High School or University. The prior Master's degree was in most cases one of Delft's own engineering curricula.

Almost a century later the dissertation is still a respectable performance, but it can no longer be called exceptional. The thesis is a published book (500-1000 copies), usually in the English language. In most cases the study concerns a problem that is oriented internationally: in literature, activities and coaching. Though the formative nature of the doctoral study of the individual remains to be recognized, the emphasis shifts towards a contribution by the 'promovendus' and the university to the stream of publications relating to a specific field of research. The regular position of the doctoral student has become a salaried, temporary, research assistant. In the majority of cases the prior degree still is one of the 25 engineering M.Sc.'s at the Dutch Universities of Technology. Understandably, those of Delft dominate. The proportion of foreign degrees, however, is becoming significant. Also non-technological studies often are a basis for admittance to doctoral studies at Delft.

In a study published by the Institute for Research of Scientific Education (IOWO, 1995) it was shown that the effort of several years to acquire the Dutch doctor's degree is not reflected by the salary or level of the position obtained, neither is it detrimental in those

respects. The effort is rewarding: the young doctor has access to more interesting functions with more facilities and freedom. The classical saying on science in general and on the doctorate in particular still applies: "Scientia nobilitat", meaning "Science ennobles".

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**Fifty early doctorates and fifty recent ones;  
change and continuity**

## Objective and approach

During a lustral year, as now in 2002, the Delft's institute for engineering education is giving special attention to its history. In the 160 years since its founding in 1842 the institute has changed names, tasks and national status. In 1905 it became legally recognized as an institute for scientific engineering education. The recognition included the right to award the doctor's degree. Since then this degree has been bestowed more than 3800 times and a doctorate 'honoris causa' was awarded 94 times. How this prerogative, the 'ius promovendi', came about and how it was viewed upon by the established universities and by engineers, and how this prerogative was effected during the 20th century, has been told in the preceding chapter. In the following, some more details about the 'Delft doctorates' will be given. As the number of almost 4000 dissertations is too large to allow easy surveying of details, it was decided to compare two collections of fifty doctorates each. For obvious reasons, the first consists of the first fifty ones, taking place in the period 1906-1916. To contrast this early group, a recent fifty was chosen, namely the group of doctorates with serial numbers 3551-3600, covering the period September-November 2000. Another 200 new doctorates were added to Delft's score and to the list in this book, since. The 4000th doctorate will probably be reached in 2003. The following comparison of both sets of doctorates, the 'early group' versus the 'recent group' illustrates several developments and constants during the century of doctorates at Delft.

## Differences in situation

A comparison of two groups of performances that are separated by many years, becomes the more meaningful when relevant differences in the background are taken into account. The decade 1906-1916 of the old group, saw a position and a level of the technological sciences and education that were substantially different from the situation at the end of 2000. The rates at which new doctorates issued, evidently differ, but another point of contrast is that about 1910 the doctor's degree for an engineer was a rarity, whereas nationally it nowadays happens daily, and in Delft about 180 times per annum. In the beginning period doctoral studies could only be entered by those having an M.Sc. degree in engineering from Delft, with the legal exception for a few foreign, similar institutes. In 2000 the majority of admitted candidates still has a Dutch M.Sc. degree in engineering, but a substantial number possesses some different degree, even sometimes outside the fields of science and technology. In a few cases a B.Sc. degree from one of the Dutch Higher Vocational Schools (HBO) is accepted for admission. Quite a few doctoral students now have received their prior degree from abroad. Nowadays, the 'promovendus', the doctoral candidate, is usually a research-assistant-trainee, a junior staff member employed by the

university. In the first decades of the twentieth century, however, doctoral studies tended to be a part-time occupation, combined with daily duties as a teacher, an engineer in industry or an instructor at the Delft Technical High School. Up to 1922, to qualify as a teacher at the Gymnasium (the secondary school preparing for university education) a doctorate was usually required. It also seems that in those days a doctorate at Delft was more often considered a stepping stone towards a readership or a professorship. Nowadays a doctor's title is principally a recognition of being a full-fledged researcher. Maybe, in the old period a Doctor Engineer pursued a scientific career for longer, whilst a modern career tends to show a shift towards managerial responsibilities, even four to six years after receiving the doctor's diploma. About 1910 the usual career path was: Diploma five-year Higher Burgher School → Candidate in Engineering (B.Sc.) → Diploma Engineer (M.Sc.) → Doctorate. In modern times there is a broad diversity of secondary education and in degrees preceding the doctoral studies. The modal path now is something like: Diploma six-year Preparatory Scientific Education (VWO) → Diploma Engineer (M.Sc.) → Doctorate. What has changed in these paths, is the duration. The duration of the secondary school grew from 5 to 6 years, the engineering studies also from the usual 5 to 6, and the doctoral study from 4 to 5 years on the average. Each phase was stretched by one year. In 2002 the traditional European Bachelor's and Master's degrees will reappear, making the future career path and the path of 1910 more similar.

## **Characteristics of the "fifty/fifty"**

Upon comparing the two groups of doctorates the curiosity should, most preferably, be directed to aspects of scientific quality. For this, however, an objective yardstick that spans a century seems hardly feasible. As we shall see later on the *judicium 'cum laude'*, cannot be used as an objective measure. What remain are the characteristics that are objectively registered. Four sets of characteristics could be collected and listed. Three 'dimensions' concern the subject of the dissertation, the prior degree and the *judicium* respectively. A second set of variables is formed by personal characteristics of the young doctor: age, gender, admission based on either a foreign or a domestic diploma. A third set consists of formal properties of the dissertation: language, number of pages, number of additional propositions. The fourth group of dimensions regards the supervision and the examination: the Faculty of the promotor(s), whether there is one promotor or more, whether the promotor bears a doctor's degree himself and, finally, the composition of the doctoral committee. To add some more depth to the statistical data of the frequencies and averages of these 13 characteristics, some outlines of dissertations, examples from both periods, are first presented.

## Some exemplary outlines

### *Nicolaas L. Söhngen, Chemical Engineer*

Nicolaas L. Söhngen was the first person to acquire, at Delft and in the Netherlands, the degree of Doctor in Technological Science. This happened to be with honours: the distinction 'Cum Laude' was conferred. The defence of the thesis and the handing over of the diploma took place on Friday July 6, 1906, at "two and a half hours" in the Princen Room of the building at Oude Delft 95, where in 1843 the teaching of engineers at the Delft Academy had also started. The young doctor was 28 years of age, born at Oirschot in the province North-Brabant. He had successfully completed his study (1898-1902) for Chemical engineer (also called 'technologist' in those days) at the Delft Polytechnical School, the predecessor of the Technical High School. In 1904 and 1905 he was assistant at this 'PS'. The title of the thesis was: *The origin and disappearance of Hydrogen and Methane under the influence of the organic life\**). It comprised 139 pages and was accompanied by a list of 12 propositions. In a short preface thanks are expressed to his teachers, among them the promotor and the Rector. Remarkably, no mention can be found of its being the first Delft thesis. The first and second chapters give a survey of the history and state of the art in the field of study. Thereafter, three chapters follow with his own investigations, and finally a summary of one page concludes the thesis. One gets the impression that the chemical formulas and experimental set-ups are rather elementary. A few drawings of the set ups are presented and four microscopic (600 x) photos of bacteria are shown. The subject has many practical applications. In the thesis, the literature is referred to through footnotes. The thesis is written in Dutch, but most of the citations are in German or French. The additional propositions show a broad content and all are of a chemical/technical nature. As an example, Proposition V: *It cannot be assumed as proven that large quantities of hydrogen can be found in the higher layers of the atmosphere.* The promotor was professor dr.ir. M.W. Beijerinck, technologist at the Department of Chemical Engineering and Mining. Since 1895 he taught microbiology at the Polytechnical School. During his subsequent career at the Technical High School (TH) till 1925 he fulfilled the promotorship three more times. The doctoral ceremony was chaired by the Rector Magnificus professor dr. S. Hoogerwerff, professor at the same department as the promotor. The doctoral committee consisted of seven members out of the Senate, the body of all the professors at the TH. Later on, from 1918 till 1934, Dr.ir. Söhngen was professor at the Dutch Agricultural High School at Wageningen, the Netherlands.

### *Frédéric C. Huygen, Mechanical Engineer*

On March 26<sup>th</sup> 1907 the mechanical engineer Frédéric C. Huygen received the doctorate in Technological Science. He was then 25 years of age, born at Amersfoort in the province Utrecht. The subject of the thesis (172 pages) was: *On the working of exhausts with*

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\* ) Dutch titles of theses and additional propositions have been translated as closely as possible.

*locomotives.* It is a study carried out in the practice of engineering. The promotor was professor ir. I. Franco of the 'Department D' (Mechanical Engineering, Shipbuilding and Electrotechnology), who was full-time professor in Mechanical Engineering from 1900 to 1916. This happened to be the only time he acted as promotor. The dissertation consists of four chapters: objective and approach, history of the problem, researching in the laboratory and in practice. Three thick envelopes with tables and drawings are added as appendices. In a preface thanks are expressed to, among others, the State Railways. German, French and English literature references are given in footnotes.

The subject concerns optimization of shape and size of the funnel of locomotives with regard to the steam and combustion products, and with pressure, flow and temperature as process variables. The calculations are modest and the design of the practical assessments is rather simple. Seven additional propositions accompany the thesis. Proposition III advocates the founding of a bureau of studies within the railway company. In 1916 we find this 'doctor engineer' in the oil industry.

#### ***Willem B. Peteri, Civil Engineer***

As a third example we take the doctorate with ordinal number 30. On Saturday June 14, 1913 the doctor's degree was obtained by Willem B. Peteri, civil engineer. The dissertation's title was: *Governmental interventions in town building before the peace of Westphalia*. The 'young doctor' was 29 of age and was born in Deventer, in the province of Overijssel. His promotor was professor mr.dr. J.H. Valckenier Kips, of the Department of General Sciences, who till 1932 taught Constitutional and Administrative Law. He acted eight times as promotor. Among the eight 'promovendi' is not included the non-successful one of 1914, who has been mentioned in the previous chapter. The dissertation of Peteri had 293 pages, three sections and sixteen chapters, plus ten photographs. Several city plans can be found as appendices. At the end of the preface we find a bibliography, but further literature references appear as footnotes. Remarkable are the lengthy citations, sometimes comprising more than one page. The study is of a descriptive, historical nature and deals with the genesis of Dutch towns and related legislation, and concludes with the consequences regarding city planning and prosperity. Eighteen propositions have been added; the final one, at a length of half a page, praises the utility of teaching free drawing to engineers. Peteri was teacher at a secondary school and remained so after receiving his doctor's degree.

#### ***Felix A. Vening Meinesz, Civil Engineer***

The civil engineer Felix A. Vening Meinesz received his doctorate on October 26, 1915. He was then 28 years of age. The title of his dissertation was: *Contribution to the theory of pendulum observations*. His promotor was professor dr.ir. J. Cardinaal of the Department of General Sciences, professor of pure and applied mathematics and theoretical mechanics.

The doctor's degree was awarded cum laude. The object of study of the thesis was the determination of the force of gravity as accurately as possible. The assignment was issued by the Governmental Committee on Measurements of Degrees and Level and the study was carried out in the Netherlands. The dissertation has 162 pages. There are 21 propositions, most of them being of a technological nature. Proposition X is, more or less, an exception: *Land reclamation in the Zuyderzee requires more than with common reclamations, to take into account the aesthetic aspect concerning the division and parcelling of the areas within dikes.* In 1939 Vening Meinesz was nominated a part-time professor in Physical Geodetics at Delft, his principal positions being professor at the Utrecht University and Director of the National Meteorological Institute. He retired from Delft in 1957.

After these four examples from the old group four short outlines of doctorates of the group from the year 2000 follow.

***Mario Alvarez Grima, Master of Science in Geology***

Mario Alvarez Grima, obtained his doctor's degree at Delft on September 18, 2000. The dissertation was named: *Neuro-fuzzy modeling in Engineering Geology: applications to mechanical rock excavation, rock strength estimation and geological mapping.* His earlier degree was an M.Sc. in geology from Cuba. Promotors were professor dr. A.K. Turner and professor dr.ir. P. van der Veer, both from the Faculty of Civil Engineering and Geosciences. Mr Grima tackles the problem that, in many engineering geological projects, the relationships among process variables are not exactly known. This hinders the use of crisp mathematical modelling tools based on the principles of physics or mechanics. In this thesis a modelling framework was developed to help the approach of these problems in an efficient and systematic way. The dissertation has 216 pages and nineteen additional propositions.

***Elias A.J.F. Peters, Physics Engineer***

On September 21, 2000 a doctorate was conferred cum laude to the physics engineer, Elias A.J.F. Peters, who had written the dissertation: *Polymers in flow modeling and simulation.* The thesis treats a number of subjects from the field of polymer technology, using a microscopic description of polymer liquids. The thesis counts 292 pages and all its chapters were previously published in first rate scientific journals. Ten propositions have been added. The promotor was professor dr.ir. B.H.H.A. van den Brule from the Faculty of Design, Engineering and Production.

***Ronald van Oers, Engineer in Architecture***

The M.Sc. in Architecture Ronald van Oers defended his thesis on September 22, 2000. The subject was: *Dutch town planning overseas during VOC and WIC /United Trading Company of*

*the East Indies and West Indian Trading Company) rule, 1600-1800.* Promotors were professor dr.ir. F.W. van Voorden and professor ir. J. van Heeling, both from the Faculty of Architecture. The dissertation offers an overview of the Dutch-founded settlements overseas, their origins, design and development, as well as insights into their planning and building process. Different typologies of the VOC and WIC are given and an outline of Dutch colonial town planning is described. Many maps from the seventeenth and eighteenth century illustrate this book of 219 pages. There are twelve additional propositions.

#### ***Luca Canali, Physical Engineer***

Luca Canali, having an M.Sc. in physics from Italy, acquired the doctor's degree at Delft on November 4, 2000. His study was called: *Novel scanning probes applied to the study of nanostructures.* The aim of his study was to measure electronic properties of nanostructures and mesoscopic systems with the highest possible resolution, both in space and energy. Experiments are described regarding the combination of three key experimental methods: scanning tunnelling microscopy, low-temperature transport techniques and lithographic microfabrication. Sample preparation is crucial for scanning probe experiments, a few results of which are given. The dissertation has 162 pages. Nine propositions are added. The promotors were professor dr.ir. J.E. Mooij and professor dr.ir. L.P. Kouwenhoven, both from the Faculty of Applied Sciences.

## **Comparing contents (class of subject, prior degree and judicium)**

### ***Field of study***

The subject classification scheme (see p. 57) of Delft's dissertations, which has been derived from the system used by the Central Library of Delft University of Technology and which has already been mentioned in the preceding chapter, was used for the old and the recent group. This resulted into the histogram of Figure 5. The comparison shows large differences between the groups. It is also remarkable that of the 19 classified fields, some are not present in either the old or the recent group and some are absent in both. The fifty dissertations of the period 1906-1916 are spread across 10 fields, although a clear dominance of chemistry can be found and, secondly, of the geosciences. In the group of autumn 2000 we find a more even distribution, with more classes (13) and less dominance of one class, although material science, electrical engineering and physics have the higher frequencies. The differences between the groups should be interpreted against the background that around 1910 many of the subjects of the classification did not yet exist in engineering, such as aerospace engineering or informatics. Furthermore, it should be

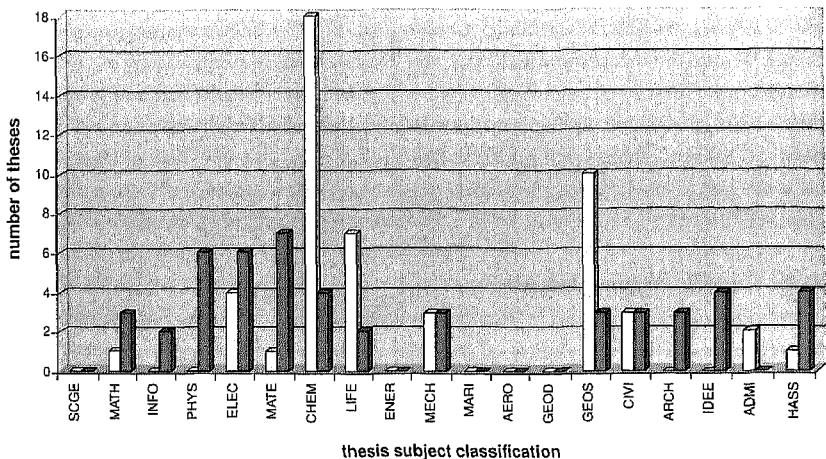


Figure 5: Classification of theses according to subject: □ 50 early doctorates, ■ 50 recent doctorates

realised that the time window of the recent group is rather narrow, allowing for the accidental absence of some of the fields. Both groups, however, may not be regarded as statistical samples; they do not represent a larger population of dissertations. The frequency distribution of all 3804 doctorates from the entire period of almost a century is shown in Figure 6.

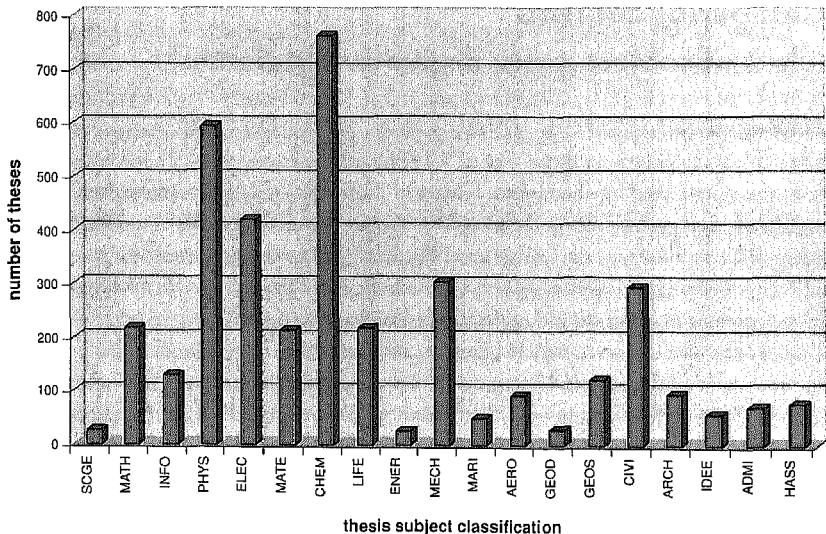


Figure 6: Classification of the total number of theses according to subject. For subject classification scheme see p. 57

### Prior degree

Between the old and the recent periods many differences can be expected in the degrees, required for doctoral studies at Delft. In the beginning of the twentieth century only seven M.Sc. engineering curricula existed at Delft, compared to some 25 in the Netherlands today. Also, the legislation has broadened the admission requirements: any Master's degree, sometimes even a Bachelor's degree. Prior degrees may come from various institutes of higher learning, national or foreign. The comparison is shown in the following table.

Engineering M.Sc.	1906-1916	Autumn 2000	
		Engineering M.Sc.	Other Master's degree
Chemical eng.	24	2	
Mining eng.	11	-	
Civil eng.	7	3	*)
Mechanical eng.	7	2	
Electrical eng.	1	8	
Shipbuilding	-	-	
Architecture	-	3	
Appl. physics eng.	-	13	
Aerospace eng.	-	1	
Industr. Design eng.	-	1	
Materials eng.	-	1	
Eng. Unspecified	-	1	
Agricultural eng.	-	1	
		36	14
	50	50	

\*) 3 chemistry, 2 mathematics, 2 geology and 1 physics, biology, geography, psychology, education, history, law, each

The table shows that the differences are substantial indeed. Two of the seven old M.Sc. engineering degrees produced no doctorate in the beginning period and of these seven two are not represented in the recent group. In 2000 several new engineering degrees serve as starting points for doctoral studies, but also 14 of these 50 persons have degrees different from engineering. The 'new' engineering studies, mentioned in the table, appeared after 1916: applied physics engineering in 1929, aerospace engineering in 1943, industrial design engineering in 1964, materials engineering in 1987 and agricultural engineering at Wageningen University in 1917. A striking phenomenon is that the quantitative dominance, in the beginning, of chemical engineers has been substituted by that of applied

physics engineers in modern times. Another peak is found with electrotechnical engineers. The past century shows a proliferation in the degrees prior to the doctorate.

### *Judicium*

The only special judicium of doctorates, that also leads to a special diploma, is the Cum Laude (with honours). In the old group of 50 the high number of 24 cum laudes is found. Among the recent 50 there are merely five degrees with honours. In the long period from 1906-1970 the annual average of degrees with honours at Delft is 30 per cent. In the period 1970-1982 there was the egalitarian regime 'sine laude': no special praise was allowed. In 1982 the old tradition was restored. Allowing for local and historical variations, for Dutch universities the average of doctorates with the predicate cum laude is about 7 per cent. This data sufficiently shows that this judicium can hardly be relied upon as a yardstick for scientific quality, when applied across many years or across several disciplines.

## **Comparison of personal characteristics (age, gender, foreign diplomas)**

### *Age*

The average age of the 50 'young' doctors of the beginning period proves to be more than four years lower than the average age of the recent group. The precise mean values are 28 versus 33 years of age, standard deviations being 4 and 6 respectively. In the old period we find many new doctors of about 23 years old, but the modal age in 2000 was 30. We have described above how the duration at the secondary school and the factual duration of the engineering studies were stretched and that, on the average, it takes five years to complete a modern doctoral study in the Netherlands. Even taking this into account the mean value still needs an explanation. Perhaps this can partly be found in the increasing percentage of doctoral students having a prior degree from abroad, assuming that a wandering career may imply longer periods for transition and adjustment.

### *Gender*

In the period of 1906-1916 there was only one 'promovenda' at Delft. This first female doctor at Delft was the chemical engineer Jeanne E. van Amstel. Later on she became assistant at the TH. In the group of autumn 2000 the number of female doctors has increased to 8 out of 50. The percentage of 16 also more or less reflects the average numerical proportion of the female students in the Delft engineering studies. It is to be noted that the proportion largely depends on the numbers of a few studies such as architecture and industrial design engineering, which are, however, underrepresented

among the doctoral students at Delft. The percentage of 16 is still far from the ideal emancipatory balance.

### ***Foreign diploma***

Before 1917 a Delft M.Sc. in engineering was required to enter the doctoral studies in technological science, although the law made a few exemptions for similar foreign diplomas. Exemptions did not occur among the first group of fifty. One promovendus, born in Vienna, had a Delft M.Sc. and wrote his thesis in Dutch. Among the recent group of fifty, however, thirteen have been admitted on the basis of a foreign diploma. It cannot be concluded that in the beginning of the 20th century the Delft doctorate was a purely national matter. Six out of the first 50 were born in the Dutch East Indies. This 'colonial picture' gets even more colour when one finds that in 1916 ten of the Delft's doctors were employed in the Dutch East Indies and that two more were employed in other countries.

## **Comparing theses (language, pages, propositions)**

Nationally it was a long standing tradition to publish the dissertation as a real, printed book. The tradition was, of course, immediately adopted by the new Technical High School, in 1906. The number of copies was rather small -we estimate it at around one hundred only- but the books contributed considerably to the growing number of Dutch centres of documentation concerning engineering. In recent times the theses are on an electronical basis too, if only for the printing procedure. The number of hard copies is much larger, usually around 500 or more. CD-ROMs for extra texts, figures or animations are annexed to the printed thesis in increasing numbers or serve outside the University as replacements for the printed edition.

### ***Language***

For comparative study of languages four suffice: Dutch, English, German and Afrikaans. In the old group the respective frequencies were: 45, 0, 4 and 1. Within the recent group they are: 3, 47, 0 and 0 respectively. It is obvious that the English language, the 'lingua franca' of science and technology, has almost completely replaced the Dutch language. Regulations still permit the publishing of a dissertation in a language different from English or Dutch, but this rarely occurs. The Delft doctoral ceremony, being the public defence of the thesis and the handing over of the diploma, takes place in German about once a year only. Rather often the ceremony is bilingual, alternating between English and Dutch, for the convenience of the foreign committee members and the audience, and also sometimes to give the candidate an easier linguistic basis during his defence. The shift towards English as

the language of instruction at Dutch universities actually seems to be preluded by this doctoral ceremony. See figure 7.

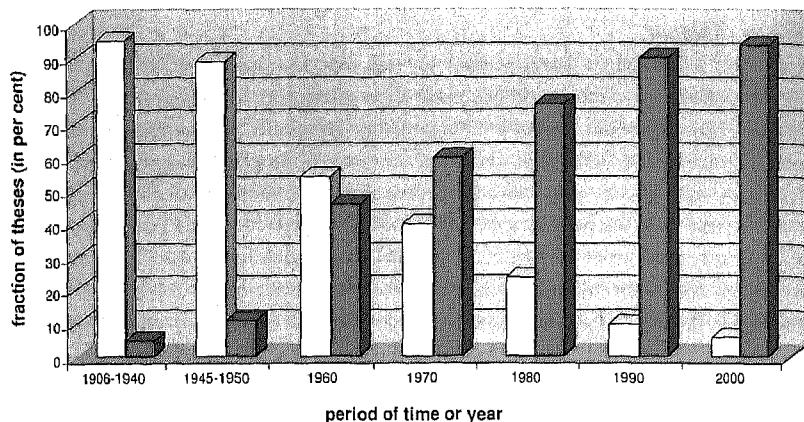


Figure 7: Thesis language: ■ = non-Dutch, □ = Dutch

### *Number of pages*

In the beginning period, more often than not, the thesis had less than 80 pages. This does not happen in the recent period. The modal size, however, remains at 130 – 180 pages. It is difficult to conclude whether in the early days one had less to say or that the reporting was done more concisely, or whether it is just the other way round. The difference between averages is small and it is plausible that in both periods the personal styles of the promovendi and the promotores cause differences. What does count as a historical difference, however, is that presently the abundance of measuring and computing equipment yields relatively more numerical tables, graphics and statistical analyses, and the same applies to the use of photographs and colour. In the beginning of the 20th century, out of necessity one had to be content with written text only. In those days it never occurred that the largest part of the thesis consisted of chapters that had already been published or accepted for publication as articles in international scientific journals. In those days the pressure to publish in scientific journals at an early stage seems to have been experienced as less urgent. What sometimes can be found in the theses of the old period are neatly folded sets of technical drawings and hand-written tables in separate envelopes attached to the dissertation.

### *Number of additional propositions*

In the old period it was obligatory to add several separate propositions to the thesis.

Nowadays a Dutch university is free to require additional propositions or not. Delft continues the old tradition. Extra propositions are remnants of the Mediaeval custom to emphasize the academic debating skills during the doctoral ceremony. In some periods of time the proof of being able to maturely participating in a learned debate, was the only thing that counted for the doctor's title. When propositions are required by university regulations, it is usually stated that some of them should not stem from the study in the thesis itself. This regulation refers to the traditional ideal that doctors have more intellectual abilities than just specific research skills. In general, the attention for the 'other' propositions tends to erode. Sometimes this results in propositions, that are neither academically defensible, nor pointedly formulated, but ventilate personal opinions in a way that does not witness the degree of wisdom to be expected from an average person of 32 years of age. In the last decades it is not unusual that the last proposition is some humoristic statement. In Delft this has indeed produced many amusing 'propositions', selections of which have been published in two booklets: *De beste stellingen zijn van hout* [1995] and *Het paard van Damocles* [2000] (edited by Beta Imaginations, Rotterdam). Most of the puns in Dutch, just like the titles of the booklets cannot easily be translated. Upon comparing the number of propositions in the old and recent periods it becomes clear that in the first period in the majority of cases ten to twenty propositions accompany the thesis, whereas in 2000 this number has been reduced to in between seven and ten. The (exceptional) maxima are thirty and sixteen respectively.

## **Comparing supervision and examination (promotor, doctoral committee)**

After a period of several years of preparation the dissertation is admitted for public defence by a doctoral committee, including the promotor(s). Then through learned questions and -as may be expected- ditto answers, a final test and judgement take place. During the preceding period the members of the committee have studied the dissertation and judged it as "defensible". Sometimes they have recommended some alterations in the text. The main task of the promotor, or promotor(s), has been earlier fulfilled: initiating the project, recruiting the candidate, more or less intensively coaching the project's design, planning its progress and the publishing. In Delft this procedure has remained unchanged during the twentieth century. In the old period, however, all the persons involved came from Delft, whereas now in most committees foreign guests participate. Also the Faculties, called Departments, were different from those in 2000. The number and names of the departments changed even during the 1906-1916 decade. For the sake of comparison we present the old period according to the situation of 1912-1916.

### *Faculty of the promotor(s)*

During the decade from 1906 to 1916 there was more than one promotor for only two doctorates. This brings the total of professor promotors at 52 for the first period. In 2000 the presence of more than one promotor occurred more often, resulting in 68 promotors. In Delft the promotors carry an equal responsibility. For the sake of statistics we refer to them as first, second and third promotor, but this does not imply a ranking of involvement. In the two tables below it is shown to which Faculty the promotors belonged. The names of the Faculties do not adequately reflect the fields of study covered by the dissertations. The subject classification is given on p. 57. For example, of the eight promotors from the Department of General Sciences in the decade 1906-1916 three taught physics, two taught mathematics and one was teaching law. It is remarkable that in the old group half of the doctoral projects belonged to the Department of Chemical Engineering. In the table presenting 2000 a more even distribution can be seen, although Applied Sciences is predominant. Nowadays, the number of promotorships of professors is an important earning factor for a Faculty, because this 'output' also influences the budget and the size of the research staff. The latter hardly depends on the number of students in the engineering curricula. In the beginning of the 20th century doctoral projects were less important than teaching duties, but also in that period there seems to be almost no correlation between teaching duties and doctoral studies.

Period 1906 – 1916		
Department (Faculty)	number of promotors	
	1st	2nd
- General Sciences	8	2
- Civil Engineering	1	
- Architecture	-	
- Mechanical Engineering, Shipbuilding & Electrotechnique	7	
- Chemical Engineering	25	
- Mining	9	
Total: 52	50	2

### *Number of promotors per thesis*

As can be seen in the tables, the presence of a second promotor was exceptional in the old group. In the group of 2000 this happens in one-third of the cases and for one doctorate there is even a third promotor. Additional promotors are often recruited from other

universities. Nowadays the responsibility for a thesis is more often shared among different institutions. This phenomenon could be due to an increased frequency of multidisciplinary subjects of study, requiring also specialists from outside Delft University to be an additional promotor. But it seems more likely that it is the change in customs within academia. In the old days the doctorate was mainly a matter of the Department. In 2000 we see an eagerness to co-operate and to participate in world-wide networks, as the special, international field of study better identifies a researcher than a single Faculty or University. Later on we shall see this impression confirmed by an analysis of the composition of the doctoral committees.

Autumn 2000			
Faculty	number of promotors		
	1st	2nd	3rd
- from outside Delft	3	6	1
- Architecture	3	1	
- Civil Engineering & Geosciences	4	2	
- Information Technology & Systems	8		
- Aerospace Engineering	-		
- Design, Engineering & Production	7	3	
- Technology, Policy & Management	6	2	
- Applied Sciences	19	3	
Total: 68	50	17	1

### *Doctor's degree of promotor*

In the early period of Delft's ius promovendi research activities were relatively few, and only slowly increasing. The responsibility for this development was in the hands of the body of professors, of whom most had, understandably, not obtained a doctor's degree themselves. Many of those who did have a doctor's title came from outside the field of engineering. Their contribution was indispensable for the broadening and founding of engineering sciences. Comparing both periods, the percentage of promotors not having the doctor's title went down from 27% to 10%. The percentage of promotors not being engineer themselves changed only little, from 43% to 38%. It should be realized that in both groups some professors appear as promotor more than once. Of the early group professor dr.ir. J. Böeseken had a share of nine doctorates. End 2000 the contributions were more equal, in the sense that in the latter group only three professors acted twice as promotor.

Academic titles of promotor:

	1906-1916	Autumn 2000
Dr.Ir.	19	35
Dr. otherwise	18	26
Ir.	10	7
Other	4	-
Total:	51	68

*Composition of doctoral committees*

The responsibilities and composition of doctoral committees are laid down in the Doctoral Regulations of the University. In the beginning period a doctoral committee consisted of Delft professors only, and most of them came from the Department of the promotor. In modern times it is not unusual that some members are not (full) professor and that members also come from other universities, often from abroad. Since 1988 in Delft the role of 'adjunct promotor' was created for those who actively coached a doctoral study but had not the rank of professor (though in international comparison their rank is 'associate professor').

Number of members of Doctoral Committees

	1906-1916	autumn 2000
6	-	1
7	10	10
8	19	38
9	16	1
10	4	-
11	1	-
Total:	50	50

The most common size of the doctoral committee remains eight. The acting Rector Magnificus, chairing the ceremony, is included in this number. In the old period it used to be the Rector himself, whereas in the last decades it usually is a member of the 'Committee for substituting the Rector during doctoral ceremonies'. In recent days the composition of the doctoral committees does vary quite a bit. In the most common composition (ten times) there are two members from outside Delft, but not from universities abroad. It also occurs (18 times) that all outside members are from foreign universities. For the total of these fifty doctorates we count 389 committee members, of whom 105 come from outside

Delft University of Technology and of these guests 49 come from abroad. Sometimes guests also come from research institutes outside universities, from industry or governmental agencies. In those cases a doctor's title is required for participating in doctoral committees and ceremonies. In general, the compositions of the doctoral committees reflects the open, international and multidisciplinary character of modern doctoral studies.

Composition doctoral committees Autumn 2000:		
Number of Doctoral Committees	members from outside Delft	members from a foreign university
1	-	-
3	1	-
7	1	1
10	2	-
5	2	1
9	2	2
2	3	-
5	3	1
4	3	2
2	3	3
1	4	-
1	4	2
50		

## Summary of the comparisons

The preceding exercise demonstrates that, on the one hand, the doctorates in Delft remained similar in many respects. The exercise was based on juxtaposition of two groups of fifty doctorates each, one from the decade 1906-'16 and the other from the autumn of 2000. In the recent period we have seen a broader variety of the scientific areas covered by the theses, a wider diversity in the prior degrees and also a substantial number of doctoral students coming from abroad. On the average, 'young doctors' are four years older when obtaining the doctor's degree. Also the number of women obtaining a doctor's title is increasing. As far as language is concerned, the shift from Dutch to English is remarkable, see Figure 7. There is not much change in the average number of pages of dissertations, but there is a substantial increase in tables, graphs and illustrations. Nowadays the distribution of copies is much wider and larger. The number of literature references has grown considerably and their place changes from footnotes to a bibliography at the end of the

thesis or chapters. A recent phenomenon is to include, as chapters in the thesis, articles published elsewhere. In the old group the number of additional propositions tended to be larger. Recently, the dual promotorship occurs rather frequently and the position of an adjunct promotor has also been introduced. At the beginning of the 20th century it occurred more frequently that a promotor bore no doctor's title himself. The percentage of promotors not being engineer stayed at around 40 per cent. Changes may be found in the composition of the doctoral committees: more non-professors, more guests from outside Delft University and from abroad. The doctoral study, and also the ceremony, have become more international and it is supported by members of a world-wide, specific network. The doctoral study has also become a full-time job for the doctoral students, rather than a part-time job. The preparation of a thesis has on the average increased from four to five years. The impression suggests itself that in the course of a century the doctorate at Delft, its admission as well as the recognition of the doctor being a full-fledged researcher, has maintained its indisputably high quality.

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**Extract from the register of doctorates at Delft  
University of Technology 1906 through 2001**

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Each item of the following list mentions the full name of the doctor, the title of the thesis, a subject classification code, the date of the thesis defence and the name(s) of the promotor(s) and concludes with the predicate "cum laude", whenever conferred.

A list of the subject classification codes follows.

SCGE Sciences - General

MATH Mathematics & Theoretical Mechanics

INFO Informatics & Computer Science

PHYS Physics & Astronomy

ELEC Electrical Engineering & Electronics

MATE Materials Science

CHEM Chemistry & Chemical Engineering

LIFE Environmental & Life Sciences

ENER Energy

MECH Mechanical Engineering

MARI Maritime Engineering

AERO Aerospace Engineering

GEOD Geodesy

GEOS Geoscience

CIVI Civil Engineering

ARCH Architecture & Urban Planning

IDEE Industrial Design Engineering

ADMI Administration & Management

HASS Humanities, Arts & Social Sciences

- 1 Nicolaas Louis Söhngen, Het ontstaan en het verdwijnen van waterstof en methaan onder den invloed van het organische leven, LIFE, 1906.07.06, cum laude, *prof.dr.ir. M.W. Beijerinck*
- 2 E.H.M. Beekman, Geschiedenis der systematische mineralogie, GEOS, 1906.11.15, *prof.dr. G.A.F. Molengraaff*
- 3 Frédéric Constant Huygen, Over de exhaustwerking bij locomotieven, MECH, 1907.03.26, cum laude, *prof.ir. I. Franco*
- 4 Gerard de Gelder, De berekening, de bouw en het bedrijf van het kabelnet der gemeente Amsterdam, ELEC, 1907.06.20, *prof.ir. C. Feldmann*
- 5 Gerrit van Iterson jr., Mathematische und mikroskopisch-anatomische Studien über Blattstellungen nebst Betrachtungen über den Schalenbau der Miliolinen, LIFE, 1907.07.10, cum laude, *prof.dr.ir. M.W. Beijerinck*
- 6 Jan Karel van Gelder, Over de toepassing van de centrifugaalkracht voor de scheiding en zuivering van erts en kolen, GEOS, 1908.04.02, *prof.ir. C.J. van Loon*
- 7 Nicolaas Koomans, Over den invloed der zelfinductie in telephoongeledingen, ELEC, 1908.04.10, *prof.ir. C.L. van der Bilt*
- 8 Pieter Tesch, Der Niederländische Boden und die Ablagerungen des Rheines und der Maas aus der jüngeren Tertiär- und der älteren Diluvialzeit, GEOS, 1908.10.26, *prof.dr. G.A.F. Molengraaff*
- 9 Pieter Nicolaas Degens, Legeeringen van tin en lood, MATE, 1908.11.23, *prof.dr. W. Reinders*
- 10 Jan Willem van Dijk, Parallelbedrijf van Wisselstroombomachines, ELEC, 1909.06.25, *prof.ir. C. Feldmann*
- 11 Abraham Wijnberg, Over rietwas en de mogelijkheid zijner technische gewinnung, LIFE, 1909.06.28, cum laude, *prof.dr.ir. G. van Iterson*
- 12 Frits Fontein, Onderzoeken in verband met de afscheiding van foezelolie uit alcoholische vloeistoffen, CHEM, 1909.10.22, cum laude, *prof.dr. L. Aronstein*
- 13 Josef Ignaz Julius Maria Schmutz, Bijdrage tot de kennis der postcenomane hypoabyssische en effusieve gesteenten van het westelijk Müller-gebergte in Centraal-Borneo, GEOS, 1910.01.26, cum laude, *prof.ir. J.A. Grutterink*
- 14 Johan Francois Barthold van Hasselt, Bijdrage tot de kennis der constitutie van het bixine, CHEM, 1910.05.30, cum laude, *prof.dr.ir. J. Böeseken*
- 15 Egbert Cornelis Nicolaas van Hoepen, De bouw van het Siluur van Gotland, GEOS, 1910.06.24, cum laude, *prof.dr. H.G. Jonker*
- 16 Hendrik Albertus Brouwer, Oorsprong en samenstelling der Transvaalsche nepheliensyenieten, GEOS, 1910.10.12, cum laude, *prof.dr. G.A.F. Molengraaff*
- 17 Bernard Willem van Eldik Thieme, Het laurinezuur en de laurinen, CHEM, 1911.02.20, cum laude, *prof.dr.ir. J. Böeseken*
- 18 Theodorus van der Waerden, Geschooldheid en techniek. Onderzoek naar den invloed van arbeidssplitsing en machinerie op de mate van vereischte oefening en bekwaamheid der arbeiders, HASS, 1911.03.29, *prof.mr. D. van Blom*
- 19 Wilhelm Jacques Franck, Somarische kern- en celdeeling en microsporogenese bij het suikerriet, LIFE, 1911.04.27, *prof.dr.ir. G. van Iterson*

- 20 **Willem Meyeringh**, Studie over de factoren op het vochtgehalte der boter van invloed, CHEM. 1911.06.24, *prof.dr. W. Reinders*
- 21 **Abraham Louis Willem Eduard van der Veen**, Physisch en kristallografisch onderzoek naar de symmetrie van diamant, CHEM. 1911.07.07, *prof.ir. J.A. Grutterink*, *prof.dr. M. de Haas*
- 22 **Ludolph Reinier Wentholt**, Stranden en strandverdediging, CIVI. 1912.02.15, *prof.ir. W.K. Behrens*
- 23 **Jeanne Egbertine van Amstel**, De temperatuursinvloed op physiologische processen der alcoholgist, CHEM. 1912.03.29, cum laude, *prof.dr.ir. G. van Iterson*
- 24 **Paulus Martinus Verhoeckx**, Proeve eenen theorie van het roteerend magnetisch veld, ELEC. 1912.04.22, cum laude, *prof.ir. J.A. Snijders*, *prof.dr. G. Schouten*
- 25 **Johann Gerhard Wilhelm Sieger**, Het aethyleren van chloorbenzol, CHEM. 1912.06.20, *prof.dr.ir. J. Böeseken*
- 26 **Hendrik Jacobus Prins**, Bijdrage tot de kennis der katalyse. De katalytische werking van aluminiumhalogeniden, CHEM. 1912.10.23, *prof.dr.ir. J. Böeseken*
- 27 **Hein Israël Waterman**, Over eenige factoren, die de ontwikkeling van Penicillium glaucum beïnvloeden, CHEM. 1913.01.20, cum laude, *prof.dr.ir. J. Böeseken*
- 28 **Simon Cornelis Johannes Olivier**, Snelheidsmetingen bij de reactie van Friedel en Crafts, CHEM. 1913.02.03, cum laude, *prof.dr.ir. J. Böeseken*
- 29 **Johan Herman Adolf Haarman**, Hoekijzerverbindingen in het bijzonder die der langs- aan dwarsdragers in bruggen, CIVI. 1913.02.24, *prof.ir. J. Klapper*
- 30 **Willem Barent Peteri**, Overheidsbemoeiingen met stedegebouw tot aan den vrede van Munster, ADMI. 1913.06.14, *prof.mr.dr. J.H. Valkenier Kips*
- 31 **Willem Carel Klein**, Tektonische und stratigraphische Beobachtungen am Südwestrande des Limburgischen Kohlenreviers, GEOS. 1913.06.24, cum laude, *prof.dr. H.G. Jonker*
- 32 **Jan van Hettinga Tromp**, Het sociale arbeidscontract. Beschouwingen over de bemoeiing van de Overheid met arbeidsvoorwaarden, in verband met de praktijk van het Amsterdamsche Werklieden-Reglement, ADMI. 1913.06.28, *prof.mr. D. van Blom*
- 33 **Nicolaas Jacobus Aloysius Taverne**, De oxydatie en de polymerisatie van sojaolie, CHEM. 1913.11.03, *prof.dr. A.M.A.A. Steger*
- 34 **Jan Rueb**, Over het verwerken van tinersten, GEOS. 1913.11.05, cum laude, *prof.ir. S.J. Vermaes*
- 35 **Albert Jan Kluyver**, Biochemische suikerbepalingen, CHEM. 1914.05.15, cum laude, *prof.dr.ir. G. van Iterson*
- 36 **Johan August Heymann**, De voeding der oester, LIFE. 1914.05.20, *prof.dr.ir. M.W. Beijerinck*
- 37 **Emile Benjamin Wolff**, Temperatuurmetingen in een dieselmotor, MECH. 1914.06.05, *prof. P. Meyer*
- 38 **Jan Arnoldus Schouten**, Grundlagen der Vektor - und Affinoranalysis, MATH. 1914.06.17, cum laude, *prof.dr.ir. J. Cardinaal*
- 39 **Jan Daniël Ruys**, Drinkwaterreiniging met hypochlorieten, LIFE. 1914.06.23, *prof.dr. J.G. Sleeswijk*

- 40 Cornelis Johan van Nieuwenburg,** De stabiliteit der mercuriohalogeniden, CHEM, 1914.10.16, *prof.dr. W. Reinders*
- 41 Pieter Eduard Verkade,** Hydratatie van organische zuuranhydrieden, CHEM, 1915.03.05, cum laude, *prof.dr.ir. J. Böseken*
- 42 Willem David Cohen,** Reductie van aromatische ketonen, CHEM, 1915.03.19, *prof.dr.ir. J. Böseken*
- 43 Felix Andries Vening Meinesz,** Bijdragen tot de theorie der slingerwaarnemingen, MATH, 1915.03.26, cum laude, *prof.dr.ir. J. Cardinaal*
- 44 Louis Guillaume den Berger,** Landbouwscheikundig onderzoekingen omtrent de irrigatie op Java, LIFE, 1915.10.13, *prof.dr. W. Reinders*
- 45 Jan Versluys,** De capillaire werkingen in den bodem, GEOS, 1916.02.16, cum laude, *prof.dr. M. de Haas*
- 46 Frans Goudriaan,** Dissociatie-evenwichten in het stelsel metaal-zwavelzuurstof. Bijdrage tot de theorie der roostprocessen, CHEM, 1916.05.11, cum laude, *prof.dr. W. Reinders*
- 47 Cornelis Johannes de Groot,** Radio-telegrafie in de tropen, ELEC, 1916.06.05, cum laude, *prof.ir. C.L. van der Bilt*
- 48 Rudolf Adriaan Weerman,** Over de inwerking van natriumhypochloriet op amiden van onverzadigde zuren en oxyzuren, CHEM, 1916.07.07, cum laude, *prof.dr.ir. J. Böseken*
- 49 Arnold van Rossem,** Bijdrage tot de kennis van het vulcanisatieproces, CHEM, 1916.09.29, cum laude, *prof.dr.ir. G. van Iterson*
- 50 Christiaan Theodoor Groothoff,** De primaire tinertsafzettingen van Billiton, GEOS, 1916.10.27, *prof.dr. G.A.F. Molengraaff*
- 51 Arie Korevaar,** Studies over het mechanisme van het hydreren, CHEM, 1917.06.01, cum laude, *prof.dr. A.M.A.A. Steger*
- 52 Willem Frederik Gisolf,** Beschrijving van een microscopisch onderzoek van gabbro's en amfibolieten, herkomstig van Midden-Celebes, GEOS, 1917.06.26, *prof.ir. J.A. Grutterink*
- 53 Lodewijk Hamburger,** Over lichtemissie door gassen en mengsels van gassen bij elektrische ontladingen, CHEM, 1917.07.04, cum laude, *prof.dr. W. Reinders, prof.dr. L.H. Siertsema*
- 54 Johan Philip Pfeiffer,** De waarde van wetenschappelijk onderzoek voor de vaststelling van technische eigenschappen van hout, CHEM, 1917.09.14, cum laude, *prof.dr.ir. G. van Iterson*
- 55 August Louis van Scherpenberg,** Onderzoeken naar de constitutie van het euxanthoogeen, de moederstof van het Indisch geel, CHEM, 1918.06.21, *prof.dr.ir. G. van Iterson*
- 56 Pieter Persant Snoep,** Technisch-hygiënische beschouwingen over de economie van den industrieelen arbeid, HAS, 1918.11.08, *prof.dr. J.G. Sleeswijk, prof.dr. J.G.C. Volmer*
- 57 Ursul Philip Lely,** Waarschijnlijkheidsrekening bij automatische telefonie, MATH, 1918.11.22, cum laude, *prof.dr. F. Schuh*
- 58 George Egbert Moeffelman,** De acetyleering van nitrophenolen onder den invloed van eenige katalysatoren, CHEM, 1919.05.02, *prof.dr.ir. J. Böseken*
- 59 Christiaan van Loon,** Stereochemie der cyclopentaan- en der hydrindeen-1,2-dioolen, CHEM, 1919.07.04, cum laude, *prof.dr.ir. J. Böseken*

**60 Johanna Hendrika Maria Manders**, Application of direct analysis to pulsating and oscillating phenomena, ELEC, 1919.07.07, cum laude, *prof.dr.ir. J.A. Schouten, prof.ir. C. Feldmann*

**61 Adriaan Willem Coster van Voorhout**, Condensatie producten van phenol en formaldehyde, CHEM, 1919.10.17, *prof.dr.ir. J. Böeseken*

**62 Frederik Ernst van Haeften**, De bereiding van de trichloornitro- en de trinitrobenzolen en de inwerking van natriummethylaat daarop, CHEM, 1920.04.15, *prof.dr.ir. J. Böeseken*

**63 Willem Martinus Meijer**, De stoomturbine als voortstuwingswerkruig voor koopvaardijschepen, MECH, 1920.06.23, *prof.ir. J.C. Dijxhoorn, prof.dr. M. de Haas Kips*

**64 Hendrik Gerrit van Beusekom**, Beschouwingen over den woningnood, HASS, 1920.06.24, *prof.mr.dr. J.H. Valckenier*

**65 Charles Edward Adrianus Maitland**, Staatstelefoon-exploitatie, ELEC, 1920.06.25, *prof.ir. C.L. van der Bilt, prof.dr. J.G.C. Vöhner*

**66 Jacob Pohlmann**, De scheikunde der eiwitten en de physiologische polypeptidensythese, LIFE, 1920.07.05, *prof.dr. J.G. Sleeswijk*

**67 Cornelis Willem Lely**, De invloed van de Zuiderzee op de stormvloedstanden langs de Friesche kust, CIVI, 1921.02.21, cum laude, *prof.ir. G.H. Vries Broekman*

**68 Hendricus Couvert, De configuratie van eenige suikers**, CHEM, 1921.02.22, *prof.dr.ir. J. Böeseken*

**69 Frederik Charles Gerretsen**, Een onderzoek naar de nitrificatie en denitrificatie in tropische gronden, LIFE, 1921.02.24, *prof.dr.ir. M.W. Beijerinck, prof.dr. W. Reinders*

**70 Jan Joachim Borren**, Een nieuwe methode ter bepaling van grootte en richting der stroomsnelheid van vloeistoffen; beschouwingen over de verschijnselen in de doode ruimte van een centrifugaalpomp, MECH, 1921.05.18, *prof.ir. J.C. Dijxhoorn, prof.dr. J.M. Burgers*

**71 Frederik Willem Hisschemöller**, De evenwichten der permutieten, CHEM, 1921.06.09, *prof.dr. F.E.C. Scheffer*

**72 Carel Willem Schonebaum**, Ozoniseren van fabrieksproducten der suiker-industrie, CHEM, 1921.11.16, *prof.dr.ir. H.I. Waterman*

**73 Popko van Groningen**, Evenwichten in de stelsels ijzer-koolstof-zuurstof en ijzer-waterstof-zuurstof, CHEM, 1921.12.21, *prof.dr. W. Reinders*

**74 Emile van Thiel**, Acetyleringen met azijnzuuranhydried onder invloed van katalysatoren, CHEM, 1922.03.24, *prof.dr.ir. J. Böeseken*

**75 Henri George Derkx**, Bijdrage tot de kennis van den ruimtelijken bouw van atoomringsystemen, CHEM, 1922.05.10, cum laude, *prof.dr.ir. J. Böeseken*

**76 Frans Cornelis van Heurn**, De gronden van het cultuurgebied van Sumatra's Oostkust en hunne vruchtbaarheid voor cultuurgewassen, LIFE, 1922.07.03, *prof.dr.ir. G. van Iterson*

- 77 Han Tiauw Tjong, De industrialisatie van China, HASS, 1922.09.13, cum laude, *prof.mr.dr. J.H. Valckenier Kips*
- 78 Jan Goudriaan jr., De doelmatigheid van de Amsterdamsche broodvoorziening, HASS, 1922.11.17, cum laude, *prof.dr. J.G.C. Volmer, prof.ir. I.P. de Vooy*
- 79 Carl Adolph Hugo von Wolzogen Kühr, Onderzoeken aangaande de mikroflora aanwezig in normaal en serechziek suikerriet, LIFE, 1923.06.06, *prof.dr. A.J. Kluyver*
- 80 Frederik Jan Nellensteyn, Bereiding en constitutie van asphalt, CHEM, 1923.07.05, *prof.dr.ir. H.I. Waterman*
- 81 Jacob Heslinga, Onderzoeken over de quantitatieve bepaling van chloor, broom en jodium in organische verbindingen, CHEM, 1923.09.12, *prof.ir. H. ter Meulen*
- 82 Johannes Fredericus Bertram, IJzeren ophaalbruggen, CIVI, 1923.09.14, *prof.ir. N.C. Kist*
- 83 Wilhelm Heinrich Hetzel, Bijdrage tot de geologie van de Sierra Alhamilla (provincie Almeria), GEOS, 1923.10.10, *prof.dr. G.A.F. Molengraaff, prof.dr.ir. H.A. Brouwer*
- 84 Hendrina Johanna de Wijs, Samenstelling en bestendigheid van eenige metaal-ammoniakionen, CHEM, 1923.10.16, *prof.dr. F.E.C. Scheffer*
- 85 Samuel Isidoor Vles, Reactiesnelheid van zuurstof met oplossingen van eenige anorganische zouten, CHEM, 1924.01.25, cum laude, *prof.dr. W. Reinders*
- 86 Petrus Hendrik Hermans, Onderzoek naar de ruimtelijke configuratie van enkele glykolen; een kritiese beschouwing over de betekenis der boorzuur- en acetonverbindingen voor de stereochemie, CHEM, 1924.03.19, cum laude, *prof.dr.ir. J. Böseken*
- 87 Dirk Frederik Slothouwer, Bouwkunst der Nederlandsche renaissance in Denemarken, ARCH, 1924.03.26, *prof.ir. J.A.G. van der Steur*
- 88 Maximiliaan Lodewijk van der Schaaff, Critische beschouwingen betreffende de wettelijke bepalingen tot bescherming van den industrielen eigendom, meer in het bijzonder in Nederland, ADMI, 1924.05.14, *prof.mr.dr. J.A. Veraart*
- 89 Jacobus Meulenhoff, Bijdrage tot de kennis van organische boriumverbindingen, CHEM, 1924.05.21, *prof.dr.ir. J. Böseken*
- 90 Hijman Limburg, Onderzoeken over emulsies, CHEM, 1924.06.11, *prof.dr. W. Reinders*
- 91 Jan Coops jr., De stereoisomerie der wijnsteenzuren in verband met de complexvorming met boorzuur, CHEM, 1924.06.18, cum laude, *prof.dr.ir. J. Böseken*
- 92 Bernard Gerard van der Hegge Zijnen, Measurements of the velocity distribution in the boundary layer along a plane surface, MECH, 1924.10.09, *prof.dr. J.M. Burgers*
- 93 Wessel Wessel, De begrippen "werkwijze", "stof" en "voortbrengsel" in het Nederlandsche octrooirecht., ADMI, 1924.10.30, *prof.mr.dr. J.A. Verant*

- 94 Martinus Jacobus Willem Roegholt**, Het stadsgewest. Een studie over den trek naar de steden en zijn gemeentelijk-economische gevolgen, HASS, 1925.04.29, *prof.dr. J.G.C. Volmer, prof.mr.dr. J.H. Valkenier Kips*
- 95 Cornelis Pieter Adriaan Zeijlmans van Emmichoven**, Geologische onderzoeken in de Sierra de los Filabres (provincie Almeria, Spanje), GEOS, 1925.05.20, cum laude, *prof.dr.ir. H.A. Brouwer*
- 96 Hermanus Hartman**, De verbrandingswarmte van homologe en isomere dicarbozuren en dicarbonzuuranhydriden, CHEM, 1925.06.10, *prof.dr.ir. J. Böeseken*
- 97 Hubert ter Meulen**, Onderzoeken over de bepaling van zwavel in anorganische verbindingen, CHEM, 1925.06.17, cum laude, *prof.ir. H. ter Meulen*
- 98 Jeremias van Dorp**, De analyse der uitlaatgassen voor de bepaling van het luchtverbruik van een automobielmotor, MECH, 1925.06.23, *prof. P. Meyer*
- 99 Henri George Nolen**, Transformatorvelden. Een onderzoek der magnetische velden in transformatoren en van den invloed dien deze op het net uitoefenen, ELEC, 1925.07.01, cum laude, *prof.ir. C. Feldmann*
- 100 Bartholomeus Lambertus Voskuil**, Onderzoek naar de bruikbaarheid van het hoogtevliegtuig voor verkeersdoeleinden, AERO, 1925.08.26, *prof. P. Meyer, prof.dr. J.M. Burgers*
- 101 Henri Caspar Joseph Hubert Gelissen**, De constitutie der diacylperoxyden en hun betekenis voor de chemische synthese, CHEM, 1925.09.28, cum laude, *prof.dr.ir. J. Böeseken*
- 102 Willem de Visser**, Het kalandereffect en het krimpeffect van ongevulcaniseerde rubber, CHEM, 1925.10.01, cum laude, *prof.dr.ir. G. van Iterson*
- 103 George Bernard Peppelman van Kampen**, Een onderzoek naar de chemische samenstelling van vergiftige beukenenkoek, CHEM, 1925.10.07, *prof.dr.ir. J. Böeseken*
- 104 Hendrik Willem Hofstede**, Het pandanblad als grondstof voor de pandanhoedenindustrie op Java, LIFE, 1925.10.16, *prof.dr.ir. G. van Iterson*
- 105 Franciscus Visser 't Hooft**, Biochemische onderzoeken over het geslacht Actobacter, LIFE, 1925.11.03, *prof.dr. A.J. Kluyver*
- 106 Pieter Honig**, Vergelijkend onderzoek van adsorptiekolen, GEOS, 1925.11.09, cum laude, *prof.dr. W. Reinders*
- 107 Jan Hendrik Plantenga**, Les initiateurs du style baroque dans le Brabant, ARCH, 1925.11.11, cum laude, *prof.ir. J.A.G. van der Steur*
- 108 Joannes Petrus Dudok van Heel jr.**, Onderzoeken over de ontwikkeling van de anthere, van den zaadknop en van het zaad bij Beta vulgaris L, LIFE, 1925.11.20, *prof.dr.ir. G. van Iterson*
- 109 Wiebold Frans Brandsma**, Reactiesnelheden, CHEM, 1925.12.17, cum laude, *prof.dr. F.E.C. Scheffer*
- 110 Samuel Hannik**, Tectoniek van den Löwenberger-Goldberger trog, GEOS, 1926.01.22, *prof.dr.ir. H.A. Brouwer*
- 111 Marinus Floris de Bruyne**, Ontratting en desinfectie, LIFE, 1926.02.03, *prof.dr. J.G. Sleeswijk*

- 112 **Hendrikus Antonius Josephus Schoutissen**, Studies in de diazochemie, tevens als bijdragen tot het substitutieprobleem in de benzolkern, CHEM, 1926.03.19, cum laude, *prof.dr.ir. J. Böseken*
- 113 **Louis van der Heide**, Het inversiegevaar van zwavelzuur in de suikerfabricage, CHEM, 1926.03.24, *prof.dr.ir. H.I. Waterman*
- 114 **Nicolaas Jacobus Maria Taverne**, Vulkaanstudiën op Java, GEOS, 1926.04.21, *prof.dr.ir. H.A. Brouwer*
- 115 **James Meyndert William Nash**, De geologie der Grande-Chartreuseketens, GEOS, 1926.05.07, cum laude, *prof.dr.in. H.A. Brouwer*
- 116 **Hendrik Jean Louis Donker**, Bijdrage tot de kennis der boterzuur-, butylalcohol- en acetongistingen, LIFE, 1926.06.04, cum laude, *prof.dr. A.J. Kluyver*
- 117 **Charles Johannes de Wolff**, De saccharosevorming in aardappelen tijdens het drogen, LIFE, 1926.06.25, cum laude, *prof.dr.ir. H.I. Waterman*
- 118 **Gerrit van der Lee**, Onderzoeken over het vanadiumpentoxyde-sol, CHEM, 1926.07.01, cum laude, *prof.dr. W. Reinders*
- 119 **Louis Edmond den Dooren de Jong**, Bijdrage tot de kennis van het mineralisatieproces, CHEM, 1926.09.24, *prof.dr. A.J. Kluyver*
- 120 **Arthur Ferdinand August Reynhart**, Studies in de chemie der peroxyden, tevens een bijdrage tot de kennis der karalytische verschijnselen, CHEM, 1926.09.28, *prof.dr.ir. J. Böseken*
- 121 **Willem Maurits Bendien**, Bestendigheid en elektrische lading in mengsels van lyophobe en lyophile kolloiden, CHEM, 1926.11.02, *prof.dr. W. Reinders*
- 122 **Frederikus Jacobus Faber**, Bijdrage tot de geologie van Zuid-Angola (Afrika), GEOS, 1926.11.12, cum laude, *prof.dr. G.A.E. Molengraaff*
- 123 **Siegfried Leonard Langedijk**, Bijdrage tot de kennis der photochemische alcoholoxydatie, CHEM, 1926.12.13, *prof.dr.ir. J. Böseken*
- 124 **Willem Theodoor Bähler**, Theorie van het electromagnetische telefoonrelais, ELEC, 1927.01.12, cum laude, *prof.jhr.dr. G.J. Elias*
- 125 **Johannes Gerardus Weeldenburg**, De inwerking van natronloog op zwavelkoolstof, CHEM, 1927.03.28, *prof.dr.ir. J. Böseken*
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cum laude, prof.ir. H.F. Grondjys

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253 Victor Emanuel Gonsalves,  
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- 255 Pieter Nicolaas Degens, De langzame verbranding van methaan, CHEM, 1937.11.11, *prof.dr. F.E.C. Scheffer*
- 256 Elise Maria Juditha Mulders, Het systeem broom-water, CHEM, 1937.11.18, *prof.dr. F.E.C. Scheffer*
- 257 Jannis Pieter Mazure, De berekening van getijden en stormvloeden op benedenvlakken, CIVI, 1937.12.16, cum laude, *prof.dr. J.M. Burgers*
- 258 Johan Marie Furnée, Wisselwerking tussen boorzuur en de pentolen, CHEM, 1938.01.27, *prof.dr.ir. J. Böeseken*
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- 260 Frederik Johan Christiaan van der Schalk, De wiskundige-statistische analyse van de arbeidsproductiviteit en haar praktische toepassing op eenige bedrijfstakken en ondernemingen in Nederland, ADMI, 1938.02.10, *prof.mr.dr. J.A. Veraart, prof.ir. P. Landberg*
- 261 Johannes Jacobus van der Spek, Cyclische acetalen van pyrocatechol, CHEM, 1938.02.24, *prof.dr.ir. J. Böeseken*
- 262 Wilhelmus Petrus Antonius van Lammeren, Analyse der voortstuwingsscomponenten in verband met het schaaleffect bij scheepsmodelproeven, MARI, 1938.03.18, cum laude, *prof. N. Kal*
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- 272 Cornelus van Vlodrop, Katalytische hydrogeneering van vette oliën, CHEM, 1938.11.10, cum laude, *prof.dr.ir. H.I. Waterman*
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- 274 Tjalkko Willem Anton Borgesius, Enkele chemisch-technische toepassingen van tyrosine bevattende eiwitten, CHEM, 1939.02.23, *prof.dr.ir. H.I. Waterman*
- 275 Wybe Johannes Oosterkamp, Problemen bij de constructie van technische röntgenbuizen, PHYS, 1939.02.24, *prof.dr. H.B. Dorgelo*
- 276 Leendert Gerrit Verstege, Eenige bedrijfseconomische beschouwingen over de poetsmiddelenindustrie in Nederland, HASS, 1939.03.28, *prof.dr.ir. J. Goudriaan*
- 277 Zander Yske van der Meer, Het opkomen van den waterstaat als taak van het landsbestuur in de Republiek der Vereenigde Provinciën, HASS, 1939.03.30, *prof.ir. J.J. Jacobs*
- 278 Willem Bernard Kloos, Het Nationaal Plan, ARCH, 1939.05.12, *prof.mr.dr. J.A. Veraart, prof.ir. M.J. Granpré Molière*
- 279 Constant Lodewijk Marius Kerkhoven, Het tempo van arbeidsverrichtingen in de massaproductie als functie van het aantal arbeidsuren, de lengte van den werkcyclus en de samenstelling daarvan, HASS, 1939.05.25, *prof.dr.ir. J. Goudriaan*
- 280 Darey van der Want, Cellulose - Natriumhydroxyde - Water. De opname van Natriumhydroxyde en water door watten, bij loogconcentraties van 0-50%, CHEM, 1939.05.31, *prof.dr.ir. H.I. Waterman, prof.dr. W. Reinders*
- 281 Dirk Willem van Gelder, Over de stroomverdeling in electrolysecellen, CHEM, 1939.06.02, cum laude, *prof.dr. W. Reinders, prof.dr. C. Zwicker*
- 282 Clara Henderina de Minjer, Damp-vlucistofevenwichten in enige ternaire stelsels, CHEM, 1939.06.08, cum laude, *prof.dr. W. Reinders*
- 283 Koenraad Evert Stork, Eenige verschijnselen bij het onder belasting regelen van transformatoren, ELEC, 1939.06.21, *prof.dr.ir. H.G. Nolen*
- 284 Willem van Rijswijk, De samenwerking van een dieselmotor met een door een gasturbine gedreven drukvulpomp, MECH, 1939.06.30, *prof. P. Meyer*
- 285 Arnout Slooff, Het bepalen van chloor, broom en jodium in organische verbindingen door hydreering, CHEM, 1939.11.09, *prof.dr. F.E.C. Scheffer*
- 286 Dirk Willem van Krevelen, De geïnduceerde pyrolyse van methaan, CHEM, 1939.12.19, *prof.dr.ir. H.I. Waterman*
- 287 Han Hoog, De katalytische cycliseering van alifatische koolwaterstoffen, CHEM, 1940.02.13, cum laude, *prof.dr. F.E.C. Scheffer*
- 288 Jan Cornelis Louis Bernard Pet, Prijs en waarde van stedelijke bouwgrond, ARCH, 1940.03.19, *prof.mr.dr. J.A. Veraart*

- 289 **Matieu Theodoor Jozef Custers**, Onderzoeken over het gistgeslacht *Brettanomyces*, LIFE, 1940.05.03, *prof.dr. A.J. Kluyver*
- 290 **Dirk van Duyn**, Bijdrage tot de kennis van de wolfraambronzen, MATE, 1940.05.07, *prof.dr. F.E.C. Scheffer*
- 291 **Kornelis de Boer**, Stereofonische geluidsweergave, PHYS, 1941.04.10, *prof.dr. C. Zwikker*
- 292 **Herman Ebbinge**, De bereiding van titaandioxyde-pigmenten, CHEM, 1941.04.22, *prof.dr.ir. H.I. Waterman, prof.dr. W.G. Burgers*
- 293 **Willem Johannes Cornelis de Kok**, Bijdrage tot de kennis van minerale oliën, CHEM, 1941.04.22, *prof.dr.in. H.I. Waterman, prof.dr.ir. P.E. Verkade*
- 294 **Franciscus Augustinus Marie Josephus Smits van Waesberghé**, Onderzoeken over microben-amylasen, LIFE, 1941.07.28, *prof.dr. A.J. Kluyver*
- 295 **Kurt Joann Schulz**, Over den spanningstoestand in doorboorde platen. Een bijdrage tot het sterkeonderzoek van klinknaden, MECH, 1941.09.06, cum laude, *prof.dr.ir. C.B. Biezeno*
- 296 **Hendrik Cornelis Anthony van Duuren**, Typedruktelegrafie op radiooverbindingen, ELEC, 1941.12.09, *prof.dr.ir. W.Th. Bähler*
- 297 **Pieter Cornelis Lindenbergh**, Bijdrage tot oordeelkundig beheer van het duinwaterkapitaal, LIFE, 1941.12.16, cum laude, *prof.ir. C.K. Visser, prof.ir. J.T. Thijssse*
- 298 **Willem Louis Ghijsen**, Onderzoek naar het gedrag van mengsels van waterstofperoxyde en aldehyden in water, CHEM, 1942.01.29, *prof.dr. F.E.C. Scheffer*
- 299 **Aloysius Ignatius Marie Keulemans**, Isomerisatie en thermodynamische stabiliteit van koolwaterstoffen, CHEM, 1942.02.20, cum laude, *prof.dr. F.E.C. Scheffer*
- 300 **Jan Korringa**, Onderzoeken op het gebied der algebraïsche optiek, PHYS, 1942.03.13, *prof.dr. R. Kronig*
- 301 **Paulus Bastiaan Rottier**, Fluorometrische en spectrophotometrische bepaling van lactoflavine in micro-organismen, LIFE, 1942.03.20, *prof.dr. A.J. Kluyver, prof.dr. H.B. Dorgelo*
- 302 **Cornelis Willem Kosten**, Over de elastische eigenschappen van gevulcaniseerde rubber, PHYS, 1942.03.27, cum laude, *prof.dr. C. Zwikker*
- 303 **Pieter Leendert Kooijman**, De bereiding van peroxyden door oxydatie van propaan en aethaan en hun toepassing, CHEM, 1942.06.02, cum laude, *prof.dr. F.E.C. Scheffer*
- 304 **Johan Lodeijk Hendrik Jonker**, Stroomverdeeling in versterkerbuizen, ELEC, 1942.06.05, *prof.jhr.dr. G.J. Elias*
- 305 **Lambert Willem Nijboer**, Onderzoek naar den weerstand van bitumen-mineraalaggregaat mengsels tegen plastische deformatie, PHYS, 1942.07.03, *prof.dr. C. Zwikker*
- 306 **Cornelis Johannes Dionisius Maria Verhagen**, Theorie en metingen over de impedantie en de stabiliteit van gasontladingen, PHYS, 1942.10.30, *prof.dr. H.B. Dorgelo*
- 307 **Leendert Kosten**, Over blokkeerings- en wachtproblemen, MATH, 1942.12.17, cum laude, *prof.dr.ir. W.Th. Bähler, prof.dr. H. Bremekamp*

- 308 **Samuel van der Meer**, De vulcanisatie van rubber met phenolformaldehyd-derivaten, CHEM, 1943.04.15, *prof.dr.ir. A. van Rossem*
- 309 **Adelbert van Weel**, De natuurlijke gevoeligheidsgrens van radio-ontvangers voor zeer korte golflengte, ELEC, 1943.04.16, *prof.dr. C. Zwikker*
- 310 **Ernest Franz Julius Janetzky**, Onderzoeken over een synthese van indoolderivaten, CHEM, 1943.05.10, *prof.dr.ir. P.E. Verkade*
- 311 **Gerrit Jan van Amerongen**, De permeabiliteit van rubberachtige stoffen voor gassen, PHYS, 1943.05.14, *prof.dr. C. Zwikker*
- 312 **Arjen Nawijn**, Het gasontladingsmechanisme van den Geiger-Müller-teller, PHYS, 1943.05.24, *prof.dr. H.B. Dorgelo*
- 313 **Johan Hubert Egbert Hessels**, De polydispersiteit van hevea-latex, CHEM, 1943.07.05, *prof.dr.ir. A. van Rossem*
- 314 **Bastiaan Jacob Dirk Meeuse**, Oriënterende onderzoeken over de vorming van rietsuiker uit zetmeel in planten bij lage temperatuur, LIFE, 1943.07.23, cum laude, *prof.dr.ir. G. van Iterson*
- 315 **Marcel Jean Nestor Pourbaix**, Thermodynamique des solutions aqueuses diluées. Représentation graphique du rôle du pH et du potentiel, CHEM, 1945.10.31, cum laude, *prof.dr. F.E.C. Scheffer; prof.dr. W.G. Burgers*
- 316 **Matijs van der Waarden**, De adsorptie van enige gassen en hun binaire mengsels aan vaste stoffen, CHEM, 1945.11.14, *prof.dr. F.E.C. Scheffer*
- 317 **Warner Tjardus Koiter**, Over de stabiliteit van het elastisch evenwicht, MECH, 1945.11.14, cum laude, *prof.dr.ir. C.B. Biezeno*
- 318 **Cornelis Vermande**, Onderzoeken over sulfietcellulose uit stroo, LIFE, 1945.12.12, *prof.ir. E.L. Selleger*
- 319 **Adriaan van Wijngaarden**, Enige toepassingen van fourierintegralen op elastische problemen, MECH, 1945.12.12, cum laude, *prof.dr.ir. C.B. Biezeno*
- 320 **Gustaaf Schmit**, Het optreden van methaan in watergas, CHEM, 1945.12.19, *prof.dr. F.E.C. Scheffer*
- 321 **Joann Diederic Wackwitz**, Het verband tusschen arbeidsprestatie en leeftijd, HASS, 1946.01.24, *prof.dr.ir. J. Goudriaan*
- 322 **Eduard Albert Marie Fernand Dahmen**, Harden en andere omzettingen van vette oliën onder invloed van zwaveldioxyde, CHEM, 1946.01.30, cum laude, *prof.dr.ir. H.I. Waterman*
- 323 **Johan Michaël Goppel**, Quantitatieve röntgenografische onderzoeken aan rubber, PHYS, 1946.02.13, *prof.dr. H.B. Dorgelo, prof.dr.ir. A. van Rossem*
- 324 **Nico Lamme**, Bijdrage tot de kennis der synthese van koolwaterstoffen volgens Fischer-Tropsch, CHEM, 1946.02.20, *prof.dr.ir. H.I. Waterman*
- 325 **Henricus Joannes Antonius de Goeij**, Het nacopieer-effect bij belichte chromaatlagen, MATE, 1946.02.27, cum laude, *prof.dr. W.G. Burgers*

- 326 **Hendrikus Gerhardus Geelings**,  
De invloed van de atmosfeer en de  
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lasschen, MATE, 1946.03.13, prof.dr.ir. W.F.  
Brandsma
- 327 **Christiaan Pieter van Dijk**,  
Bereiding, smaak en anaesthetische  
werking van enige alkoxy-amino-  
nitrobenzenen, LIFE, 1946.04.04, cum laude,  
prof.dr.ir. P.E. Verkade
- 328 **Mathijs Hubertus Reinier  
Johannes Plusjé**, Physische-chemische  
onderzoeken over het ontsluiten van  
ruw fosfaat met salpeterzuur, CHEM,  
1946.05.22, cum laude, prof.dr. F.E.C. Scheffer
- 329 **Jacob van Slooten**, Meetkundige  
beschouwingen in verband met de theorie  
der elektrische vierpolen, MATH, 1946.05.22,  
cum laude, prof.dr. B. van den Pol, prof.dr. O.  
Bottema
- 330 **Frans Louis Henri Marie  
Stumpers**, Eenige onderzoeken over  
trillingen met frequentiemodulatie, ELEC,  
1946.05.29, prof.dr. B. van den Pol, prof.dr. H.  
Bremekamp
- 331 **Niclaas Warmoltz**, Over het  
mechanisme van den capaciteeven ontsteker  
en van den weerstandontsteker, PHYS,  
1946.05.29, prof.dr. M.J. Druyvesteyn
- 332 **Pieter Henricus Witjens**,  
Onderzoeken over de alkoxy-amino-  
nitro-benzenen, CHEM, 1946.06.20, cum  
laude, prof.dr.ir. P.E. Verkade
333. **Jan Johannes Geluk**, Galm en  
geluidsabsorptie, PHYS, 1946.07.09, prof.dr. C.  
Zwikker
- 334 **Richard Ernst Strube**,  
Onderzoeken in verband met de locaal-  
anaesthetische werking van alkoxy-  
nitroanilinen, LIFE, 1946.07.09, prof.dr.ir. P.E.  
Verkade
- 335 **Gerhard Gustav Hugh Hamm**,  
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de rotatieplastometer, MATE, 1946.07.10,  
prof.dr.ir. A. van Rossem
- 336 **Pieter Reinier Antonius Maltha**,  
Onderzoeken over de invloed van L-  
ascorbinezuur en van verbindingen met  
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G. van Iterson
- 337 **Theodorus Morel**, Een nieuwe  
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- 338 **Reinier Timman**, Beschouwingen  
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samendrukbaarheid van de lucht, AERO,  
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prof.dr. J.M. Burgers
- 339 **Jan Jacob Verschuur**, Theorie en  
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enkele soorten electromagnetische  
trillholten, ELEC, 1946.11.27, prof.dr. C.  
Zwikker
- 340 **Christianus Theodorus Fanciscus  
van der Wijck**, Uitbreidning van  
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bij inachtneming van een magnetisch veld,  
ELEC, 1946.11.27, cum laude, prof.jhr.dr. G.J.  
Elias
- 341 **Sijbrand Broersma**, Magnetic  
measurements on organic compounds,  
PHYS, 1947.01.09, cum laude, prof.dr. R. Kronig
- 342 **Jacob Hendrik Edelman**, Over de  
berekening van grondwaterstroomingen,  
CIVI, 1947.01.28, prof.in. J.T. Thijssse, prof.dr. O.  
Bottema

- 343 **Siebold Frederik Bohlken**, Bijdrage tot de bepaling van de bestendigheid van vuurvaste chamottestenen tegen desintegratie door koolmonoxyde, CHEM, 1947.01.28, *prof.dr.ir. C.J. van Nieuwenburg*
- 344 **Charles Gerardus Theodorus Petrus Schnellen**, Onderzoeken over de methaaninsting, CHEM, 1947.03.26, *prof.dr. A.J. Kluyver*
- 345 **Barend Visser**, Toeassing van de kansberekening op den regenval met het oog op polderbemaling, CIVI, 1947.04.23, *prof. J.M. Tienstra, prof.dr. O. Bottema*
- 346 **Roelof Maarten Marie Oberman**, The bridge marker key automatic switching system, ELEC, 1947.05.28, cum laude, *prof.dr.ir. W.Th. Bähler*
- 347 **Mathijs Gevers**, The relation between the power factor and the temperature coefficient of the dielectric constant of solid dielectrics, PHYS, 1947.06.04, *prof.dr. C. Zwikker*
- 348 **Bartholomeus Meindert Wepster**, Onderzoeken over sterische beïnvloeding van mesomerie, CHEM, 1947.06.04, cum laude, *prof.dr.ir. P.E. Verkade*
- 349 **Martinus Gerardus Ydo**, Plezier in het werk. Een statistisch vergelijkend onderzoek naar de mate van plezier in het werk bij het personeel van enige middelgrote, particuliere, industriële bedrijven in ons land, HASS, 1947.06.30, *prof.dr.ir. J. Goudriaan*
- 350 **Martin Jan Breuning**, Vrachtautovervoer, publiekrechtelijke regeling van het motorisch goederenvervoer langs landwegen, ADMI, 1947.07.01, *prof.mr. A.C. Josephus Jitta*
- 351 **Tchen Chan Mou**, Mean value and correlation problems connected with the motion of small particles suspended in a turbulent fluid, MECH, 1947.07.01, cum laude, *prof.dr. J.M. Burgers*
- 352 **George Arnold Maria Diepen**, De oplosbaarheid van vaste stoffen in superkritische gassen, CHEM, 1947.07.09, cum laude, *prof.dr. E.E.C. Scheffer*
- 353 **Wilhelm Götz Stephan**, Practische toeassingen op het gebied der algebraïsche optica, PHYS, 1947.09.17, *prof.dr. A.C.S. van Heel*
- 354 **Flores Helkner**, On concentric optical systems, PHYS, 1947.09.24, *prof.dr. A.C.S. van Heel*
- 355 **Tjoeng Tin Fong**, Arbeidstoestanden en arbeidsbescherming in Indonesië, HASS, 1947.10.16, *prof.mr.d. J.A. Veruurt*
- 356 **Nicolaas Daniël Rudolph Schaafsma**, De verwijdering van organische stoffen uit oppervlaktewater, in het bijzonder uit veenwater in Nederlands-Indië, LIFE, 1947.10.23, *prof.dr.ir. H.L. Waterman*
- 357 **Johannes Adrianus Haringx**, Over sterk samendrukbare schroefveren en rubberstaven en over hun toepassing bij trillingsvrije opstellingen, MECH, 1947.12.10, cum laude, *prof.dr.ir. C.B. Biezeno*
- 358 **Geldolph Adriaan Kohnstamm**, De toekomst van Nederlands industriële ontwikkeling, een technisch-economische studie, HASS, 1947.12.10, cum laude, *prof.mr.d. J.A. Veruurt*
- 359 **Johan Hendrik Greidanus**, De belasting van vliegtuigen door symmetrische remousstooten, AERO, 1947.12.17, cum laude, *prof.dr.ir. H.J. van der Maas*

- 360 Jan Visman**, De monsterneming van heterogene binomiale korrelmengsels, in het bijzonder steenkool, GEOS, 1947.12.17, *prof.ir. C.L. van Nes, prof.dr. S.C. van Veen*
- 361 Marcel Gérard Diehl**, Beschouwingen over bimetaal met betrekking tot zijn toepassing in thermische maximumrelais, ELEC, 1948.04.14, *prof.dr.ir. H.S. Hallo*
- 362 Arend Maarten Haas**, De berekening van paddestoelyloceren, CIVI, 1948.04.14, *prof.ir. P.P. Bijlaard*
- 363 Hendrik Antonie Leniger**, De technologie van het verflenssen van theeblad, LIFE, 1948.06.09, cum laude, *prof.dr.ir. G. van Iterson*
- 364 Willem Marcus du Chatel**, Rente en afschrijving als functie van de netto-opbrengst. Beschouwingen over het vraagstuk van de afschrijving, HASS, 1948.06.23, *prof.dr.ir. J. Goudriaan*
- 365 Godfried Johan van der Bie**, Koperverbindingen in latex en rubber en hun invloed op de duurzaamheid, CHEM, 1948.07.07, *prof.dr.ir. A. van Rossem*
- 366 Dirk Roelof Kreger**, An X-Ray Study of Waxy Coatings from Plants, LIFE, 1948.07.07, cum laude, *prof.dr.ir. G. van Iterson, prof.dr. H.B. Dorgelo*
- 367 Wilhelm Petrus Robbertse**, Over de verdichtings- en verdunningsverschijnselen in een gas veroorzaakt door de stoot van een zuiger met zeer hoge snelheid, MECH, 1948.10.20, *prof.dr. J.M. Burgers, prof.dr. S.C. van Veen*
- 368 Paul Wintgens**, Slaand boren met hardmetaal, MECH, 1948.10.20, *prof.ir. C.L. van Nes*
- 369 Anton Dammes de Pater**, Inleidend onderzoek naar het dynamisch gedrag van spoorstaven, MECH, 1948.11.10, *prof.dr.ir. C.B. Biezeno*
- 370 Gerrit Feiko Janssonius**, Nieuwe vereffeningsmethoden voor het berekenen van balkroosters, CIVI, 1948.11.10, *prof.ir. P.P. Bijlaard, prof.ir. C.G.J. Vreedenburgh*
- 371 Hendrik Adolf Lauwerier**, Axiomatische onderzoeken over de vlakke meetkunde, PHYS, 1948.11.24, *prof.dr. O. Bottema*
- 372 Hendrik Johannes Selling**, Enige toepassingen van de spectrofotometrie en colorimetrie in de textiel- en papierindustrie, PHYS, 1949.03.23, *prof.dr. A.C.S. van Heel*
- 373 Johannes Gerardus Niesten**, Het registreren van polaire diagrammen van harmonische grootheden met behulp van electronenstraalsoscillograaf en camera, speciaal met betrekking tot de opname van polaire stroomfiguren aan asynchrone drailstroommachines, ELEC, 1949.04.13, *prof.ir. M. de Lange*
- 374 Hendrik Mol**, Theorie van de wisselstroombel, ELEC, 1949.05.25, *prof.dr.ir. W.Th. Bähler*
- 375 Charles Thomas Nix**, Bijdrage tot de vormleer van de stedebouw in het bijzonder voor Indonesië, ARCH, 1949.06.22, *prof.ir. M.J. Granpré Mollière*
- 376 Charles Eduard Marie de Kuijper**, Bijdrage tot de berekening van de spreidingsreactantie van transformatoren en van de krachten welke op de wikkelingen van transformatoren werken, ELEC, 1949.11.09, cum laude, *prof.dr.ir. H.G. Nolen*

- 377 **Engelbert Wiegman van Heuven**, Acoustical measurements on church-bells and carillons, PHYS, 1949.12.21, prof.dr. M.J. Druyvesteyn
- 378 **Jakob Tjakko Groenman**, Behandeling van de koppelkromme met behulp van isotrope coördinaten, MATH, 1950.02.22, prof.dr. O. Bottema
- 379 **Eugène Henri François van der Lely**, Een bijdrage tot de economische betrekenis van het energieverbruik. Een technisch-economische studie, ENER, 1950.02.22, prof.mr.dr. J.A. Veraart
- 380 **Willem May**, Röntgenografisch onderzoek van aluminiumkristallen, ontstaan door rekristallisatie, MATE, 1950.06.07, prof.dr. W.G. Burgers
- 381 **Cornelis Emilius Mulders**, Ultrasone nagalmmetingen in vloeistoffen, PHYS, 1950.06.07, prof.dr. R. Kronig
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Evenwichten bij hoge druk tussen fluide phasen in binaire en ternaire systemen met ont menging, CHEM, 1951.11.28, cum laude, *prof.dr. F.E.C. Scheffer*

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- 3776 Johannes Jacobus Graaff,** Designing interactive systems, INFO, 2001.11.19, *prof.dr. H.G. Sol*
- 3777 Anke Marja Berends,** Development of supported liquid membrane extraction processes for slurry treatment, MECH, 2001.11.20, *prof.dr. G.J. Witkamp*
- 3778 Jan Marinus Verhelst,** Model evaluation and dynamics of a viscoelastic flow in a complex geometry, MECH, 2001.11.20, *prof.dr.ir. F.T.M. Nieuwstadt*
- 3779 Jacob Johan Piet,** Excitonic interactions in multichromophoric arrays, CHEM, 2001.11.20, *prof.dr.ir. A.H.M. Verkooijen*
- 3780 Ioannis Patras,** Object based video segmentation with region-labeling, ELEC, 2001.11.26, *prof.dr.ir. R.L. Lagendijk*
- 3781 Ewout Kemner,** Organometallics in confined geometries: Ferrocene in zeolite Y, PHYS, 2001.11.26, *prof.dr. G.J. Kearley, prof.dr. I.M. de Schepper*
- 3782 Bartholomeus Hendrikus Maria Gerritsen,** Using weighted alpha complexes in subsurface modelling, MECH, 2001.11.26, *prof.dr.ir. K. van der Werff, prof.dr.ir. J.T. Fokkema*
- 3783 Jeroen Leonardus den Hollander,** Liquid-liquid chromatographic systems for enzymatic reactors, LIFE, 2001.11.27, *prof.dr.ir. L.A.M. van der Wielen, prof.ir. K.C.A.M. Luyben*
- 3784 Richard Quint van der Linde,** Bipedal walking active springs, gait synthesis & prototype, MECH, 2001.11.27, cum laude, *prof.dr.ir. H.G. Stassen, prof.dr. F.C.T. van der Helm*

**3785 Justus Laurens Herder**, Energy-free systems, MECH, 2001.11.27, cum laude, *prof.ir. J.C. Cool*

**3786 Jeroen Chritiaan Martijn Goudswaard**, Multi-angle multi-scale analysis of seismic reflection data, GEOS, 2001.12.03, *prof.dr.ir. C.P.A. Wapenaar, prof.dr.ir. J.T. Fokkema*

**3787 Gerd-Jan ten Brink,, Green catalytic oxidations**, CHEM, 2001.12.03, cum laude, *prof.dr. R.A. Sheldon*

**3788 Wieke Blok**, Chains and Networks in Multimodal Passenger Transport. Exploring a design approach, INFO, 2001.12.03, *prof.dr. H.G. Sol*

**3789 Hendrik Willem Christiaan Postma**, Carbon nanotube junctions and devices, PHYS, 2001.12.04, *prof.dr. C. Dekker*

**3790 Renate Gerarda Klaassen**, The international university curriculum: challenges in English-medium engineering education, HASS, 2001.12.04, *prof.dr. W. Veen, prof.dr. W. Herrlitz*

**3791 Sjoerd Jan Gelsema**, Advanced  $\gamma$ -ray spectrometry dealing with coincidence and attenuation effects, PHYS, 2001.12.04, *prof.dr.ir. J.J.M. de Goeij, prof.dr.ir. C.W.E. van Eijk*

**3792 Iulian Apachitei**, Synthesis and characterization of composite autocatalytic nickel coatings on aluminium, MATE, 2001.12.07, *prof.ir. L. Katgerman*

**3793 Matheo Joseph Rooden**, Design models for anticipating future usage, IDEE, 2001.12.10, *prof. W.S. Green, prof. J.R. Wilson*

**3794 Daniël Verkoeijen**, The measurement and modeling of granulation processes - a turbo view, MATE, 2001.12.10, *prof. M.Sc. B. Scarlett*

**3795 Sjirk Holger Koekebakker**, Model based control of flight simulator motion systems, MECH, 2001.12.10, *prof.ir. O.H. Bosgra*

**3796 Gerhard Jan Gelderblom**, User cognition in product operation, IDEE, 2001.12.11, *prof. W.S. Green, prof.dr. W.A. Wagenaar*

**3797 Jan Rijn Zeevaart**, Metal ion speciation in blood plasma as a tool in predicting in vivo behaviour of potential bone seeking radio-pharmaceuticals, LIFE, 2001.12.11, *prof.dr.ir. J.J.M. de Goeij*

**3798 Zhenhua Ma**, Measurement of particle size and shape by laser light scattering, MATE, 2001.12.11, *prof. M.Sc. B. Scarlett*

**3799 Hendrik Jacobus Arie Breur**, Fouling and bioprotection of metals, MATE, 2001.12.14, *prof.dr. J.H.W. de Wit, prof.dr.ir. J. van Turnhout*

**3800 Jorg Wilfred Janssen**, Spatially resolved spectroscopy of carbon nanotubes, PHYS, 2001.12.14, *prof.dr.ir. L.R. Kouwenhoven, prof.dr. C. Dekker*

**3801 Dick de Ridder**, Adaptive methods of image processing, PHYS, 2001.12.14, *prof.dr.ir. L.J. van Vliet*

**3802 Otto Matthäus Heeres**, Modern strategies for the computational modelling of the cyclic and transient behaviour of soils, CIVI, 2001.12.17, *prof.dr.ir. R. de Bont*

**3803 Eelco Luc Jansen**, Nonlinear vibrations of anisotropic cylindrical shells, AERO, 2001.12.17, *prof.dr. J. Arbocz*

**3804 Richard Johannes Matheus Janssen**, Structure and shear in a cohesive powder, MATE, 2001.12.17, *prof. M.Sc. B. Scarlett.*

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**Extract from the register of honorary doctorates**

Each item of the following list mentions the name of the honorary doctor, the date of the decree awarding the doctorate, the preamble (in Dutch), the date of awarding the doctorate honoris causa, the name of the appointed promotor and other relevant data.

[1] **A. Kuyper**

1906.12.19: wegens zijn uitstekende verdiensten, welke zijn gelegen in zijne handelingen als minister en (welke) ten voordeel strekken van de geheele Technische Hoogeschool. *1907.01.08*, Prof.dr. S. Hoogewerff, (Ing. 22 (1907) no.2 blz. 29-30)

[2] **J. Bosscha**

1906.12.19: wegens zijne zeer uitstekende verdiensten als natuuronderzoeker, ... als voortreffelijk leermeester in de toegepaste natuurkunde ... en als voorbereider ... van plannen tot uitbreidung en verbetering van het technisch onderwijs. *1907.01.08*, Prof.dr. S. Hoogewerff, (Ing. 22(1907) no.2 blz. 30-31)

[3] **G. van Diesen**

1906.12.19: wegens zijne buitengewone verdiensten op technisch-wetenschappelijk gebied en als uitvoerend ingenieur. *1907.01.08*, Prof.ir. S.G. Everts, (Ing. 22 (1907) no.3 blz. 59)

[4] **C. Lely**

1906.12.19: wegens zijne buitengewone verdiensten als ingenieur, ten opzichte van de ontwikkeling der verkeersmiddelen in Nederland en zijne koloniën, en op het gebied der sociaaltechnische wergeving. *1907.01.08*, Prof.ir. S.G. Everts, (Ing. 22 (1907) no.3 blz. 59-60)

[5] **J. Kraus**

1906.12.19: wegens zijne buitengewone verdiensten als ingenieur en ten opzichte van het hooger technisch onderwijs. *1907.01.08*, Prof.ir. S.G. Everts, (Ing. 22 (1907) no.3 blz. 60-61)

[6] **P.J.H. Cuypers**

1906.12.19: wegens zijn verdiensten voor de bouwkunst, de archeologie, de herleving van het ambacht en het vakonderwijs. *1907.01.08*, Prof.ir. J.F. Klinkhamer, (Ing.22 (1907) no.5 blz. 107-110)

[7] **J.H. van 't Hoff**

1907.12.20: wegens zijne zeer bijzondere verdiensten op het gebied der scheikunde en hare toepassingen. Gezondheidsredenen verhinderen de overreiking van het diploma in een buitengewone vergadering van de Senaat.

[8] **R.D.M. Verbeek**

1908.12.17: wegens zijne bijzondere verdiensten op het gebied der geologie van den Nederlandsch-Indischen Archipel. *1909.01.08*, Prof.dr. G.A.F. Molengraaff, (Ing. 24 (1909) no. 3 blz. 55-58)

[9] **J. Lorié**

1911.12.16: wegens zijn bijzondere verdiensten op het gebied der geologie van Nederland. *1912.01.08*, Prof.dr. H.G. Jonker, (Ing. 27 (1912) no.2 blz. 60-61)

[10] **J.L. Cluysenaer**

1913.06.20: wegens zijne zeer uitstekende verdiensten: als ingenieur ten aanziene van den ingenieursstand, op het gebied van het technisch hooger onderwijs, en voor de Technische Hoogeschool in het bijzonder. *1913.09.19*, Prof.ir. W.K. Behrens, (Ing. 28 (1913) no.39 blz. 819-822)

[11] **A.C.C.G. van Hemert**

1916.12.08: wegens zijne uitstekende verdiensten op het gebied van onderwijs en wetenschap, techniek en onderneming. *1917.01.08*, Prof.ir. J. Nelemans, (Jaarb. 1917 blz. 57-62)

[12] **G.W. van Heukelom**

1916.12.08: wegens zijne uitznemende verdiensten als ontwerpend en uitvoerend ingenieur, bouwmeester van spoorgewerken. *1917.01.08*, Prof.ir. J. Nelemans, (Jaarb. 1917 blz. 62-68)

[13] **G.L.F. Philips**

1916.12.08: wegens zijne bijzondere verdiensten voor de bevordering van het wetenschappelijk onderzoek in de nijverheid. *1917.01.08*, Prof.dr. W. Reinders, (Jaarb. 1917 blz. 69-75)

[14] **H.A. Lorentz**

1918.01.23: op grond van zijne buitengewone verdiensten voor wetenschap en onderwijs in het algemeen en de theoretische electriciteitsleer, fundamente der electrotechniek, in her bijzonder. *1918.03.07*, Prof.dr. M. de Haas, (Jaarb. 1918 blz. 17-33), Antwoord: De ontwikkeling der natuurkunde in de laatste halve eeuw. (Jaarb. 1918 blz. 34-40)

[15] **J. Schroeder van der Kolk**

1918.12.16: op grond van het belangrijke wetenschappelijke werk, dat hij geleverd heeft betreffende de berekening en het experimentele onderzoek van bruggen. *1919.01.08*, Prof.ir. N.C. Kist, (Jaarb. 1919 blz. 43-49)

[16] **H. Kamerlingh Onnes**

1919.11.28: wegens zijn zeer uitstekende verdiensten voor de wetenschap en de techniek der lage temperaturen. *1920.01.08*, Prof.dr. L.H. Siertsema, (Jaarb. 1920 blz. 38-45)

[17] **C.P. Holst Gilliszoon**

1922.05.26: wegens de even oorspronkelijke als wetenschappelijk-paedagogische wijze, waarop hij vele technische vraagstukken op uiteenlopende gebieden heeft bewerkt en onderwezen. *1922.06.02*, Prof.ir. J.A.G. van der Steur, (Jaarb. 1922 blz. 21-23)

[18] **H.P. Berlage**

1924.12.08: wegens zijn baanbrekenden arbeid in de bouwkunstbeweging. *1925.01.08*, Prof.ir. J.A.G. van der Steur, (Jaarb. 1925 blz. 49-57)

[19] **R.G. Waller**

1925.05.25: wegens zijn uitstekende verdiensten als leider van grote industriële ondernemingen. *1925.10.06*, Prof.dr. J.G.C. Volmer, (Jaarb. 1926 blz. 48-59), Antwoord: Over het belang van de ingenieursstudie voor toekomstige leiders der industrie. (Jaarb. 1926 blz. 60-64)

[20] **N. Easton Wing**

1927.12.06: wegens zijn baanbrekend werk op geologisch en mijnbouwkundig gebied, vooral in verband met den bodembouw in Nederlandsch Oost-Indië. *1928.01.09*, Prof.dr. G.A.F. Molengraaff, (Jaarb. 1928 blz. 38-49)

[21] **C.F. Stork**

1928.12.03: wegens zijn zeer uitstekende verdiensten als technisch leider van grote industriële ondernemingen en als bevorderaar van den werktuigbouw in Nederland. *1929.03.13*, L.A. van Royen, (Jaarb. 1929 blz. 62-75), Antwoord: Over plaats en taak van de Nederlandse metaalindustrie. (Jaarb. 1929 blz 76-81)

[22] **H.W.A. Deterding**

1928.12.03: wegens zijn zeldzame verdiensten als stichter en leider van een der machtigste industriële concerns en als bevorderaar van de ontwikkeling der techniek in Nederland. *1929.03.13*, Prof.dr. J.G.C. Volmer, (Jaarb. 1929 blz. 82-91), Antwoord: De waarde van het personeel en in het bijzonder van academici voor de onderneming. (Jaarb. 1929 blz. 92-94)

[23] **F.K.Th. van Iterson**

1930.06.16: wegens zijn zeer bijzondere verdiensten voor de ontwikkeling van de werktuigbouwkunde en hare hulp-wetenschappen. *1930.09.22*, Prof.ir. A.J. ter Linden, (Jaarb. 1930 blz. 50-56)

[24] **P. Joosting**

1930.06.16: wegens zijn uitnemende verdiensten op het gebied van den brugbouw. *1930.09.22*, Prof.ir. N.C. Kist, (Jaarb. 1930 blz. 57-63)

[25] **J.A. Ringers**

1930.06.16: wegens zijn uitnemende verdiensten op het gebied van de waterbouwkunde. *1930.09.22*, Prof.ir G.H. van Mourik Broekman, (Jaarb. 1930 blz. 64-70)

[26] **G. Holst**

1933.12.05: wegens zijn zeer uitstekende verdiensten voor wetenschap en industrie in het algemeen en de technische physica in het bijzonder. *1934.01.08*, Prof.dr. M. de Haas, (Jaarb. 1934 blz. 54-61)

[27] **M.H. Damme**

1937.11.30: op grond van zijne veelzijdige en vruchtbare werkzaamheid als ingenieur in het algemeen en in het bijzonder wegens zijne buitengewone verdiensten als bevorderaar van de ontwikkeling, toepassing en organisatie van de electrische verbindingstechniek. *1938.01.08*, Prof.dr.ir. W.Th. Bähler, (Jaarb. 1938 blz. 41-52), Antwoord: Over het staatsbedrijf als een verkeislijke ondernemingsvorm. (Jaarb. 1938 blz. 53-57)

[28] **W.J.H. Harmsen**

1946.11.28: wegens zijn groote technische verdiensten als leider bij den bouw van bruggen in de Rijkswegen vóór den oorlog en wegens zijn groote technische en organisatorische verdiensten ten aanzien van het spoedig herstel van oorlogsschade aan de Waterstaatswerken in beheer bij het Rijk en andere openbare lichamen na de bevrijding. *1947.01.08*, Prof.ir. J.W. Thierry, (Jaarb. 1947 blz. 33-37)

[29] **W. Hupkes**

1946.11.28: wegens zijn zeer uitstekende verdiensten als technisch leider van het spoorwegbedrijf en als bevorderaar van den werktuigbouw in ons land. *1947.01.08*, Prof.ir. F. Westendorp, (Jaarb. 1947 blz. 38-42)

[30] **A. Plesman**

1946.11.28: wegens zijn uitstekende verdiensten als baanbrekend leider van de Nederlandsche verkeersluchtvaart. *1947.01.08*, Prof.dr.ir. H.J. van der Maas, (Jaarb. 1947 blz. 43-47)

[31] **D.P. Ross van Lennep**

1946.11.28: wegens zijn uitnemende verdiensten op chemisch-technologisch gebied. *1947.01.08*, Prof.dr. H.I. Waterman, (Jaarb. 1947 blz. 48-51)

[32] **A. Stoll**

1947.06.19: op grond van zijn buitengewone verdiensten op het gebied der biochemie en in het bijzonder ook op dat der technische botanie. *1947.09.15*, Prof.dr.ir. G. van Iterson Jr, (Discours, prononcé par le Professeur G. van Iterson Jr, le 15 septembre 1947, à l'occasion de la remise au Professeur Dr. A. Stoll de la bulle de docteur honoris causa dans la science technique. Delft 1947, 11 blz.)

[33] **V.J.P. de Blocq van Kuffeler**

1949.03.15: wegens zijn uitstekende organisatorische en technische verdiensten bij de afsluiting en gedeeltelijke drooglegging van de Zuiderzee. *1949.09.19*, Prof.ir. J.T. Thijssse, (Jaarb. 1949 blz. 53-57)

[34] **P. Verhagen**

1949.12.07: op grond van zijn oorspronkelijk en omvangrijk aandeel in de herleving van de Nederlandsche stedebouwkunde en van zijn voortreffelijke bijdrage tot den wederopbouw van stad en land. *1950.01.07*, Prof.ir. J.H. Froger, (Jaarb. 1950 blz. 38-42)

[35] **J. C. van Staveren**

1950.03.22: op grond van zijn organisatorischen en technisch-wetenschappelijken arbeid voor de Nederlandse electriciteitsvoorziening, die ook ver buiten de grenzen van ons vaderland erkenning en waardeering heeft gevonden. *1950.09.18*, Prof.Dr.-Ing.ir. H.S. Hallo, (Jaarb. 1950 blz. 43-47)

[36] **Bernhard, Prins der Nederlanden**

1951.07.03: wegens zijn zeer uitstekende verdiensten. *1951.11.16*, Prof.dr.ir. A.J. Kuyver, (Jaarb. 1952 blz. 58-68), Antwoord: Techniek en economie als grondslag van de industrialisatie. (Jaarb. 1952 blz. 69-75)

[37] **H.J. van Doorne**

1953.03.27: op grond van zijn uitstekende verdiensten voor de ontwikkeling van de Nederlandse rijverheid op het gebied van de bouw van motorvoertuigen en aanverwante constructies in zijn hoedanigheid van constructeur en ondernemer. *1953.09.21*, Prof.ir. J.J. Broeze, (Jaarb. 1953 b/z. 47-53), Antwoord: De voorsprong van de ingenieur op de auto-clidact. (Jaarb. 1953 blz. 54-57)

[38] **L. Neher**

1954.06.21: op grond van de door hem beroerde stuwend activiteit bij de leiding en de wederophouw van het Staatsbedrijf der Posterijen, Telegrafie en Telefonie. *1954.09.20*, Prof.ir L.H.M. Huydts, (Jaarb. 1954 blz. 68-80), Antwoord: Zuivere en toegepaste wetenschap als basis der telecommunicatietechniek. (Jaarb. 1954 blz. 82-86)

[39] **J.J.P. Oud**

1955.05.26: op grond van zijn uitnemende verdiensten als bouwmeester en publicist voor de ontwikkeling van de architectuur in de twintigste eeuw. *1955.09.26*, Prof.ir. J.F. Berghoef, (Jaarb. 1955 blz. 81-85)

[40] **F.Q. den Hollander**

1955.05.26: op grond van zijn uitstekende verdiensten op technisch-wetenschappelijk en organisatorisch gebied in het bijzonder als leider van de Nederlandsche Spoorwegen. *1955.09.26*, Prof.ir. H.C.A. van Eldik Thieme, (Jaarb. 1955 blz. 86-90)

[41] **Th.S.G.J.M. van Schaik**

1955.05.26: op grond van zijn uitnemende verdiensten op wetenschappelijk, technisch en constructief gebied. *1955.09.26*, Prof.dr.ir. J.W.H. Uyttenbogaart, (Jaarb. 1955 blz. 91-93)

[42] **H.A. Hidde Nijland**

1955.05.26: op grond van zijn zeer bijzondere verdiensten als constructeur en als grondvoster van een internationale industrie van unieke betekenis. *1955.09.26*, Prof.ir. W. Fontein, (Jaarb. 1955 blz. 94-96)

[43] **H. Bloemgarten**

1955.05.26: op grond van zijn systematische en efficiënte bevordering der ontwikkeling van de petroleumwinningstechniek en van het daartoe vereiste wetenschappelijk onderzoek. *1955.09.26*, Prof.dr.ir. F.J. Faber, (Jaarb. 1955 blz. 97-100)

[44] **Th. von Kármán**

1956.07.05: op grond van zijn zeer uitstekende verdiensten op het gebied van de technische wetenschap in het algemeen en die op het terrein van de elasticiteitstheorie, de plasticiteitstheorie en de aero- en hydrodynamica in het bijzonder, alsmede op grond van de belangrijke bijdrage, die hij geleverd heeft tot de internationale samenwerking op dit wetenschapsgebied. 1956.09.17, Prof.dr.ir. C.B. Biezeno, (Jaarb. 1956 blz. 81-92)

[45] **J.D. Cockcroft**

1958.06.13: op grond van zijn zeer uitstekende verdiensten voor de zuivere en technische natuurkunde, meer in het bijzonder wat betreft de toepassingen van de kernenergie. 1959.01.10, Prof.dr. R. Kronig, (Jaarb. 1959 blz. 79-85)

[46] **A. Bouwers**

1962.12.17: wegens zijn zeer uitstekende verdiensten voor de technische natuurkunde, meer in het bijzonder wat betreft de ontwikkeling van röntgenapparaten en optische instrumenten. 1963.01.12, Prof.dr. A.C.S. van Heel, (Jaarb. 1963 blz. 63-72)

[47] **G.T. Rietveld**

1963.12.10: wegens zijn uitnemende verdiensten voor de vernieuwing van bouwen meubelkunst, in het bijzonder voor de creatieve bijdragen tot de synthese van moderne techniek, ruimtelijkheid en vorm. 1964.01.11, Prof.ir. J.H. van den Broek, (Jaarb. 1964 blz. 61-71)

[48] **J.D. Fast**

1964.06.29: op grond van zijn uitstekende verdiensten op het gebied van wetenschappelijk en technisch metaalonderzoek. 1965.01.09, Prof.dr. W.G. Burgers, (Jaarb. 1965 blz. 63-72)

[49] **J.G. van der Corput**

1965.06.21: op grond van zijn uitnemende verdiensten voor de wiskunde in het algemeen en in het bijzonder voor het aandeel in de verspreiding van de nieuwe inzichten omrent haar maatschappelijke betekenis. 1966.01.10, Prof.dr. S.C. van Veen

[50] **J.P. den Hartog**

1966.06.27: op grond van zijn zeer uitstekende verdiensten voor de toepassing van de mechanica in de techniek, in het bijzonder op het gebied van de mechanische trillingen. 1967.01.14, Prof.dr.ir. W.T. Koiter, (Jaarb. 1967)

[51] **G.H. Bast**

1966.06.27: op grond van zijn zeer uitstekende verdiensten voor de transmissie van informatie, in het bijzonder op het gebied van de draaggolftelefonie. 1967.01.14, Prof.dr.ir. J.L. Bordewijk, (Jaarb. 1967)

[52] **J.M. Bijvoet**

1966.06.27: op grond van zijn zeer uitstekende verdiensten voor de ontwikkeling van de röntgenstructuuranalyse in Nederland. 1967.01.14, Prof.dr. W.G. Burgers, (Jaarb. 1967)

[53] **E.J.W. Verwey**

1966.06.27: op grond van zijn zeer uitstekende verdiensten op het gebied van de wetenschappelijke beïnvloeding van de eigenschappen van de vaste stof ten behoeve van elektronische toepassingen. 1967.01.14, Prof.dr. J.H. de Boer, (Jaarb. 1967)

[54] **Th.P. Tromp**

1967.12.11: wegens uitnemende verdiensten als technisch leider en organisator van een der grootste industrieën in ons land. *1968.01.13*, Prof.ir. D.A.A. Koolen

[55] **A. Drijver**

1968.12.09: wegens zijn uitstekende verdiensten als ingenieur-ontwerper en als leider van de technische afdeling van een groot bedrijf. *1969.01.11*, Prof.ir. G. Prins

[56] **K. Posthumus**

1969.12.08: wegens zijn zeer uitstekende verdiensten voor de ontwikkeling van de elektronische techniek. *1970.01.10*, Prof. J.W. Alexander

[57] **B.D.H. Tellegen**

1969.12.08: wegens zijn zeer uitstekende verdiensten voor de ontwikkeling van de theorie der elektrische netwerken en van de elektronica. *1970.01.10*, Prof.dr.ir. J.P. Schouten

[58] **D. Gabor**

1970.12.07: wegens zijn verdiensten voor de Technische Natuurkunde, in het bijzonder de optica van licht en elektronen. *1971.01.09*, Prof.dr.ir. J.B. Le Poole

[59] **H. Rinia**

1970.12.07: wegens zijn verdiensten op grond van zijn multidisciplinair gerichte inventiviteit waarmede hij door toepassing van de natuurwetenschappen heeft bijgedragen tot belangrijke ontwikkelingen van de technische wetenschappen, in het bijzonder in die van de werktuigbouwkunde. *1971.01.09*, Prof.ir. H. Blok

[60] **W. van Tijen**

1972.12.04: wegens zeer uitstekende verdiensten op het gebied van de vernieuwing van de woningbouw. *1972.01.12*, Prof.ir. M. Gout

[61] **J.J. Went**

1973.11.19: wegens zeer uitstekende verdiensten met betrekking tot het toepassen van uiteenlopende takken van de natuurkunde op vele gebieden van de techniek. *1974.01.11*, Prof.dr.ir. J.B. Le Poole

[62] **H.C. van Meerten**

1973.11.19: wegens zeer uitstekende verdiensten als ingenieur-ontwerper en technischwetenschappelijk leider bij de ontwikkeling van vliegtuigen. *1975.01.10*, Prof.ir. H. Wittemberg

[63] **W.M.J. Soete**

1975.12.01: wegens zeer uitstekende verdiensten ten aanzien van de ontwikkeling van de lastechniek in het bijzonder ter verhoging van de veiligheid van gelaste konstrukties. *1976.01.09*, Prof. H.G. Geerlings

[64] **L. Schepers**

1976.11.15: op grond van zijn uitmuntende verdiensten voor de Nederlandse ingenieurswereld in de ruimste zin en voor de Delftse ingenieurswereld in het bijzonder. *1977.01.07*, Prof.ir. H.J. de Wijs

[65] **G. Lorentzen**

1976.11.15: op grond van de algemene invloed van zijn werk op de ontwikkeling van de koeltechniek op wetenschappelijke basis alsmede van zijn invloed op verspreiding van deze kennis in internationaal verband met name naar de derde wereld. *1977.01.07*, Prof.ir. A.L. Stolk

[66] **R.B. Bird**

1976.11.15: wegens zijn zeer uitstekende verdiensten op het gebied van de fysische transportverschijnselen in het algemeen en van de rheologie van macromoleculaire vloeistoffen in het bijzonder. *1977.01.07*, Prof.dr. H.R.K.N. Janeschitz-Kriegl

[67] **J. Bear**

1977.11.21: op grond van zijn wetenschappelijke verdiensten bij het ontwikkelen van de theorie over het stromen van vloeistoffen door poreuze grondlagen zoals zand en grind. *1978.01.13*, Prof.dr.ir. G. de Josselin de Jong

[68] **A. van Wijngaarden**

1978.11.20: op grond van zijn uitzonderlijke verdiensten voor de bevordering van de informatica. *1979.01.12*, Prof.dr.ir. W.L. van der Poel

[69] **W.F. Schut**

1981.12.14: op grond van zijn uitstekende verdiensten op het terrein van het bouwen en de gebouwde omgeving. *1982.01.21*, Prof.ir. H. Wiggerts

[70] **A. Horowitz**

1981.12.14: op grond van diens zeer uitstekende verdiensten voor de ontwikkeling van de techniek en van de technische wetenschappen. *1982.01.21*, Prof.dr. D. de Jong

[71] **D.W. van Krevelen**

1983.11.28: op grond van zijn zeer uitstekende verdiensten op het gebied van de steenkooltechnologie en de polymeertechnologie, de fundamentele chemische technologie. *1984.01.20*, Prof.drs. P.J. van den Berg

[72] **Suyono Sosrodarsono**

1984.10.11: op grond van zijn zeer uitstekende verdiensten terzake van de bevordering van de technische wetenschappen en de toepassing daarvan, met name door het scheppen van een voedingsbodem daarvoor door organisatorische, commerciële en leidinggevende activiteiten. *1985.01.25*, Prof.ir. H.J. Schoemaker

[73] **H.A. Ferguson**

1986.09.22: op grond van zijn uitstekende verdiensten voor de wetenschappelijke onderbouwing van het Deltaplan en de impulsen die daarvan zijn uitgegaan naar de betrokken technische wetenschappen. *1987.01.09*, Prof.ir. H. Wiggerts

[74] **W. Dekker**

1986.09.22: op grond van diens zeer uitstekende verdiensten op het gebied van leiding geven aan elektrotechnisch gerichte, industriële activiteiten vooral in Nederland en Europa en zijn creatieve bevordering van wetenschappelijk onderzoek en technische innovatie. *1987.01.09*, Prof.ir. H.R. van Nauta Lemke

[75] **G.J. Wormmeester**

1986.09.22: op grond van diens zeer uitstekende verdiensten als dynamisch leider en innovator bij de vormgeving en realisering van het containeroverslagbeuren. *1987.01.09*, Prof.ir. G. Prins

[76] **Elbert L. Rutan**

1989.11.06: wegens zijn vernieuwende invloed op de vliegtuigontwikkeling door het tonen van uitzonderlijke vindingrijkheid, doelmatigheid en veelzijdigheid bij het ontwerpen, bouwen en beproeven van een groot aantal vliegtuigtypen. *1990.01.12*, Prof.ir. E. Torenbeek

[77] **A.E. van Eyck**

1989.11.06: op grond van uitzonderlijke verdiensten voor de ontwikkeling en vernieuwing van de architectuur en de stedebouw, die gebaseerd is op zijn consistente cultuurfilosofie en zijn wortels vindt in een humanitaire integrale benadering van kunst, architectuur en stedebouw. *1990.01.12*, Prof.arch.HBO J. van Stigt

[78] **A.R. Miedema**

1990.10.15: op grond van zijn uitstekende verdiensten op het gebied van de fysica van metaallegeringen. *1991.01.11*, Prof.dr.ir. A. van den Beukel, Prof.dr.ir. S. Radelaar

[79] **Thomas B. Sheridan**

1990.10.15: wegens zijn wezenlijke bijdrage in de ontwikkeling van de telerobotica en de menselijke supervisie van geautomatiseerde systemen. *1991.01.11*, Prof.dr.ir. H.G. Stassen

[80] **J.F. Agema**

1991.08.26: op grond van zijn uitzonderlijke verdiensten op het gebied van het onwerp en de bouw van grote waterbouwkundige werken in Nederland, en meer in het bijzonder zijn inzet voor het invoeren van probabilistische technieken en kwaliteitsborging in de waterbouw. *1992.01.22*, Prof.ir. K. d'Angremond

[81] **J.M.H. Levert Sengers**

1991.08.26: op grond van haar uitzonderlijke verdiensten op het gebied van de thermodynamische eigenschappen van enkelvoudige stoffen en mengsels, in het bijzonder nabij het kritische punt. *1992.01.22*, Prof.dr.ir. J. de Swaan Arons

[82] **Renzo Piano**

1991.08.26: op grond van zijn uitzonderlijke verdiensten op het gebied van de ontwikkeling van de bouwkunst en daarbij zijn vindingrijk en evenwichtig gebruik van nieuwe technieken in het belang van mens, natuur en cultuur. *1992.01.22*, Prof.ir. L.C.W.M Röling

[83] **J.V. Sengers**

1991.08.26: op grond van zijn uitzonderlijke verdiensten op het gebied van experimenteel en theoretisch onderzoek van niet-evenwichtsverschijnselen in verdichte fluida alsmede de praktische toepassing daarvan. *1992.01.22*, Prof.dr. J.J. van Loef

[84] **P. Winsemius**

1991.08.26: op grond van zijn uitzonderlijke verdiensten op het gebied van het uitdragen van een inzichtelijke systematiek en het uitvoeren van een oplossingsgerichte aanpak van de milieuproblematiek. *1992.01.22*, Prof.ir. H.P. van Heel

[85] **W.H. Crouwel**

1993.09.13: op grond van zijn uitzonderlijke verdiensten op het gebied van het grafisch en ruimtelijk ontwerpen, in het bijzonder wegens zijn heldere en zakelijke stijl en de oorspronkelijke wijze waarop hij gebruik maakt van nieuwe technieken, en zijn vermogen om een groot en gevarieerd publiek te boeien en te inspireren. *1994.01.07*, Prof.dr.ir. R. den Buurman

[86] **J.W. Geus**

1995.10.23: op grond van zijn uitzonderlijke verdiensten op het gebied van de heterogene katalyse en meer in het bijzonder voor zijn innovatieve bijdragen aan duurzame ontwikkeling in de chemische procesindustrie. *1996.01.05*, Prof.dr. J. Schoonman

[87] **Santiago Calatrava Valls**

1996.09.23: op grond van zijn uitzonderlijke culturele en vaktechnische verdiensten op het gebied van de bouwkunst, en meer in het bijzonder voor de creatieve aanpak waarmee hij als architect, ingenieur en vormgever de synthese van wetenschap, technologie en kunst in zijn ontwerpen weer te realiseren. *1997.01.10*, Prof. C.G. Dam

[88] **Neville John Hogan**

1996.09.23: op grond van zijn uitzonderlijke verdiensten op het gebied van de biomechanica en meer in het bijzonder zijn grote bijdrage aan de beschrijving van de besturing van het spierskelet-stelsel ten behoeve van de revalidatietechniek. *1997.01.10*, Prof.dr.ir. H.G. Stassen

[89] **Byron D. Tapley**

1997.08.25: op grond van zijn uitzonderlijke verdiensten op het gebied van de astrodynamica en het gebruik van satellieten voor geodetisch, geofysisch en oceanografisch onderzoek, in het bijzonder voor zijn vele initiatieven tot het realiseren van nieuwe satellietmissies, en zijn vermogen om jonge wetenschappers te inspireren. *1998.01.09*, Prof.ir. K.F. Wakker

[90] **Gerrit Blom**

1997.08.25: op grond van zijn uitzonderlijke verdiensten op het gebied van het integraal waterbeheer en de bestrijding van verontreiniging van het oppervlakewater; alsmede wegens de wijze waarop hij heeft bijgedragen aan het behoud van unieke kennis en ervaring bij de Rijkswaterstaat. *1998.01.09*, Prof.ir. K. d'Angremond

[91] **Else Kooi**

1999.08.25: op grond van zijn uitzonderlijke verdiensten op het gebied van de micro-elektronica, alsmede wegens de unieke wijze waarop hij het vakgebied stimuleert en zijn kennis en ervaring overdraagt. *2000.01.07*, Prof.dr. C.I.M. Beenakker

[92] **Cornelis le Pair**

1999.08.25: op grond van zijn initiatief om de Technologiestichting STW op te richten, en zijn uitzonderlijke verdiensten op het gebied van het stimuleren van technisch-wetenschappelijk onderzoek aan de Nederlandse universiteiten en het betrekken van het bedrijfsleven bij dat onderzoek. *2000.01.07*, Prof.ir. K.F. Wakker

[93] **Peter Alfred Ziegler**

2000.06.21: op grond van zijn uitzonderlijke verdiensten op het gebied van toegepaste geologie, beoefend in een hecht samenwerkingsverband tussen industrie en universiteit. *2001.01.05*, Prof.dr.ir. J.T. Fokkema

[94] **Floris Takens**

2000.06.21: op grond van zijn uitzonderlijke verdiensten op het gebied van de wiskunde, in het bijzonder dat van de dynamische systemen, en haar toepassingen in de technische wetenschappen. *2001.01.05*, Prof.dr. J.M. Aarts