

## Harry van der Laan

— ESO's Director General from 1988 to 1992

— *Summary of his professional biography*

Harry van der Laan was born in 1936 on a farm in Blyham, the Netherlands, and moved with his parents and his four siblings to Ontario, Canada at the age of sixteen. He worked in a variety of menial jobs as an immigrant boy for two years, then entered the final year of highschool to complete the Ontario Senior Matriculation as valedictorian and winner of two scholarships to finance his honours course in Mathematics and Physics at Western University. Upon graduation in 1960 he won the Gold Medal for Applied Mathematics and a Commonwealth Scholarship for doctorate studies at the Cavendish Laboratory, Cambridge University. He completed his PhD Cantab in Astronomy and Astrophysics in 1963, writing his thesis on non-thermal cosmic radio sources under the supervision of Sir Martin Ryle, English radio astronomer who developed revolutionary radio telescope systems. Ryle was awarded the Nobel Prize in physics (1974) for developing and implementing the concept of earth rotation aperture synthesis.

Van der Laan had a prominent career as a radio astronomer, beginning as an associate professor of astronomy at Western University, the university where he had completed his first degree, after studying philosophy for a postdoc year at Amsterdam's Free University. He was a guest scientist at the HQ of the National Radio Astronomy Observatory in Charlottesville, Va. in the summer semesters of 1964, '65 and '66 when director David Heeschen was in the initial planning phase of the VLA, inaugurated in October 1980.

With Emil Blum (Observatoire de Meudon) and Peter Mezger (Max Planck Institute for Radio Astronomy), both also guest scientists at NRAO, he conceived the Young European Radio Astronomers Conference, an annual meeting to break the isolation of the many small institutes in their discipline in Europe. YERAC began in May 1968 in Meudon and continues to this day. It has neither a budget nor a secretariat, but half a page of ground rules. It has given nearly every young radio astronomer in Europe their first international experience, providing the field a dynamic pattern of

interactions for fifty years. See the YERAC website for the entire series, its participants, programmes and hosts. Note that from the start, Eastern Europeans were included in spite of the depths of the Cold War.

In 1967 Professor Jan Hendrik Oort persuaded Van der Laan to join Leiden Observatory to lead the preparations for the scientific exploitation of the Westerbork Synthesis Radio Telescope. The WSRT, based on the principles Ryle developed, was inaugurated in June 1970. At the end of that summer Professor Oort (\*1900) retired and Leiden University appointed Van der Laan as full professor of radio astronomy. He stayed in Leiden for twenty years, serving Leiden Observatory as its scientific director for much of that time. He spent one academic year (1974-75) as visiting scientist in Princeton at the Institute for Advanced Study. He was twice a participant (1970 and 1981) in the coveted Semaines d'Etudes at the Pontifical Academy in Rome. From 1969 till 1987 he had, in addition to his Leiden work, the parallel responsibility of leading the Netherlands Foundation for Radio Astronomy, overseeing the radio observatories Dwingeloo and Westerbork as 'Executive Board Member'.

During his Leiden years Van der Laan held numerous national and international functions, including the presidency of the IAU's Radio Astronomy Commission, the largest of the Union at the time. Most important was his initiative to form a Strategic Alliance between UK and NL astronomy, aiming for telescopes from submm and IR to optical wavelengths in the Northern Hemisphere. Such facilities needed for the deeper analysis of WSRT data which was beyond the capacities of NL budgets and manpower by themselves. The process began with informal discussions at the IAU General Assembly in Montreal (1979) between Professor F. Graham Smith and Van der Laan. This continued for several years of arduous political and technical work, resulting in the Isaac Newton Group of telescopes on the Spanish island of La Palma and the submm telescope JCMT on Mauna Kea, Hawaii. There was 80 vs 20 % UK and NL participation respectively in all aspects of the joint projects, technically, financially and in observing time.

Astronomy in the Netherlands has a strong outreach tradition, with professionals of all ranks giving talks and sharing their discoveries wherever they find an audience. Van der Laan's contributions, in

addition to local events, were twofold. Around 1980 he was the designer and chief editor of a television series on Galaxies, thirteen one hour national telecasts, each one involving a senior astronomer and a different topic. It was presented by the same articulate Amsterdam astronomy student Roel Gathier with the professor of that particular programme. The course was accompanied by a well illustrated book of some four hundred pages, written under Van der Laan's guidance by Niek de Kort, a very smart Leiden student. The course was telecast twice a week at awkward hours and repeated in that format one year later. All thirty two thousand books printed were sold and the enrollment was gauged at a quarter million. This course raised the first year university enrollment for astronomy majors by up to fifty percent, an interest that has not faded since.

Another national outreach was the hemispheric theatre including electronic planetarium in The Hague. After Holland's only planetarium was destroyed by a fire in 1979, Van der Laan proposed to The Hague's city council to construct a dome theatre with IMAX- and E&S Digistar projectors. It took years of lobbying and planning but on St. Nicolas Day in 1984 Van der Laan's dream was inaugurated, half a year before president Mitterand inaugurated Europe's second Omnimax theatre La Geode in Paris. More than 15 million paying customers have since enjoyed the nature and space documentary films in OMNIVERSUM as The Hague's attraction is called, run by a private foundation, self-sustained, without subsidies.

Van der Laan's initial association with ESO was his membership of the STC. When finalising the VLT's preparatory expert teams, DG Woltjer asked Van der Laan to chair the Site Selection Committee for ESO's Very Large Telescope. A whole set of techniques were developed by this Committee and its members' institutes to assess the astronomical quality of various sites, primarily in Chile's Atacama Desert. Director General Lodewijk Woltjer fully supported the Committee with funds and La Silla telescopes' test time as well as the invaluable efforts of dedicated staff member Marc Sarazin.

His early leadership of the site selection committee led Van der Laan to become deeply involved with the VLT concept and with the development of its complex subsystems. When in 1986 Woltjer indicated his intention to end his tenure after Council's approval of

the VLT plan, Van der Laan was asked by his Ministry of Education and Science to be available as a candidate to succeed Woltjer.

After seventeen years of Netherlands astronomers in that position, he was skeptical about the request but agreed to be part of the process. In an essay asked for by Council he indicated that without VLT approval he would not wish to lead ESO. In mid May 1987, the Council appointed Van der Laan unanimously as DG for five years from the start of 1988.

A consistent thread in Van der Laan's policy and management efforts has been the interaction and collaboration of astronomers across Europe. This is exemplified by his YERAC conception as well as the initiative for the UK/NL alliance.

Already before assuming DG responsibilities he started to chart how ESO might promote and stimulate more exchanges, collaborations and even cross border appointments among the ESO member states. His North American years had convinced Van der Laan that the US astronomy community was more productive and creative than ESO's because in Europe there were barriers of history, language, culture and borders as well as fragmented budgets. The founding fathers of ESO (and CERN) were of course well aware of such hindrances, but by 1987 Van der Laan judged the organisation and its community to still fall short of their aspirations.

Early in 1988 he decided to complement Woltjer's successful postdoc programme with a student programme where selected PhD candidates from member states could spend up to two years of their postgraduate work at either ESO HQ or with ESO-Chile. By now these programmes have amply met the ambitions just mentioned, networks of personal relations have resulted in a new dynamic where, e.g. Italians move as easily to Holland, and vice versa, as Californians move to Massachusetts v.v.

Another policy decision was to allocate the equivalent of all new telescope time, created by the completion in 1990 of the NTT, to 'key programmes', time allocations for major research ambitions on any of ESO's four biggest telescopes to multi-institutional, and preferably multinational, teams. And then not two or three nights but twenty to sixty. The response to this announcement was large

and enthusiastic. KPs brought initiatives for efforts which until then was only feasible for Californian colleagues with their own 100 inch and 200 inch telescopes. Nearly all of them were multinational and the obligation to write up KP descriptions and goals as well as progress reports for ESO's MESSENGER made for livelier PC, UC and STC meetings as well as a more interesting Journal.

Van der Laan's tenure began with two major, mostly parallel tasks: the continued operation of the La Silla Observatory, then the largest in the world; and the engineering design, tendering and construction of the Very Large Telescope VLT. Given Claus Madsen's brilliant history of ESO entitled *The Jewel on the Mountaintop*, this part of the biography can be brief. The Annual Reports 1988 to 1992 inclusive as well as governing bodies' documents contain the record of this turbulent transition period. Van der Laan's actions are also documented in *The MESSENGER* no.s 47 to 72.

When the Council approved the VLT project as described in the Woltjer era's famous Blue Book, it committed the funds and approved the concept. It failed to adjust the manpower budget except for a meager enlargement by seven staff members with indefinite contracts. This limitation became the biggest hindrance to achieving the goals set out in the Blue Book within schedule and budget. A quick study among European enterprises able to manage a project of this size and complexity as main contractor made clear that, given the schedule and several subsystems of unprecedented novelty and difficulty, none could for an acceptable price. There was no choice, ESO had to be its own main contractor.

The main contractor role would have failed but for the extraordinary dedication and professional competence of two staff members who had come aboard years ago. They had their current practice in the NTT project and the intelligence and diligence to scale that up. They are Massimo Tarenghi and Robert Fischer. Massimo pushed and pulled, demanding as much exertion as he himself demonstrated, to design and build the best telescope of the 21<sup>st</sup> century. The challenge was huge and had innumerable facets. Massimo's enthusiasm fired up the different teams: he was not always popular but he was amazingly effective.

Robert Fischer, head of procurement, was the guardian of ESO's contractual integrity vis à vis European industry. Modest but articulate, smart, dead-straight and fiercely insistent on clear calls for tender and their fair analysis, Robert was the linchpin for contractors' schedules, budgets and for transparency. That gave ESO the best value for money.

Of course there were others nearly as crucial. Jacques Beckers, inventive project scientist who assured inevitable compromises would least hurt the VLT's science potential; Daniel Enard, brilliant telescope designer and Ray Wilson, inspiration for the innovative optics team among them. What was the task of the Director General? Harry van der Laan led the top team and kept the authorities abreast and when needed at bay. He had a calm attitude towards the VLT's overall project schedule, always arguing that 'we are building this for fifty years or more and there are things we can retrofit, so an x-months' delay is not serious if it prevents a research handicap for all of the future'. In this spirit he insisted on a Cassegrain focus for all unit telescopes, a focus absent in the Blue Book's provisional design. In retrospect the science harvest of instruments FORS 1 and FORS 2 overwhelmingly vindicates that decision.

Given the size and shape of the Paranal platform, the prevailing winds and the requirements of VLT Interferometry, the DG cut short a prolonged debate and fixed the position of each of the four unit telescopes. He also erred on the side of caution when he rejected the retractable domes to go for highly novel shelters, leaning on NTT experience. Perhaps most important was his model for instrument acquisition.

It was common knowledge that in major new telescope projects, their nominal completion is often marred by (much too) late delivery of truly state-of-the-art instruments. The very tight manpower situation of the VLT project already mentioned, as well as the relatively small budget foreseen for instrumentation, made Van der Laan apprehensive of a repetition of such a debacle for the VLT. He therefore made a radical policy turn, considered by some to be very risky.

His long experience as leader of Leiden Observatory and his contacts in that position with many modest sized institutes in ESO

member states, made him acutely aware of a structural defect in European astronomy: scarce resources were preferably spent on new research students, postdocs and staff, not on assignments to industry for instrumentation subsystems. Yet there were capabilities in industry far greater and more advanced than those in individual small observatories. There was practically no cash for industrial contracts nor for travel and subsistence when opportunities for technical collaborations arose. The consequence: very few truly world class instruments appeared on the European scene in a timely fashion. That had to change.

Intense discussions with ESO instrumentation staff and community astronomers, led by Sandro D'Odorico, (optical), Allen Moorwood (infrared) and Manfred Ziebell (electronics, firm and software) brought about an ambitious first generation instrumentation plan for the VLT. It consisted of eight dream instruments about which the Users Committee and the Science-Technical Committee were enthusiastic. Regrettably it was clear that manpower and money constraints excluded its completion in time and to budget unless new resources became available. The DG saw these resources, in the institutes of member states: technical manpower, workshop and atelier space, design and S/W skills, all were available in a measure that dwarfed ESO's in-house capacities. A method was needed to engage these institutes' capabilities in a disciplined and affordable manner.

It was effected in a process analogous to the Call for Tenders to industry for NTT and VLT subsystems: meticulous performance and schedule specifications by ESO, CfTs to the whole ESO user community (University and research organisations' institutes), with some crucial differences compared to the industrial calls: the tendering institutes would *not* charge their manpower and their facilities costs, would instead specify their in-house capacities to be engaged and propose *industrial* involvement and costs where opportune. In that way the speed and the quality of instrument realisation would be greatly enhanced and the cost for ESO drastically reduced. Another obligatory requirement was that the tenders be prepared, submitted and committed to by two or more collaborating institutes, preferably in several member states.

ESO's own role was to prepare the Calls for Tenders, to assess competing tenders as submitted, to award and to supervise their

execution. Here the impressive experience and knowhow of Robert Fischer's procurement department within Gerhard Bachman's Administration Division were brought to bear. It was decided that six instruments were to be built in the community by this method, while two instruments were to be built in-house. ESO would also provide all detector systems and some other units.

The reaction to this policy was enthusiastic: finally the talented institutional teams would build world class instruments. Specialists who normally met mostly at conferences could now make plans together across borders, visit each other's universities and laboratories, could forge a joint vision and specific astronomical ambitions. All this resulted in powerful European progress and unprecedented interaction of technicians, system engineers and astronomers. What were the incentives for the participants, 'what's in it for us?' Simple really: each team that delivered and commissioned an instrument was granted a very substantial amount of privileged observing time with their own instrument on an eight-metre unit telescope. Thus, they could do their science beyond current frontiers, most enticing reward for a job well done.

By this method, the VLT became probably the first major telescope project to have the best instruments very soon after first light of each of its unit telescopes. That kickstart experience made the VLT Observatory the most successful observatory in the world today and the ESO community the most collaborative continental effort in astrophysics.

Becoming Director General tasked Van der Laan with turning the VLT into a reality, a task where he was acutely aware of the accompanying excitement, importance, and challenges ahead. Under his leadership, the VLT concept underwent significant changes, some of which were mentioned above. Ensuring its long-term science capabilities, the DG brought special emphasis on adaptive optics, on VLTI, and insisted on a suite of instruments delivered on time and matching the opportunities of so many foci. Of course these all strained budgets and schedules but an exciting astrophysics future was the goal for a large community where performance mattered more than time tables.

During his tenure as Director General, Van der Laan developed a new organisational structure at ESO, moving away from the strict



hierarchy of earlier times to a more inclusive, participatory management style. When he left ESO he had set the tone for ESO's new dynamics, had committed three quarters of the VLT budget and had transformed the ESO users from a fragmented collection of numerous institutes to a vibrant collaborating community. His successor Riccardo Giacconi brought in new skills and enormous experience from space science to complete this inspiring enterprise.

Van der Laan continues to be a prominent figure in Dutch astronomy. After ESO he became a professor at Utrecht University and upon reaching his official retirement age, which he considers an outdated notion, he formed his company PROFAST (Professorial Advice in Science and Technology). For a full decade he carried out a dozen major assignments, work that fully utilised his experience in astronomy and leadership on local, national, multinational and European stages. He always insisted on forming a working group of diverse experts from all over the globe and usually from several disciplines, who were paid by his contractors. These were ministries, science and technology organisations, the Royal Academy, technical universities, and the like. The problems were those of strategic decisions, performance assessments, mergers, management overhauls or policy developments. Several of these were in the field of space technology in relation to global change, climate monitoring, communications, information systems and database interconnections.

The largest project was for the NL Ministry of Economic Affairs to which parliament had given the task of investing some 800 million euros of natural gas profits in 'societally relevant basic research'. These funds were to be matched by partners in the national economy. Van der Laan took charge of writing a Call for Tenders, resulting in 87 proposals asking for some 3.2 billion euros. He was assisted by a small but extremely efficient team. Forming six thematic subcommittees chaired by fellow academy members, assisted by secretaries professional in that field and four foreign professors each, the systematic assessment of all proposals was undertaken, including 87 final proposer interviews on Academy premises.

The executive committee consisted of subcommittee chairs and was itself chaired by project leader Van der Laan. It submitted thirty seven proposals to the Minister as worthy of support; 90% of these were financed. One proposal was for a novel radio telescope called LOFAR. It was generously funded and today is the very successful trailblazer for the SKA. Given his personal history, former CEO of the proposing organisation ASTRON, Van der Laan recused himself from the LOFAR due diligence.

Altogether the funds were completely allocated in the largest peer review exercise known. The research itself was completed in one decade, resulting in countless publications and innovations over the entire academic spectrum from natural to pharmaceutical to technical research as well as social and cultural scholarship.

Retiring more or less at age seventy five after 50 years of full time work, Van der Laan continues as an active member of the Royal Netherlands Academy of Arts and Science and several other institutions; he referees papers and applications in his field of radio astronomy, among others for the European Science Foundation and works with policy makers on future choices.

He is emeritus professor of astronomy at both the University of Utrecht and the University of Leiden, keeps in touch with most of his thirty or so PhD students and is an active member of the IAU in a number of commissions and divisions. Two of his slogans: “The world needs more astronomers”, and “Variety is the Spice of Life”.

A chronological CV is given below.

1936	3 October birth in Blijham, Prov. of Groningen, NL
1945	Liberation of village from Nazi occupation on 11 April by Canadian and Polish troops
1949	Entry of academic high school
1953	Emigration to Ontario, Canada with parents and four siblings
1955	Entry of Ontario high school (Arva, Ont.) in grade 13
1956	Senior matriculation; valedictorian of graduating class. Awarded INCO and General Motors scholarships

- 1960 Graduation with honours in Mathematics and Physics at Western University. Awarded Dillon Gold Medal for Applied mathematics; awarded Woodrow Wilson Fellowship for postgraduate study at Stanford University; awarded Commonwealth Scholarship for doctorate studies at Cavendish Laboratory, Cambridge University
- 1960–1963 Postgraduate work with Professor Martin Ryle in the Cavendish Laboratory; member of Pembroke College
- 1962 two papers on SNRs/ shell sources of radio emission in the MNRAS still referred to 55 years later
- 1963 August: PhD examination by Professor Franz Kahn (Manchester) and Dr Peter Scheuer (Cambridge) Awarded PhD Cantab.
- 1963–1964 Philosophy studies at Free University (Amsterdam) with Professors Herman Dooyeweerd, Henk van Riessen and Kees van Peursen
- 1964–1967 Associate Professor of Astronomy at Western University; teaching duties from 1 Oct. till 30 April
- 1965–1967 Visiting Research Scientist at the National Radio Astronomy Observatory NRAO, David Heeschen, director (Charlottesville, VA) from 1 May till 30 September); conceived of YERAC with Emil Blum (Meudon, Paris) and Peter Mezger (MPIfRA, Bonn)
- 1966 Paper on quasar variability in NATURE, 211, 1131, his most cited single author paper
- 1967 Appointed scientific associate starting 1 September, at Leiden Observatory, University of Leiden with Professors Jan Hendrik Oort and Hendrik van de Hulst; promoted to senior scientific associate in December
- 1968 Promoted to Reader in astronomy per 1 May
- Appointed member of the Executive Committee (DB) of the Foundation for Radio Astronomy (NFRA/SRZM); first YERAC held at Meudon
- 1968–1970 Modernisation of Leiden astronomy curriculum
- 1969 Designated as Executive Board member/CEO of the NFRA with the Dwingeloo and Westerbork Radio Observatories by the National Organisation for Pure Research (ZWO) until September 1987

- 1970 Appointed full Professor of Radio Astronomy at Leiden University by H.M the Queen per 1 September 10, 2018 (the date of Professor Oort's retirement)  
Dedication of WSRT by Queen Juliana on 24 June
- One of 21 invited participants in Semaine d'Etude at the Vatican Pontifical Academy, theme: The Nuclei of Galaxies
- 1971 Inaugural Lecture (Oratie) Leiden University 'Winds of Change'
- 1972–1994 Thesis adviser/promotor/Doktorvater of 25 PhDs
- 1973 Appointed Vice-president, IAU Commission 40, radio astronomy till General Assembly in Grenoble, 1976
- 1974–1975 Visiting scientist at the Institute for Advanced Study, Princeton, division of Natural Sciences, host Professor John Bahcall
- 1976 President of IAU Commission 40 till General Assembly in Montreal, 1979; succeeded by Professor Govind Swarup  
Radio-X ray collaboration between HvdL c.s. (WSRT) and Riccardo Giacconi c.s. HEAO II Einstein Observatory) agreed at CFA, Harvard on 14 dec.: project RADEX
- 1976 Initiative for a 'Space Theatre/Planetarium' in The Hague in February, with proposal to City Government after fire destroyed the city's planetarium on 29 January
- 1977 Elected George Darwin Lecturer by the Royal Astronomical Society; lecture Edinburgh 7 April, published in Annals of NYAcad. of Sciences, 302, 637-655
- 1979 Designer/editor of twelve one hour programmes for national television called Sterrenstelsels (=Galaxies)
- 1980 Dedication of WSRT extension from 1.5 to 3.0 km and from 20 to 40 simultaneous baselines; on 24 June by Science Policy minister Dr. Trip
- 1981 One of 21 invited participants in Semaine d'Etude at the Vatican, theme: Astrophysical Cosmology
- 1983 Inaugural celebration of the Observatorio del Roque de los Muchachos, La Palma with six Heads of State, hosted by the King of Spain; HvdL accompanied Queen Beatrix as her adviser
- 1984 Inauguration of OMNIVERSUM, space theatre in The Hague on 4 December; first European IMAX dome in Europe

- 1987 Dedication of the James Clerk Maxwell Telescope on Mauna Kea, 27 April by H.R.H. Prince Philip
- 1987 On 8 June ESO Council elects Van der Laan as next Director General from 1 January 1988. On the 8<sup>th</sup> of December Council gives the green light to the VLT of Woltjer's Blue Book; HvdL accepts appointment 1988 Announcement of Key Programmes concept in Messenger # 52, March; On September 12, DG signs contract with Schott for spincasting four 8.2-metre mirror blanks for the VLT
- 1988 Founding member of the Academia Europaea
- 1989 First light on NTT 22/23 March;  
On July 24 DG signs contract with REOSC for polishing the four 8.2-metre mirrors of the VLT
- 1990 In a festive event on two continents on 6 February the New Technology Telescope is dedicated with distinguished guests at ESO HQ and at the NTT on La Silla, linked by electronic video communication systems (see The MESSENGER no. 59). On July 10 the DG signs a Cooperation Agreement between ESO and the Republic of Portugal
- 1991 DG Van der Laan signs the contract with the Italian AES Consortium for the design, construction and installation of the VLT's unit telescopes' main structures, in Garching on 24 September
- 1992 The difficult phase of contracting VLT instruments in the ESO community is successfully completed for the first time when on 6 February the DG signs the contracts for FORS and CONICA  
On 18 December Van der Laan signs the agreement on Enhancement of the VLT Interferometer with CNRS and MPG; his final contracting act for ESO
- 1993 Acceptance of an adjunct professorship in astronomy at Utrecht University
- 1994 Appointed Chairman of the Board of the newly formed NL Foundation for Geology, Oceanography and Atmospheric Sciences GOA
- 1996 Founding of Van der Laan's consulting firm PROFAST Professorial Advice for Science and Technology assessment, management, policy, strategy and structure. Twelve major project reports; see separate summary document\* appended

2001 Leiden University: Exaugural Lecture 'Scholars, Concepts and Discoveries' A 3x3 Silhouette  
 Appointed Commander in the Order of The Netherlands Lion by H.M. Queen Beatrix

\*Appendix of Chronological C.V. HvdL  
 A Decade of Advisory Work  
 By Professor Harry van der Laan c.s.

1995–2004 Final Reports, Assignments, Prefaces, Tables of Content, Team Compositions

I	De Nederlandse Geowetenschappen onderweg naar de 21e eeuw – Beleidsplan 1995-2001	Mei 1995
II	Earth Sciences in The Netherlands	September 1996
III	Technological Top Institutes – TTIs	August 1996
IV	Fusion Programme Evaluation – (European Commission)*	December 1996
Va Vb	Toekomst banen van ruimtetechnologie Future Trajectories of Space Technology	August 1997
VI a VI b	Een betere bewaking van Systeem Aarde Improved Monitoring of System Earth	Juni 1998
VII	Peer Review of SRON*	Juli 1999
VIII	Kwaliteit Verplicht* Naar een nieuw stelsel kwaliteitszorg voor het wetenschappelijk onderzoek	Januari 2000
IX	Scientific Space Research in The Netherlands	Februari 2001
Xa Xb	National Remote Sensing Programme End evaluation for Parliament Remote Sensing: an Integral Vision	April 2001
XI	Assessment of 69 Bsik-Projects (Assessment of 69 Knowledge projects vying for 800 million euros) (Three volumes, biggest peer review on record)	Juli 2003

XII	External Audit TNO Netherlands Institute for Applied Geoscience	Januari 2004
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\* For all but these three, HvdL was the Project Leader i.c. Chairman; for five Niek de Kort was indispensable collaborator and co-author.