Journal of Astronomical History and Heritage 3(1):45-58 (2000)

Under a tropical sky: a history of astronomy in Indonesia[1]

Bambang Hidayat
Bosscha Observatory, and Department of Astronomy,
Institut Teknologi Bandung, Bandung, Indonesia
E-mail: bhidayat99@hotmail.com

Abstract
This paper reviews the birth of astronomy as a branch of natural science in the nineteenth and early twentieth centuries on Java, Indonesia, through the three and a half year period of the Japanese occupation during World War II. In the 1950s astronomy as a science received new impetus by incorporating the science into the higher education system in Indonesia. The newly-founded Faculty of Mathematics and Natural Sciences in Bandung was honourably charged to carry out the modern science education, including astronomy. The introduction of the Anglo-Saxon system of higher education in the late 1950s, which replaced the continental system of education, is briefly sketched to serve as background information for astronomy education in the later years in Indonesia.

1 INTRODUCTION

Simplistically, the relationship between Leiden and Dutch astronomers in the Dutch East Indies (present-day Indonesia) from the 1920s until the start of World War II can best be characterized as a love-hate paternalistic affair. Pyenson (1987) describes how this kind of tie was surrounded by an atmosphere charged with a metropolitan aspiration on the one hand and colonial endeavours on the other. The atmosphere only became neutral when a young, talented, Leiden astronomer, A de Sitter, ascended to the directorship of the Bosscha Observatory in the late 1930s. Unfortunately, by that time the long shadow of World War II had already started to creep into the Dutch East Indies. The ensuing years between 1942 to 1945 were filled with hardship for, and oppression of, Dutch subjects by the Japanese. In 1945, after the War, the national movement for independence in Indonesia practically stopped astronomical activities in the Indonesia, It was only in mid-1946 that the restructuring of the Bosscha Observatory was begun by C Hins of Leiden. But, reconstruction in earnest had to wait a little longer, until 1949, when G B van Albada was appointed Director. The rather unusual situation of the 1940s makes assessment difficult, and a simple line of judgment could create some bias against what was happening at the time.

It must be added, right at the outset, that this paper is not meant to belittle the contribution of Leiden astronomers in opening the southern skies to modern astronomy in Indonesia. On the contrary, it exposes the solid influence of this Dutch School of Astronomy. Already in the middle of the nineteenth century the influence of Leiden astronomers was felt in the colony, for the directive of F Kaiser, the then Director of the Leiden Observatory, formed the sole pillar of guidance for systematic astronomical observations in the tropics. It embodied the rule and procedure for the determination of longitude and latitude in the vast area of what was then called the Dutch East Indies. The measurements were meant to improve existing maritime charts of the new territory which, at the time (around 1850), were very much in demand. Impressive territorial expansion, dictated by the colonial economy of the day, required much better topographic maps and geographical knowledge in order to ensure the hegemony of power. A 27-year old naval lieutenant, de Lange, surveyed the difficult terrain under almost unbearable tropical conditions and managed to accumulate important data essential for positional determinations. Unfortunately psychological stress caused by on-going pressure from Leiden and the poor infrastructure for the work in the colony brought an abrupt end to his life at the very young age of 39 years.

The lifestyle of an explorer such as de Lange was not atypical in the days of territorial conquest. As an astronomer by training, he carried a very heavy dual mandate upon his shoulders. He was expected to produce utilitarian knowledge and at the same time advance pure learning, which could add to the crowning achievement of metropolitan astronomy. A similar dual role was also associated with the history of the Royal Magnetic and Meteorological Observatory in Batavia (now Jakarta). Bergsma, the geophysicist, worked under the wing of Buys Ballot of the Royal Netherlands Meteorological Institute in Utrecht, and had to prove his ability to serve the needs and ambitions of many masters, both in the motherland and in the colony. He found this situation very uncomfortable, and it took him twenty years to develop the Centre of Meteorological Science (now BMG) in Jakarta. In those days, a large part of science was surveys, and surveying work in biology as well as in geology could not be left untouched, regardless of the physical conditions.

I shall not go beyond this point as it would distract us from the track of astronomy. Instead, allow me to touch upon matters concerning the founding of the Bosscha Observatory here in Indonesia. It appears that at least two centres of science in the Netherlands were involved in formulating the decision to found an observatory for the southern hemisphere in the Dutch enclave. The involvement of the Leiden School of Astronomy was only natural in view of its status, but one cannot avoid the impression that the founding of the new observatory in the tropics also stemmed from the aspirations and needs of astronomers in Groningen and Utrecht. When a native son of the Dutch East Indies, J Voute, had the desire to found a new astronomical institute in Java, he sought advice from de Sitter, who was then Director of the Leiden Observatory. Voute believed that if figures like de Sitter and Kapteyn (who was about to head the new institution in Groningen) supported his plans, then the colonial government would come through with financing. Furthermore, Voute supplemented his rationale for an astronomical institute in the colony with the premise that it would respond to both 'disciplinary' and 'national' needs. 'Disciplinary' in the sense that new avenues for scientific research could be opened up, such as the study of the structure and dynamics of stellar systems. This was Kapteyn's anticipation, and his vision led him to propose a telescope of at least eight metres focal length in order that the motions of the stars could be effectively studied. The observatory, the argument continued, would also compensate for the domination of observatories in the northern hemisphere and would complement them. In this regard Voute was correct, because the southern sky in those days was almost a *terra incognita*, not only for modern astronomy but also for double star research (through which stellar masses could be directly determined).

Moreover it was clear that the southern sky, which first received attention from Europeans through the publication of a star catalogue by Frederick de Houtman[2] in 1603, was a much richer research resource than the northern sky[3].

2 THE APPEARANCE OF SCIENTIFIC ASTRONOMY IN THE DUTCH EAST INDIES

The catalogue of stars published by Frederick de Houtman in 1603 provided the basis for the renaming of many of the southern constellations. In a publication that was brought to the attention of European astronomers, de Houtman listed 303 stars in the southern sky and provided names for the major constellations

Disputes about who was responsible for the naming of the southern constellations abound. In 1917, Knobel used circumstantial evidence and arrived at some interesting inferences. One of these was that "... the whole catalogue and the formation of the twelve new constellations must be attributed to Pieter Dirksz Keyzer, and not in any way to Frederick de Houtman." Keyzer was also a member of the first voyage expedition, along with the de Houtman. Could this allegation be correct? If it were, then we should have to rethink the whole issue. Besides, there were many other

voyages of exploration carried out by the Spanish, Portuguese, Italians, and others. But, Dekker (1987) was able to show convincingly that de Houtman deserves the credit for producing the catalogue and the sky atlas. Not only was he responsible for the catalogue but it appears that the act of the discovery was also in line with the scientific attitude of Dutch cartographers of that century. This, in turn, so Dekker emphasized, was "... instrumental in bringing about the general revival of scientific interest in the low countries of the Sixteenth Century onwards."

Looking back along the axis of time one comprehends that the act of reaching a far-away territory was a navigational achievement. With it, new ethics and values flourished. The feeling of confidence and success became a great incentive for the development of science in the Netherlands. Important as it was, serious astronomy in the Dutch East Indies had to wait for the presence of Pastor Johan Mauritz Mohr, who had studied theology at the University of Groningen and between 1737 and 1775 led the congregation of the Portuguese Church on the outskirts of Batavia. He made many astronomical observations, the results of which were communicated to the Dutch Society for Sciences in Haarlem. His observations included the two transits of Venus in the 1760s. Mohr also published his results in the *Philosophical Transactions of the Royal Society*, London. The street where his observatory existed could still be located in Batavia until the 1920s and was named "Gang Torong", a modification of the word "toren." Unfortunately, after Mohr's death scientific astronomy in Indonesia had to wait more than three generations before being taken up again in the second half of the nineteenth century (Voute, 1933).

The early and the middle parts of the nineteenth century witnessed many scientific activities in the Dutch East Indies, with the founding of scientific research centres and institutions. Notably, close to scientific astronomy was the founding of the first magnetic and meteorological observatory at Batavia. Although astronomical activities relating to trigonometrical surveying began in 1821, it was not until the 1850s that they really became a necessity. New economic and social order demanded the exact locations of sites in various parts of the archipelago be known. Although the scientific aspects of triangulation cannot be separated from observational astronomy, there were difficulties in developing pure astronomical science in the second half of the nineteenth century. Astronomy only persisted through its application to geodetic astronomy, and Dutch astronomers in the colony during that era strove to find a state of equilibrium between practical knowledge and pure learning. But it was also during this period that basic improvements to maritime charts of the archipelago were made, on the basis of astronomical observations (Haasbroek, 1977).

The East Indies Physical Society, which was founded in Batavia at the end of the nineteenth century, provided early publications about astronomy. Some of these were on the popular level in order to inform scientists in the archipelago about current trends in science back in the 'motherland', Holland. But quite a number of contributions were reports of astronomical activities, written mainly by engineers in the Geographic Institute or by naval officers in charge of geographical surveys. It was only in 1919 that a concept to develop astronomy as part of the natural sciences found support in Indonesia.

3 AN ERA OF SCIENTIFIC DEPENDENCY

Western European countries became the home of modern science during the seventeenth century. The Netherlands was one of those countries that entertained the philosophical viewpoint of the scientific revolution, experimental activities, and institutions of learning. All of these are attributes which we now identify as modern scientific enterprise.

The Bataafse Republic also enjoyed great economic progress during the eighteenth century which, in turn, catapulted science into an honorable place in the

world. Historians would, of course, argue the simple correspondence between scientific ascendancy and economic prosperity, but many would agree that scientific institutions enjoyed material abundance to fuel their progression. Certainly there was more to it: what actually counted was the spirit and ethics of scientific thought which served as the agent to propel academic life to high levels of competence.

Thus, by the beginning of the twentieth century, three centres of higher learning were already invested with the research ethic. These were located in Leiden, Groningen, and Utrecht, and each had an institution of astronomy in its own right. Among these astronomy centres, Leiden was at the forefront and was the most privileged. Pyenson (1989) believed that the Leiden Observatory enjoyed the earliest government commitment to astronomy, and it effectively functioned as a member of the Dutch Naval Institute by training officers and calibrating optical and astronomical instruments. Some of the Leiden astronomers received financial support and opportunities to participate in major scientific expeditions to foreign countries and to the Dutch colonies.

During this time, Kapteyn at Groningen created and nurtured his 'laboratory' for measuring and analyzing stellar positions, while Oudemans at Utrecht followed rather different lines. Pyenson (1989) paid tribute to Oudemans as being the most successful person in using colonial ambitions to finance pure learning. Born in Amsterdam in 1827, Oudemans grew up in a scientifically-oriented family, and at the age of sixteen he enrolled as a student at the University of Leiden. There he attended the lectures of Frederick Kaiser, who convinced him to specialize in astronomy. Kaiser later became his mentor.

The chance for Oudemans to visit the Dutch East Indies came in 1857 when the Colonial Ministry, at the proposal of the ever-present Kaiser, sought to chart the topography of the Indonesian archipelago by astronomical means. Oudemans was then appointed by King William III to become the head engineer of the Geographical Service in the Dutch Indies, which prompted him to immediately marry his long-time girlfriend. With a starting annual salary of fl.7200, he set out to follow in the footsteps of his father, to work in the Dutch East Indies, and remained there for the next twelve years. His salary is of course small by present standards, but it was a huge sum in those days.

When he arrived in 'Indie' Oudemans saw before him two tasks which were equally compelling (Pyenson, 1989). The first was to produce detailed maps by the standard procedure of topographical triangulation, and the second was to verify the positions independently by astronomical means. One might have expected that the two calculations would be different due to the perturbing effect of mountain masses on the figure of Earth. The Amsterdam Academy of Sciences expressed interest in the general survey, and it also supported the astronomical side as an exercise in pure learning.

Unfortunately the two-sided nature of Oudemans' responsibilities were not always compatible. In his report to Kaiser in 1858 (Pyenson, 1989) he mentioned specifically that the military and agricultural authorities wanted good maps. The navy, however, gave a cool response to his appeal for astronomy programmes. If he were unable "... to obtain support for carrying out my goals of taking position readings in the archipelago ..." then he would resign himself to his fate and just continue with the routine problem of triangulation. The problem lay in the top-heavy bureaucracy, he said. Kaiser was not happy with the situation, and threw up his hands in despair. His negative opinion of Oudemans' task apparently derived from his experience with an earlier Dutch attempt to survey the Indies. In 1850 the Governor General had asked Sjuurd de Lange to make astronomical observations in the Indies in order to improve maritime charts. However, as was mentioned earlier, the situation in the colony was not conducive to support the project and far from accommodative for pure science.

Without knowing the real situation in the tropics, Kaiser in 1853 severely criticized de Lange for not devoting enough time to astronomical observation and discovery. On the other hand, as was testified to in a letter from Mrs de Lange to Kaiser in the 1850s (Haasbroek, 1977), de Lange had tried hard to do his best to fulfill the expectation of his mentor in Holland. The letter was a humanist document which indicated how different the situation in the tropics was from that in the metropole during the nineteenth century.

Returning to the astronomer Oudemans, we are impressed by his persistence to carry out what he had set out to do. He had a special ambition to devote his time to surveying the 'outer possessions', and throughout his stay in the tropics he continually sought to include them in his geographical mandate. In these enterprizes he received more than casual government support, because such mapping aided their interest in systematic exploration.

To implement such a task covering large areas of the Indonesian archipelago was not an easy undertaking. Fortunately, unlike in de Lange's case, Oudemans had a few more advantages, but his travels had to depend upon when naval gunboats could be spared from policing action. In 1859 he wrote to Kaiser:

> The Naval Deparment received approval of the government to use a steamboat for an expedition with regards to the defining of the already mentioned points, as soon as this would be feasible. Nothing has happened yet. Maybe after the expedition to Bone is finished, there was a revolution in Sulawesi, but then they will probably have to send troops to Palembang.

There was always an atmosphere of uncertainty!

Despite heavy burdens as a topographer, Oudemans determined to remain in contact with European astronomy where, he thought, he would find his place after the Indies assignment. His concern to finish the longitude calculations was related to his broader academic ambitions, and he never lost an opportunity to publish scientific results in Europe. Nobody could blame him for hoping to secure a chair of astronomy in his motherland.

This ambition unfortunately had to be abandoned when he saw H G van de Sande Bakhuyzen succeed Kaiser and move to the chair at Leiden Observatory. However, he soon after heard from his friend, Johannes Bosscha (the father of Karel Bosscha, the Indonesian tea magnate), who had recently been appointed Professor of Physics at the Technische Hogeschool in Delft, that Hoeks, the Director of the Utrecht Observatory, had died. Bosscha asked how Oudemans would feel about returning to Utrecht. The message from Bosscha created a spark of hope, as it also included the comment that "... some people feel that his place should be kept open until you get back from the Indies, a course that does not seem objectionable." Oudemans did return to Utrecht some time later, but unfortunately he encountered some uncomfortable situations which will not be elaborated upon here.

However, one aspect that should not be left untouched is the scientific part of the triangulation. This all began with the initiation of the Naval Commander in Batavia, Admiral Marie Isaac Brutel de la Riviera. In 1878 he wrote to Governor General Wilhelm van Lansberge that the whole program concerning mapping of the outer possessions could now be placed back on track – and should not be delayed – if Oudemans could be persuaded to supervise the final reduction and publication of the Javan data.

Oudemans was indispensable because of the peculiar way that pure science had become an essential part of the programme. The Geographical Service had to determine the figure of Earth by employing the results of true absolute latitude and longitude measurements. In the 1870s the scientific part of the triangulation became the inherent element of the Geographic Science. Controversy appeared only later

when astronomical observations had received more serious attention. The Government then realized that accurate maps of Java did not depend on Oudemans' programme. About this Oudemans, understandably, replied reverently, and he stated in his retirement address (in 1898) that his Batavian stay was a digression, although he added that he had tried to apply a good part of the science of astronomy in his work (Pyenson, 1989).

The episode outlined above was not unique to the Indonesian case nor to astronomy, and portrayed the so-called Phases One and Two in the Basalla (1967) model of scientific diffusion. In this model Basalla treats science as a specific culture, and the spread of science as the transmission of that culture through a process which moves from cultural dependence to independence. Phase One coincides with the era when the 'nonscientific' society or nation provides a source for European science. Here the word 'nonscientific' refers to the absence of modern Western science, as was shown in the early epoch of exploration in Indonesia. With varying speed, depending upon the countries involved and the importance attached to a particular field of science, Phase One was followed by Phase Two. Phase Two is marked by a period of 'colonial' science. Sciences like biology and zoology would understandably not only enter Phase One earlier than astronomy but they would reach the second phase sooner, because of necessity. The Baconian principle was clearly heard by the Dutch colonists in Indonesia, as well as by British explorers in India and Australia. Bacon counselled "... look about (for) what kind of victual the country yields of itself ... [and then] ... consider ... what commodities the soil ... doth naturally yield, that they may in some way help to defray the charge of the plantation." This explains part of the phenomena which have just been described, namely the growth, the speed of progression, and the execution of astronomy in the Dutch East Indies theatre. In regard to colonial science in India, readers should refer to Kumar's 1993 and 1995 treatises on science and the Raj.

4 THE EMERGENCE OF AN INDEPENDENT ASTRONOMICAL TRADITION

Basalla (1967) categorizes the third phase of his diffusionist model as the phase where the process of transplantation takes place with a struggle to achieve an independent scientific tradition. Based upon a different starting point, MacLeod (1982) expounded the view of an "imperialist model" in which he treats scientific culture as an aspect of political hegemony. In his model, science transmission is regarded as an implementation of imperial policy. The transplantation of astronomy to the tropical Dutch territory during the first quarter of the twentieth century would hardly fit the scheme of MacLeod. It fits, in my opinion, that period included in the third phase of Basalla's model, except during the interregnum period of the Japanese occupational force.

According to Hins (1950) three main events blended together to give the impetus to found a powerful Dutch observatory in the southern hemisphere. The first, as already discussed, was the need to open up the southern sky for astronomical research. This had been stimulated by the research of J C Kapteyn at Groningen. During the first two decades of the twentieth century Kapteyn had convincingly shown the importance of statistical astronomy in order to study the structure of our Universe. His paper titled "First attempt at a theory of the arrangement and motion of the sidereal system" (Kapteyn, 1922) represents the culmination of his work. Here it was shown that the lack of understanding of the structure of our Universe was partly hindered by the relatively small amount of information that had been gathered from the southern hemisphere. Up to that time, a large number of observatories were found in the northern hemisphere, and it was seen as necessary to have more southern stations where modern astronomical observations could be carried out.

The second reason was the enthusiasm of Dr J G E G Voute, a civil engineer-turned-astronomer. He was Assistant at the Royal Observatory in Capetown before being invited by van Bemmelen to take charge of the time-keeping section of the

Meteorological Office in Jakarta. Voute had an interest in double-star astronomy, which had been aroused when he was associated with the Commission of Latitude Determination and had been appointed an observer at the Leiden Observatory. His six year stay at Capetown (from 1913 to 1919) not only allowed him to gain more experience in observational astronomy, but it also determined his outlook for the future. Upon his return to Indonesia he decided to follow a course which eventually led him to found an astronomical observatory.

Last but not least, is the stature of Mr K A R Bosscha, then the administrator of a flourishing tea estate in Java. His was the most influential non-astronomical factor that helped to shape and materialize the idea of an astronomical observatory in the tropics. When Voute approached him for help, Bosscha was already a legendary figure through his generous support of the scientific community in the colony. A detailed account of Bosscha was presented by van der Hucht and C L M Kerkhoven in 1982, but a few words about his involvement with the Technische Hogeschool (TH), which he founded in 1920, are warranted. He became head Curator of the TH, which was in Bandung, and showered it with his wealth and his energy. Included in the school was the Bosscha Physical Laboratory, where Professor C Clay studied cosmic rays.

These were the three factors that finally paved the way for the foundation of the Dutch East Indies Astronomical Association in 1920, the primary task of which was to build an observatory and, in the widest sense of the words, to promote the progress of astronomical science in the colony. Initiated by a telescope of 7 inches aperture donated by Professor de Sitter of Leiden Observatory, parallax observations were begun at Lembang in the early part of the 1920s at what is now the home of the Bosscha Observatory Figure 1). When the Observatory was still in *statu nascendi*, Professor van de Sande Bakhuysen (the retired Director of Leiden Observatory), at Bosscha's request, donated his fine and extensive collection of books. These were soon to become the core of the Bosscha Observatory library which, thanks to the Leids-Kerkhoven Bosscha Foundation, is still the prime astronomical library in Indonesia.

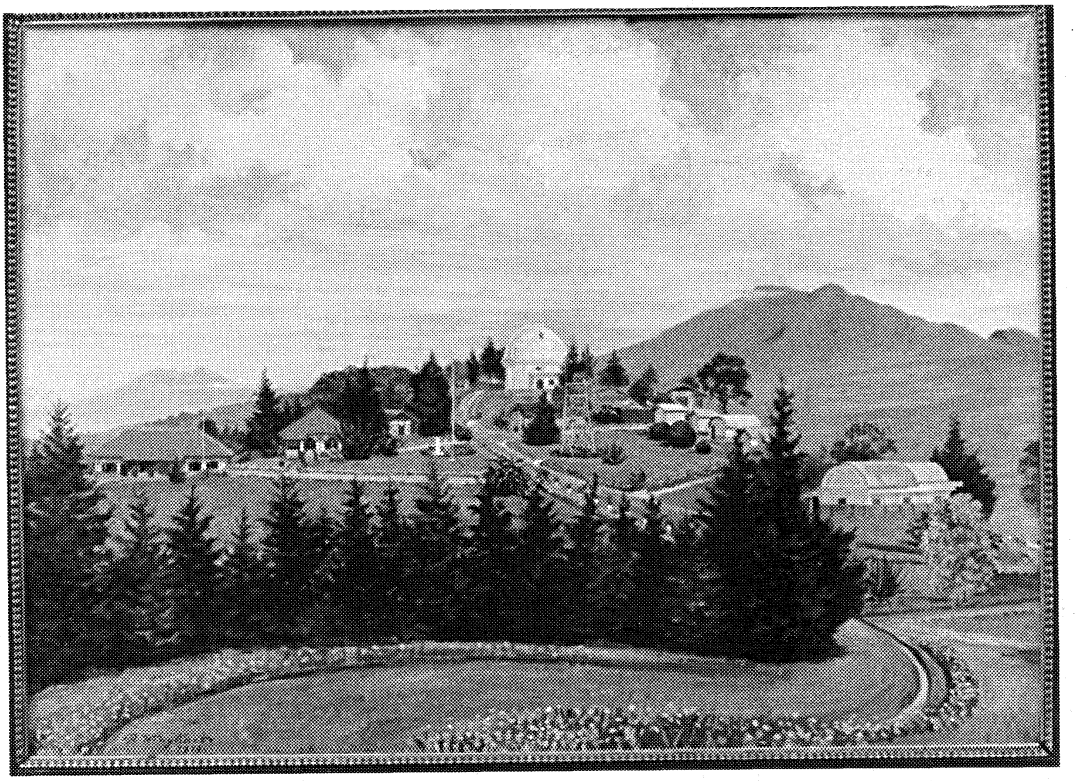

Figure 1. The Bosscha Observatory Complex as seen by a Dutch Artist in the late 1920s. From the original work to be found at the Leiden Sterrenwacht, The Netherlands).

In 1928, after five years of hard work, the main instrument was finished, a 60-cm double-refractor made by Carl Zeiss of Jena. As it has already been described by Voute (1933) and others, I shall not provide any technical details here, but it is worth noting that the completion of this telescope marked the beginning of 'modern' astronomical research in Indonesia.

Looking back at the founding process one could ponder the fact that the road to the establishment of an Indonesian observatory was not as smooth as it seems at first sight. The Director of the Royal Magnetic and Meteorological Observatory, Professor van Bemmelen, continually complained to de Sitter about the poor conditions for observing in Indonesia, even though they were far better than those of Leiden. Van Bemmelen seemed rather reluctant to see another scientific institution besides his own one faring well, and he also believed that it would be better if the new observatory could be part of his institute.

Another problem which arose during that period was caused by Voute's expectation that there would be an independent Director in the 'Indies', even though he saw no other alternative than to follow closely the research programmes pursued by Leiden. De Sitter did not actually object to this as he was not interested in a power-sharing arrangement with Groningen. In practice, he anticipated that the Director in Java would make all the local decisions and so "... it would be better to allow and recognize his power."

A third problem related to the fact that the Leiden-South Africa connection had become very strong by this time, and many Dutch astronomers had worked in South Africa and served in the observatories there. As a matter of fact, in 1923 de Sitter arrived at a bilateral exchange agreement with Dr Innes from the Union Observatory to make facilities at Johannesburg and Leiden open to astronomers from both institutions. These agreements allowed Dutch astronomers to observe the southern sky, but not from Java. Although the Leiden Professors de Sitter and Hertzsprung corresponded with Voute and with Bosscha during both the pre- and post-construction phases of the Javan observatory, the exchange had no spirit (Pyenson, 1989), and it is significant that not a single Leiden astronomer was at the opening ceremony.

Besides the photographic observation of visual double stars by Voute (1933), who served also as its first Director, several other interesting programmes were conducted at the new observatory, which was named the 'Bosscha Observatory'. In 1926 Professor Pannekoek of Amsterdam spent several months at the Observatory extending his work which was started earlier on the northern sky. This was to draw isophote brightness lines of the southern Milky Way, and many years later this monumental work was employed as a basis for the Milky Way sections of the well-known *Skalnate Pleso Atlas*, an indispensable tool for students of galactic structure. The Observatory honoured Pannekoek's visit by naming one of its observer houses "Rumah Pannekoek" (Pannekoek House), and in more recent times many visiting astronomers have stayed there when making observations at Lembang.

Other visiting astronomers early in the history of the Observatory were Dr Paul Ten Bruggencate of Göttingen (Germany) and Dr E A Wallenquist of Uppsala (Sweden). The first-mentioned astronomer studied globular clusters and carried out photometric and spectroscopic studies of variable stars, while Dr Wallenquist innitiated theoretical studies at the Observatory. He investigated some southern galactic clusters by means of their colors, and studied distributions of stars, particularly in the Sagittarius and Ophiuchus regions. A noted astronomer of the pre-War era was Dr E A Kreiken from the Amsterdam School of Astronomy, and his interests and contributions ranged from theoretical studies of physical double stars to the general distribution of stars in the Milky Way, but in particular in Scutum. Later, in 1950, Kreiken (1950) determined the Oort Constant and the potential energy of the galactic system.

Some notes on personal accounts may be relevant in this context. After a successful undertaking of ten years at Bosscha, Wallenquist returned to his native country to become Professor of Astronomy at Upsalla University. In his account, Wallenquist (1987) described the good weather condition prevailing at the Bosscha Observatory, where about 50% of nights could be used for observing. This percentage was of course higher, reaching about 80%, during the dry season (from April to October). Kreiken, who did not stay long at the Observatory, became a teacher in the HBS (school) in Central Java, and after World War II became head of the Department of Higher Education in Jakarta. According to E van Albada-van Dien (1994), he was instrumental in obtaining UNESCO's donation of the Schmidt telescope to the Bosscha Observatory. We shall return to this instrument later. *Annals* of the Observatory were published until the 1940s, and Volume IV (1940) contained the results of double star observations conducted by many astronomers. Besides Voute and the three scientists already mentioned above, Dr G Simonov participated in the observing programmes from 1936.

In 1939, Dr A de Sitter and later Dr Chr Martin, both from the Leiden School of Astronomy, came to join the staff of the Observatory, and stayed until the war broke out. Due to his age, Voute retired in this same year, and he was replaced as Director by Dr de Sitter.

Between 1943 and 1945 Indonesia was under the control of the Japanese military, and Professor Masasi Miyadi, a young Japanese army captain who later became Director of the Tokyo Astronomical Observatory, was in charge of the Bosscha Observatory. His presence saved the Observatory from improper treatment that might otherwise have taken place. According to his own account, Miyadi (1975) recognized Voute's administrative ability and was also responsible for putting him back to work in Lembang (instead of staying in a concentration camp). However, Miyadi's act was not unique as there were many other Dutch nationals in the occupied territory who were asked to continue administrative duties under the eyes of the military. This situation persisted at least until 1943 when the war situation became intolerable for employing Dutch nationals. Voute worked at the Observatory until the end of World War II, and it was he who received the official "transfer" of the facility back from Miyadi.

Despite Miyadi's efforts, the Second World War and subsequent conflicts were disastrous for the Observatory. Not only did three leading members of the staff perish, but many instruments were found to have deteriorated. After the War, Dr C Hins (1950) was sent to Indonesia from Holland to restore the Observatory, and he found the ground in a jungle-like condition. Discussions soon took place between Ir Poldervaart (Army Triangulation Brigade), Professor Dr H P Berlage (Director of Meteorology and Geodesy Office in Jakarta) and Hins to chart the steps necessary to put the Observatory into effective use once again. It took almost three years to rehabilitate the Observatory, and by August 1949 photographic observations could be resumed. Dr Elsa van Dien (later Elsa van Albada-van Dien) and Dr G B van Albada took charge of the Observatory, and they decided to continue the double star programme and laid down important plans for the 1950s. To the best of my understanding, the Lembang-Leiden connection was maintained in good condition by the van Albadas during this period. It was also during this period that Dr Iwan Nikoloff of Bulgaria joined the staff and conducted some double star observations, while Mr Santosa Nitisastro served as an assistant astronomer.

5 ASTRONOMY EDUCATION AND A NEW TELESCOPE

The importance of teaching astronomy at the university level was realized as far back as 1948, when it received attention from the Dean of the Faculty of Mathematics and Natural Sciences of the University of Indonesia, Professor M Th Leeman. He made the necessary arrangements to transfer the Observatory from a private institution (the

Dutch East Indies Astronomical Association) to the University, and in October 1951 it officially became part of his Faculty (which was later to become the Faculty of Mathematics and Natural Sciences of the Bandung Institute of Technology). In the process, Dr G B van Albada was made the first Professor in the Department of Astronomy. This was the beginning of an association with the University which would ensure a continuing supply of astronomers. It was also the first time that Indonesia incorporated an astronomy curriculum into its tertiary education programmes. Before that time, astronomy (in the guise of 'Cosmography') was taught at the secondary school level, and the classical text books by Visser or Raymond were used in high schools throughout Indonesia.

The model of astronomical education was derived from the Dutch university system, where the first three years leaned heavily on courses in physics and mathematics, with a relatively smaller amount of astronomy. Only after students passed successfully their first three years could they embark on real astronomy courses. The later part of their studies took between two and two and a half years. This system of education persisted until about 1965, when tertiary education in Indonesia became more oriented towards the Anglo-Saxon model, which made it possible for a student to follow a Bachelor's degree with a Masters or a Doctoral degree. Realizing the isolated position of Lembang as far as astronomy is concerned, young graduates are still encouraged to obtain their higher degrees in astronomy abroad. This practice allows younger colleagues to experience contact with a wider circle of astronomers, and hopefully will prevent 'in-breeding'. With this attitude in mind, Bosscha Observatory astronomers purposefully seek to establish co-operation with astronomers from other countries.

A new research direction was initiated at the Observatory in 1959 when a new 51-cm Schmidt-type $f/3.5$ telescope became available. This instrument telescope came into existence through a UNESCO project that was started in 1951, and involved the co-operation of astronomers, optical workers, and engineers from Indonesia, the Netherlands, and the United States. The optical parts for the telescope where donated by UNESCO and were prepared at the Yerkes Observatory (University of Chicago) under the supervision of Dr G P Kuiper, a former Leiden astronomer. The mechanical parts were contracted out by the Indonesian Government to the engineering firm of Rademakers (not the chocolade firm!) in Rotterdam, under the supervision of Ir B G Hooghoudt of Leiden. The assembly, adjustment, and testing were completed successfully by Dr V M Blanco from the Case Institute of Technology's Department of Astronomy (in Cleveland, USA) and Professor Pik Sin The, who is now at Amsterdam. Officially inaugurated on 1960 May 28, the telescope was used immediately to survey Hα emission-line stars in the direction of the galactic centre. Pik Sin The (1961) has already given an elaborate description of the new telescope and I shall, therefore, not repeat it here. Suffice it to say that an important feature of the telescope is its large field of view (5° x 5°), which means that it is a good instrument for research into galactic structure. In addition, the telescope is equipped with a 6° objective prism, with which spectroscopic work can be carried out.

In 1994, at a conference on The Schmidt Telescope, van Albada-van Dien (1994) gave an interesting and a very personal account of the birth of the Bosscha Observatory's Schmidt telescope. Let me quote from her paper:

> UNESCO agreed to the change that involved a somewhat higher price, and contacted the government of Republic of Indonesia about the matter. The government was told that UNESCO was willing to donate the optical parts of a Schmidt telescope for Bosscha Observatory, on the condition that the government would guarantee in writing the cost of constructing the mounting and operating of telescope. Before accepting this obligation, the officials dealing with the project sought information

about the probable costs of mounting. Based on a completely inexpert estimate of US$16,000 the government accepted the offer from UNESCO and signed the contract, to our great satisfaction.

Van Albada was then asked to find a construction company for the mounting. He contacted various well-known telescope construction companies, who offered to build the mounting for a mere (*sic*!) US$150,000 to 200,000. Gone was our satisfaction ... Van Albada in his despair contacted Jan H. Oort, Director of Leiden Observatory Foundation, a foundation, however, that in no way could make up the difference. Oort discussed the problem with the company of Rademakers in Rotterdam, a factory of high-precision tools, among which were cog-wheels. The director of that firm took a great interest in astronomy, and the firm had worked for the Leiden Observatory and Mt. Palomar Observatory. In his explorations to reduce the cost of the mounting, Oort also contacted the directors of the Mt. Wilson & Mt. Palomar Observatories. Mt. Palomar just had at its disposal the "big S," at that time the largest Schmidt telescope in existence. Its director obliged us greatly by allowing Rademakers the free use some of the designs for the "big S," among which that of the plateholder. Rademakers for its part would not charge us for a variety of other designs. And thus the marvel materialized that in 1953 Rademakers made the offer to build the mounting for US$16,000, or a little more. In case the cost would exceed US$18,000, the Leiden Observatory Foundation would provide up to US$4,000 (in the end the Foundation had to provide only US$1,000), and UNESCO too promised an additional US$2,500.

All that remained to be done, in 1954, was for the Indonesian government to sign a contract with the firm of Rademakers for the construction of the telescope mounting. Each and every one of the officials at the Department of Education in Jakarta who was party to the contract expressed great satisfaction with the offer. But the signing of the contract did not come about. It took us years to find out why, and in 1955, after a leave-of-absence, we almost decided not to return to Indonesia unless the contract was signed by the Indonesian government. Finally one of the Bandung university assistants discovered why and how: two of the government officials in Jakarta who were supposed to sign the contract were not on speaking terms with each other! We then easily passed this bottleneck by carrying in person the contract from one to the other. Meanwhile it was June 1956.

Rademakers had already done much of the preparatory work, started the actual construction of the mounting in 1957, and finished it in March 1958. The large cases containing the mounting arrived by ship in Tanjung Priok, the harbour of Jakarta, in May 1958. Van Albada and his student, Santoso, personally went to Jakarta to oversee the careful handling of the precious shipment. It took them three or four days of custom formalities, bureaucracy and some friendly gestures to get the cases from the harbour. On the final stretch to Lembang all that could go wrong went wrong. Out of gas, the crane that was to unload the truck broke down, and it turned out that the large cases with the mounting could not pass through the door of the telescope building. But, as always, solutions were found.

6 INTERNATIONAL CO-OPERATION AND THE FUTURE

The participation of Indonesia in international co-operations may be represented by its readiness to organize meetings in the country. In 1963 an international symposium on 'Stellar Photometry and Spectral Classification' was hosted by the Institute Technology Bandung, the parent institution of the Bosscha Observatory. The meeting was under the general supervision of Professor Pik-Sin The. In 1973 the International Astronomical Union entrusted Indonesia to organize an IAU School for Young Astronomers, and twelve participants from five countries took part in this meeting. Similar activities were organized again in 1983, this time in conjunction with the 60th Anniversary of the Bosscha Observatory; twenty astronomers from six countries came to attend the School, and there were fourteen teaching staff from seven countries. Professor de Jager, in his dual capacities as an officer of the IAU and a Professor of Astronomy at Utrecht, has been very supportive of Indonesian astronomy.

Indonesia only became a member of the IAU in 1979, and the late Professor Edith Muller (Switzerland) and Professor A. Blaauw (Netherlands) are to be thanked for their support. Two years after that, the Second Regional Asia-Pacific Meeting on Astronomy was organized in Bandung. This meeting, which was attended by over 115 astronomers, discussed the problems of Galactic Structure, Extra-galactic Astronomy, Binary and Variable Stars, and Astronomy Education. Since this time, the topic of Astronomy Education has been an essential feature of these Regional Meetings.

The year 1983 commemorated the 60th Anniversary of Bosscha Observatory, and in order to celebrate the occasion the IAU sponsored a Colloquium (No. 80) on Double Stars, with emphasis on physical properties and generic relations. On this occasion, and on many others, the Leids-Kerkhoven Bosscha Foundation has stood ready to promote our astronomical endeavours, and for these gestures the community of Indonesian astronomers wishes to express its grateful appreciation.

Another aspect of international co-operation is the link between astronomy in Indonesia and Japan, which was started in 1978. The activities of this fruitful co-operation have been reviewed by Kogure and Hidayat (1985).

A revival of Dutch-Indonesian co-operation in astronomy has been established formally within the framework of 'Indonesian-Netherlands Astrophysics' (INA), which has operated under the cultural treaty between the Indonesian and Dutch governments. Four main research areas have been adopted in the co-operative work. They are:

- studies of visual binaries;
- studies of the spatial distribution of the hottest and coolest stars;
- high- and low-energy astrophysical studies of evolved massive binaries; and
- investigation of shock waves and particles in curved space time corresponding to plasma and condensed media.

Under this umbrella of co-operation, Indonesian students have had the opportunity to study in the Netherlands and obtain higher degrees in astronomy.

The Indonesian astronomical community is naturally looking forward to the realization of hardware projects, which would enable it to expand its activities and research. Since the Schmidt telescope of the 1960s, a new 45-cm telescope has been commissioned (in 1989). This instrument, which was obtained through the Indonesia-Japan collaboration, is dedicated to photometry of close binary stars. A versatile instrument, this telescope is also used to carry out spectroscopic studies.

An anticipated project is the acquisition of a large optical telescope. The original idea was launched by van der Hucht (1984), who suggested that a 2.5-m class telescope would be suitable for Indonesia. The idea has been received with great and sincere enthusiasm in Indonesia, and it is hoped to produce a more elaborate view on this project in the future. Another suggested project, which has been temporary shelved, is to establish a metre radio telescope in equatorial Sumatera (see Swarup, Sukumar and Hidayat, 1984).

7 IN RETROSPECT

Since its emergence in the Netherlands back in the seventeenth century, science has become a permanent engine of progress and a determining force in the pursuit of betterment. The hegemony, and to some extent exploration, of the West in general, the Dutch in particular, has brought the earth, meteorological, biological, and astronomical sciences into our oriental Indonesian domain. In principle we, in the east, accepted the message of modern science and technology. Of course we do realize that the implantation and the effective application of such concepts strike against some long-rooted traditions and, consequently, attitudes. Therefore, the existing social structure in Indonesia may affect the growth of science in our country.

When it proclaimed its independence in 1945, Indonesia inherited a set of good modern scientific institutions, in which we should rejoice. However it took us a reasonably long time to recover the manpower needed to steer the high and noble enterprise due to the disruption of World War II. In the meantime, during the same period, new avenues of activities and new priorities relating to social institutions and welfare have impacted on our working domain. All of these have to be solved simultaneously if the country is to survive the demands of the modern world.

Astronomy eventually found its place in Indonesia, thanks to the founding fathers and Dutch scientists after World War II. Of course many things still have to be done if we are to show ourselves on the plane of modern science. There is one maxim which I would like to reiterate, that I learned in 1951 from Minnaert's book, *De Sterrenkunde en de Mensheid* (Servire, Den Haag, 1946): "Van de universiteit moet zich de wetenschap geleidelijk over het gehele volk verspreiden, zoals het bevruchtende water van de hoogten der bergen daalt en valleien bevloeit." which tranlates approximately as: "From the university scientific knowledge should flow throughout the entire population, just as enriched water from the mountains fertilizes the valleys below." This is precisely what we are striving to do with our numerous seats of higher learning in Indonesia.

8 NOTES

1 Adapted from the 'Lustrum Lecture', given at University of Leiden, May 18, 1995.

2 Frederick De Houtman was the brother of Cornelis de Houtman who later became a high official in the Dutch East Indies Company and the Governor of the islands of Maluku.

3 When de Houtman arrived on the shores of Aceh, the study of stars in the Indonesian archipelago had already been the practice of seafarers and farmers since time immemorial. The main purpose of the practice was to construct a calendar system from which agricultural activities could be organized and religious ceremonies could be conducted. Inter-island voyages also required a knowledge of the sky. It is beyond the scope of this paper to describe in detail the practice of astronomy in ancient Indonesia, but for a recent review see Hidayat (2000).

9 REFERENCES

Basalla, G., 1967. The spread of Western science. *Science*, **156**:611-622.

Dekker, E., 1987. Early explorations of the southern celestial sky. *Annals of Science*, **44**:439-470.

Haasbroek, N.D., 1977. *Prof. F. Kaiser and S.H. De Lange in hun relatie tot de Astronomiesche Plaatsbepalingen van omtrent 1850 in her voormalige Ned Indes*. Rijkscommissie voor Geodesie, Delft Netherlands. (in Dutch).

Hidayat, B., 1994. *400-year Dutch-Indonesian Relation*. Erasmus Huis, Jakarta. Unpublished.

Hidayat, B., 1997. Astronomy in Indonesia. *Journal of the Korean Astronomical Society*, **29** (Supp. Des.): S455-S457.

Hidayat, B., 2000. Indo-Malay Astronomy. In the H. Selin (ed.), *Encyclopedia for Astronomy in non-Western Culture*. In press.

Hins, C., 1950. Astronomie. In P.J.W. MacDonald, P. Braber, and H.G. Derx (eds.), *Een Eeuw Natuurwetenschap in Indonesie*. Konink Natuurk Vereeniging, Batavia. (in Dutch).

Kapteyn, J.C., 1950. Op. cit. Hins, 1950.

Kogure, T. and Hidayat, B., 1985. In *Galactic Structure and Variable Stars*. University of Kyoto, Department of Astronomy, Kyoto.

Kreiken, E.A., 1950. Office for Scientific Research, Publication No. 10, Jakarta, Indonesia.

Kumar, Deepak, 1993. *The concept of colonial science*. At International Congress of History of Science, Zaragosa, Spain, 22-29 August 1993. (an unpublished conference paper).

Kumar, Deepak, 1995. *Science and the Raj*. Oxford University Press, Oxford.

MacLeod, Roy, 1982. Changing perspectives in the social history of science. In Ina Spiegel-Rosing and Derek J. de Sola Price (eds.), *Science, Technology and Society*. London.

Miyadi, Masasi, 1975. The transfer of the Bosscha Observatory. *Astronomical Herald*, **68**:319-321. (In Japanese, and kindly translated by Prof. N. Sato).

Pyenson, L., 1989. *Empire of Reason*. Brill, Leiden.

Pyenson, L., 1990. Why science may serve political ends: cultural imperialism and the mission to civilize. *Wissenschafts-Geschichte*, **13**:65-68.

The, Pik-Sin, 1961. Bosscha New Schmidt Telescope. *Contributions from the Bosscha Observatory*, **17**.

van Albada-van Dien, E., 1994. The Bosscha Schmidt Telescope. In J. Chapman, R. Cannon, S. Harrison, and B. Hidayat (eds.), *The Future Utilization of Schmidt Telescopes*. San Francisco, Astronomical Society of the Pacific (ASP Conference Series No. 84), pp. 15-18.

van der Hucht, Karel A., 1984. 2.5 meter telescope for Indonesia. In B. Hidayat, J. Rahe and Z. Kopal (eds.), Double Stars, *Astrophysics and Space Science*, **94**:409-410.

van der Hucht, K.A. and Kerkhoven, C.L.M., 1982. De Bosscha-Sterrenwacht: van thee tot sterrenkunde. *Zenit*, July-Aug.: 292-300. (in Dutch).

Voute, J., 1933. Ann. v.d. Bosscha Sterrenwacht, Volume 1. Gebrs. Kleijne & Co. NV, Bandung.

Wallenquist, E., 1987. Over het leven op Bosscha Sternewacht bij Lembang een halve eeuw gleden. *Orion*, 1987 (Nov):6-9. (in Dutch).

Bambang Hidayat is a Professor of Astronomy at the Department of Astronomy, Institut Teknologi Bandung, and at the Bosscha Observatory of the same Institute in Bandung, Java, Indonesia. A Javanese by birth, he received his first degree (doctorandus) in astrophysics in 1960 at ITB. In 1965 he was awarded a Ph.D. in astronomy at the Case Institute of Technology, Cleveland, Ohio, USA.