

IV REPORT

OF THE

VISITING REVIEW COMMITTEE

FOR THE

NATIONAL ASTRONOMICAL
OBSERVATORY OF JAPAN

December 1997

REPORT OF THE VISITING REVIEW COMMITTEE FOR THE NATIONAL ASTRONOMICAL OBSERVATORY OF JAPAN

Executive Summary

Introduction

- (i) Japanese astronomy is currently in a phase of rapid growth. Japanese astronomers are having an increased impact upon world astronomy and are making major contributions to many frontier topics in astrophysics and cosmology, both in observation and in theory. As the single organisation responsible for all aspects of ground-based astronomy, the NAOJ has a central role to play in the development of new national facilities, such as Subaru, for Japanese and world astronomy .

Major Projects

- (ii) The single most important project for the future development of astronomy in Japan is the Subaru 8.2-metre optical-infrared telescope in Hawaii. The large manpower effort needed during the early years, both for operations and the support of data analysis facilities and archiving should not be underestimated. It is recommended that initially it will be strategically most effective to commission a small number of core instruments with optimised performance. The problems of travel to Hawaii for all staff members and for graduate students should receive urgent attention. The initiatives to develop international partnerships for instrument development and the scientific exploitation of Subaru are welcomed.
- (iii) The LMSA project is fully and very strongly endorsed. It is hoped that full approval of the project can be realised as soon as possible. The Committee also strongly recommends the immediate implementation of the Rainbow project, to incorporate the 45-metre telescope into the millimetre array at Nobeyama. This continues to be a very high priority project, not only for its astronomical importance, but also as part of the R&D efforts for the LMSA project. It is also essential that the many other R&D activities necessary for the LMSA be pursued vigorously until the construction phase is fully approved. Similar

submillimetre array projects are being developed in the USA and in Europe. The Committee recommends that the R&D activities for the LMSA project should proceed vigorously, and that these should be carried out in close consultation with the US and European projects, with a view to ensuring their compatibility for integration into a 'World Array' when that becomes feasible.

- (iv) The Committee strongly recommends the implementation of the VERA project with immediate funding. Not only is it an imaginative and important project in its scientific goals and engineering challenges, but it will also be important in stimulating the radio astronomical community in the post-Subaru era, in preparation for the LMSA.
- (v) The Committee strongly endorses the involvement of NAOJ scientists in the Solar-B project and recommends the strengthening of the links between NAOJ and ISAS. It is timely to study in more detail the relations between NAOJ and ISAS in the support of space astronomy missions. The continued operation of the solar radio interferometer facilities is recommended, as long as they are providing useful support to the Solar-B project. The Committee recommends that the Norikura Observatory should be closed in the near future.
- (vi) *The construction of the TAMA300 gravitational wave detector is very impressive. It is not clear what the future direction of this programme will be in the era of the LIGO and VIRGO arrays. The primary involvement of research groups outside NAOJ is essential if the program is to develop into a larger facility at a more spacious site.*

Other Projects

- (vii) The Committee welcomes the initiative to provide supercomputer facilities for the Japanese astronomical community as a whole through the NAOJ. Whilst recognising the scientific merit of the RISE project, it is rated as of lower priority than the other major parts of the NAOJ program. The ongoing development of optical-infrared interferometry at roughly the level proposed is supported.

The Organisation of the NAOJ

- (viii) It is mandatory that the NAOJ develop a greater capability for R&D activities for new and on-going projects. The Committee welcomes the foundation of the Advanced Technology Center as a means of fostering R&D activities.
- (ix) The Committee fully endorses the new Divisional and Departmental structure proposed for the NAOJ. The new structure will require additional staff as the new programmes are approved. The Committee believes the manpower requests are reasonable.
- (x) Research scientists are required to carry out a great deal of support work which would normally be carried out by support staff at other observatories. The ratio of technicians to scientists is much greater in the support of national and international facilities in the USA and Europe than it is in Japan. It is essential to correct this imbalance so that the astronomers can devote more of their effort to research. There remains a severe problem in determining a proper career progression for the majority of the technician/engineers.
- (xi) The Committee is in favour of keeping the 1.88-metre Okayama telescope in operation, in support of the Subaru project. The Committee recommends that the Dodaira Observatory should be closed in the era of the Subaru project.

Astronomy in Japan

- (xii) The numbers of astronomers in Japan, and particularly in the Universities, is extremely low relative to other advanced countries and to the very major investments which have been made in astronomy in Japan. The Committee wishes to see every endeavour made to increase the numbers of Japanese scientists involved in the astronomy program .
- (xiii) The Committee strongly recommends an active and out-going programme of Public Outreach as an essential component of all large Observatories.

REPORT OF THE VISITING REVIEW COMMITTEE FOR THE NATIONAL ASTRONOMICAL OBSERVATORY OF JAPAN

1. Introduction

The Visiting Review Committee for the National Astronomical Observatory of Japan (NAOJ) was invited by its Director-General, Professor K. Kodaira to carry out a review of the activities and future plans of the NAOJ. The Terms of Reference proposed by Professor Kodaira are given in Appendix A. The Review Committee agreed to these terms of reference and to the proposed schedule for the Visiting Review Committee (Appendix B).

The members of the Review Committee were: Dr. Akito Arima (chairperson), Dr. Lodewijk Woltjer (co-chairperson), Dr. Malcolm Longair (report editor), Dr. Laura P. Bautz, Dr. Yasuo Tanaka, Dr. Tsuyoshi Masumoto, Mr. Hitoshi Osaki and Dr. Ikuo Kushiro. Dr. Yoshihide Kozai was Advisor to the Visiting Review Committee. The Director General and his senior staff, as well as representatives of the University Community, were present throughout the open sessions of the Review and provided very helpful information on all issues raised by the Committee.

The Committee recognises the enormous amount of work and careful thinking which has gone into the preparations for the Review and congratulates all those concerned in making so much of the essential information available to the Committee.

2. Overview of the Achievements of the NAOJ

The NAOJ has now been in existence for almost 10 years, having been founded in 1988 to coordinate all the activities in ground-based astronomy in Japan. Central to the programme during these years has been the continued development of the Nobeyama Radio Observatory and the construction phase of the Subaru 8.2-metre optical-infrared telescope in Hawaii. At the same time, members of the Observatory have played a full role in space projects such as YOHKOH and HALCA. During these years, astronomical activity has developed enormously in Japan, a particularly important aspect

being the large increase in the number of graduate students and post-doctoral workers working in the areas supported by the NAOJ. The students have found the NAOJ a stimulating and exciting environment for carrying out research and the Committee was strongly impressed by their obvious enthusiasm .

The Committee was informed of many scientific highlights of the work of the Observatory at the frontiers of current astronomical research and singles out a few of these as representative of outstanding world-class astronomy carried out at the NAOJ:

- (i) The detection of the carbon monoxide molecule CO in the very distant quasar BR 1202-0725 at a redshift $z = 4.69$, indicating that there is a vast amount of molecular gas associated with a very massive galaxy at early cosmological epochs with the Nobeyama Millimetre Array;
- (ii) The discovery of a rotating protoplanetary disc moving in Keplerian orbits about the young star GG Tauri by observations with the 45-metre Nobeyama Telescope and the Millimetre Array;
- (iii) The discovery of a magnetic reconnection event in a compact solar flare, identified by hard X-ray emission at the footpoints and peak of the arch of a solar loop, from observations with the YOHKOH satellite;
- (iv) The discovery of the most convincing evidence for a supermassive black hole in the nucleus of the galaxy NGC4258, in a collaborative program of observations with the Nobeyama radio telescope, followed up by observations with the US Very Long Baseline Array.

The excellence of the research includes the area of theoretical astrophysics. A significant part of these endeavours is being conducted at the NOAJ, as part of the support for Japanese astronomy as a whole, and is often carried out in collaboration with University scientists.

The vitality of astronomical research in Japan was vividly demonstrated by the great success of the 23rd General Assembly of the International Astronomical Union held in Kyoto in August 1997. The members of the Committee who attended the General Assembly were particularly impressed by the quality of the work presented by the young Japanese astronomers and to observe their full integration into the international community of young astronomers. It is gratifying that there is a large demand for higher degrees in astronomy from well-qualified students and the astronomy Professors in

the Japanese Universities are very fully occupied in coping with the increasing numbers of research students.

Japanese astronomy is in a phase of rapid development and Japanese astronomers are making increasing contributions to many different aspects of the astronomical sciences. This development will continue into the first quarter of the 21st century. Japanese astronomers, and the international community, are keenly looking forward to the coming generation of advanced astronomical facilities. As the single organisation responsible for all aspects of ground-based astronomy, the NAOJ has a central role to play in these developments in Japan and in the world at large.

3. SUBARU

The single most important project for the future development of astronomy in Japan is the SUBARU 8.2 metre optical-infrared telescope in Hawaii. With this development, Japan has leap-frogged into the big league of world optical-infrared astronomy. First light is expected in the summer of 1998 and full operations are planned to begin in 2000. The Committee was informed of the plans for the completion of construction and the commissioning of the telescope and endorses these proposals. The Committee offers the following reflections upon the proposals by the project team :

- (i) Commissioning the telescope and its instruments will involve a very large effort. Past experience suggests that it will take some time beyond the formal date of the completion of commissioning before the Telescope will enter its routine operational phase. It is important not to underestimate the large manpower effort needed during the early years of operation.
- (ii) To foster instrumentation development in Japan, a suite of seven instruments is proposed for the initial complement of scientific instruments. The reasons for adopting this ambitious plan are applauded. The Committee suggests that past experience has shown that the most scientifically productive policy is to ensure that a small number of core instruments, say, 2 or 3 , operate with outstanding performance as early as possible. These core instruments can be optimised to exploit the unique capabilities of the Telescope and its site in Hawaii. It is recommended that the other instruments be

commissioned in a timely manner, once a few core instruments are operating with high performance in a routine way. It has also been found that keeping one or two core instruments on the telescope for long periods makes most effective use of the telescope time.

- (iii) It is noted that it is planned to begin the next phase of instrument construction in 1999. The Observatory should consider whether it might not be better to delay this phase of the programme until after a *few of the first generation of instruments have been fully commissioned on the telescope*. On the other hand, the Committee would not wish to see a diminution in the R&D efforts for future generations of instruments.
- (iv) The Committee was informed of the plans for data analysis and archiving of the data from Subaru. It will be very important to ensure that Subaru staff members play a determining role in the data analysis *facilities and the Subaru archive*. Experience has shown that these are labour-intensive activities and the full involvement of active astronomers is essential. It is crucial not to underestimate the efforts needed in these areas. It is also strongly recommended that, for data archiving, the facilities and experience of the Space Telescope Science Institute for the Hubble Space Telescope and the European Southern Observatory be fully exploited. These organisations are happy to make their archiving software available to other *organisations and they have been notably successful in satisfying the needs of the community*.
- (v) The Committee strongly welcomes the initiative to provide supercomputing facilities for astrophysical simulations to the Japanese community of astronomers as a whole as part of the programme of the NAOJ. These will support the many excellent programs of theoretical research being carried on in the NAOJ and the Universities.
- (vi) The Committee was informed of the problems of funding travel to Hawaii for staff, technical staff and research students. It is strongly urged that these problems be solved urgently so that all those who need to travel to the overseas Observatories can do so routinely. It is understood that it is particularly difficult to fund the travel of graduate students. The Committee strongly recommends that every effort be made to resolve this particular problem so that graduate students can

spend time at the Hawaii Observatory. In the past, they could have taken part in an observing run, but under the proposed operating plan, which will involve a large component of queue observing, this is not so feasible. A very good alternative is to ensure that they spend some time, say a month, working at the Observatory during the period when their observations are to be taken and participating fully in the day-to-day operations of the Observatory. The Committee was informed that there are ways within the Japanese system whereby students could be hired temporarily to participate in the operations of the Observatory.

- (vii) The Committee was informed that it is intended that a large fraction of the observations be carried out in 'queue' observing mode. There are many variants on this theme, including remote observing, remote operations, remote eavesdropping, classical observing, and so on. It will be very important to match the operating mode of the telescope to its capabilities at various phases of its development. The key consideration is that the very best science is effectively supported at all times and the observing modes adapted to that requirement.
- (viii) Experience of the Hubble Space Telescope and the coming generation of 8-metre telescopes has suggested that scientific preparation of the Japanese astronomical community to submit competitive proposal is very important. It is of great importance that the quality of Japanese proposals be at a very high level from the outset and this requires a considerable effort on the part of the Observatory. Simulation programmes for the expected performance of the scientific instruments on the telescope are very valuable, as well as workshops and meetings throughout Japan to ensure that the community responds very positively to the opportunities. The Committee was very pleased to learn that these initiatives are already taking place. A good example of type of project which will require considerable scientific preparation concerns joint programmes involving observations from both Astro-E and Subaru, so that the cream of the new science is carried out by Japanese scientists.
- (ix) The Committee welcomes the international collaborative programmes which have been developed with the UK, the USA and Australia for instrument development and scientific exploitation of the Subaru Telescope.

4. Large Millimetre/Submillimetre Array and Rainbow

The next major programme, of comparable magnitude to the Subaru project, will be the Large Millimetre/Submillimetre Array (LMSA), to be located in the Atacama Desert in Chile on an outstanding observing site at an altitude of about 5,000 metres. The scientific case for this major new initiative is outstanding, and complements the capabilities of the Subaru telescope. The importance of the millimetre and submillimetre wavebands for pursuing studies of the origins of planets, stars and galaxies has been widely recognised in the USA and Europe, as well as in Japan, and proposals are at different stages of development for this order-of-magnitude increase in scientific capability. Japanese astronomers have made a wholly convincing case that the LMSA is a natural successor to the millimetre facilities at Nobeyama and builds on areas in which Japanese astronomers and engineers have developed great expertise and capability. The Committee is very pleased to endorse fully the proposals for the development and construction of the LMSA.

In addition, the Committee makes the following recommendations and observations:

- (i) The Rainbow project, to incorporate the 45-metre telescope into the Millimetre Array at Nobeyama was strongly recommended by the Nobeyama Review Committee, and it continues to be a very high priority project, not only for its astronomical importance, but also as part of the R&D efforts for the LMSA project.
- (ii) In addition, it is essential that the many R&D activities necessary for the LMSA be pursued vigorously until the construction of the facilities are fully approved. The Committee hopes that the full approval of the LMSA project can be realised as soon as possible.
- (iii) Similar submillimetre array projects are being developed in the USA and in Europe. The USA Millimetre Array Project (MMA), also planned for the Atacama Desert in Chile, is well established and has obtained a significant amount of R&D funding for the next three years. It seems possible that the construction of that array might begin in about 2001. The USA project is contingent upon international participation. There is an ongoing series of meetings between the

Japanese and US scientists to ensure the compatibility of the projects and to make it feasible to operate the arrays separately or together as a larger, longer baseline array of significantly enhanced science capability.

- (iv) The European project, the Large Southern Array (LSA), also planned for the Atacama Desert, is at an early stage of development, although there is strong community support. There is an ongoing dialogue between the European and US scientists about integrating the plans for the MMA and the LSA, with a view to coalescing the projects and accommodating the aspirations of both the US and European communities.
- (v) There would be enormous scientific and economic advantages if the *three projects could be consolidated into a 'World Array' for sub-millimetre astronomy*. The concept is not that the three projects should be merged into a single project, but rather that the arrays should be designed so that each can be operated separately, or as a combined array. The Committee noted that the Japanese government has given its approval to international collaborations in the Large Hadron Collider of CERN and to international collaboration in the Deep-sea Ocean Drilling Ship in order to share the substantial operating costs. Similar considerations apply to the LMSA project. If it were possible to come to some form of international agreement in the construction and operation of the arrays proposed for the Atacama Desert, there would be significant savings in the infrastructure, construction and operating costs on an outstanding, but difficult, site.
- (vi) In view of the different stages of development of these projects and the uncertainties about phasing and timing, the Committee recommends that the R&D activities for the LMSA project should *proceed vigorously, but that these should be carried out in close consultation with the US and European projects, in order to ensure their compatibility for integration into a World Array when that becomes feasible*.

5. VLBI Exploration for Radio Astrometry (VERA)

The Committee was strongly impressed by the ingenuity of the VERA project in opening up new possibilities in astronomy and geophysics. By

careful phase compensation, trial observations and modelling of the system performance have shown that positional accuracies of 10 microarcseconds are possible for the measurement of the positions of maser sources in our own and other galaxies. It will be possible to map the motions of thousands of maser sources throughout our Galaxy, providing a complete three-dimensional map of their velocities, with distances accurate to 10%. This offers a completely new approach to the determination of the structure of our Galaxy and addresses such important issues as the nature and distribution of the dark gravitating matter which binds our Galaxy. Experiments with the Nobeyama millimetre array have indicated how the necessary phase precision may be achieved. In addition, the precision of the measurements would enable crustal dynamics within Japan to be studied, as well as making an essential contribution to the RISE project (see below).

This project is seen as a 'small' project relative to Subaru and the LMSA and it is proposed to undertake the construction over a three year period beginning in 1998. There remain R&D activities to be completed in the near future and to establish that the very rapid slewing of the telescopes, every ten seconds to enable the compensation corrections for water vapour fluctuations in the atmosphere to be included, is feasible throughout the life of the project. *The Committee strongly recommends the implementation of the VERA project.* If budgetary restrictions do not allow the project to be fully implemented immediately, a smaller-scale program with fewer stations could begin straightaway, additional telescopes being incorporated into the array in due course.

The Committee noted that the VERA project will give the Mizusawa Observatory a new lease of life and bring together expertise in high precision radio astronomy and astrodynamics. It will also address the recommendations of the Review Panel for the Division of Astrometry and Celestial Mechanics and of Earth Rotation and Related Fields that the efforts of the Mizusawa Observatory should be oriented more to astrophysics and geophysics than to measurement. It will also be a powerful stimulus to activate the radio astronomical community in Japan, in particular, in the Universities, and it will enable the LMSA project to be carried out more cost effectively. The Committee recommends that the project should be integrated into the overall development of radio astronomy within the Observatory .

The issue of possible international collaboration in this project was discussed. One of the big logistic advantages of the present proposal is that it can be carried out entirely within Japanese territory, two of the four telescopes being located at the extremities of Northern and Southern Japan. It might be possible to interest Korean and Chinese astronomers in the project.

6. Researches in Selenology (RISE)

This project would make use of the VERA array to make very precise measurements of the positions of a Japanese Moon orbiter. The objective of the RISE project is to measure very precisely the moment of inertia of the Moon as a means of determining its internal structures, for example, whether or not it has an iron core. This is an ingenious experiment and makes good use of the expertise within the Observatory in the fields of precise astrometry and gravimetry. The project would involve 10 people for about 10 years. Whilst recognising the scientific value of this project, the Committee rates it as of lower priority than the other major parts of the programme of the NAOJ.

7. SOLAR-B and the Future of Ground-based Solar Facilities

The Committee was very impressed by the remarkable success of the YOHKOH satellite in providing a completely new view of activity on the surface of the Sun. Solar-B is the successor to YOHKOH. The success of YOHKOH has been strongly dependent upon the involvement of scientists from the NAOJ, although the programme has been completely managed by ISAS. The scientific direction of Solar-B will be largely dependent upon the Solar Division of the NAOJ, although it will have no authority over the budget at ISAS. The Committee strongly endorses the involvement of NAOJ scientists in Solar-B and recommends the strengthening of the links between NAOJ and ISAS. At the same time, it recommends that it is timely to study in more detail the relations between NAOJ and ISAS in the support of space astronomy missions.

The Committee recommends the continuing operation of the solar radio interferometer facilities, so long as they are providing useful support to the Solar-B project, and so long as they operate essentially automatically. The solar interferometer was not seen as being viable on its own within the NAOJ, but could be operated by a University group in the longer term. The

Committee agrees that the Norikura solar coronagraphic telescopes are no longer viable and that the Norikura Observatory should be closed in the near future. Involvement in a major Advanced Ground-based Solar Facility could be considered in an international context.

8. Optical-Infrared Interferometry

The Committee agreed that optical-infrared interferometry will be one of the growing areas of astronomy in the mid-term future. Although the results have not made a major impact upon astronomy and astrophysics at present, the techniques are advancing rapidly and some impressive results are beginning to be obtained. The Committee supports the ongoing development of optical-infrared interferometry at roughly the level proposed, understanding that the plans for large optical-infrared arrays are probably quite far in the future.

9. Gravitational Wave Observatory

The Committee was impressed by the construction of the TAMA300 gravitational wave detector. This facility incorporates essentially all of the most advanced features of the gravitational wave detectors being developed in the USA (LIGO) and Europe (VIRGO). The aim is to attain a strain sensitivity of about 6×10^{-20} , at which there is a reasonable chance that gravitational waves will be detected. It was noted that this project has involved scientists from a number of other institutes, in particular, from KEK and ICRR, and from theorists.

On its own, it is not clear what the future direction of this programme would be when the LIGO and VIRGO arrays are in operation. The sensitivity of the two LIGO arrays, for example, will each be an order of magnitude greater than that of TAMA300. As is proposed, the primary involvement of research groups outside NAOJ would seem essential if the programme is to advance to a large facility at a more spacious site in the future.

10. The Advanced Technology Center and R&D Activities

The Committee considers it mandatory that the NAOJ develop a greater capability for R&D activities for new and on-going projects. The Director-General pointed out that, because of the lack of R&D resources, some programmes in the past had become more expensive than necessary. The

Committee welcomes the founding of the Advanced Technology Center as a means of alleviating this problem. The examples of the work being carried out in the Center were very impressive. For example, the development of large area CCD detectors is exactly the type of development needed to exploit fully the capabilities of Subaru.

11. The Reorganisation of the NAOJ

The Committee recognised the enormous amount of effort which had gone into planning the new Divisional and Departmental structure of the Observatory. *The Committee is particularly impressed that the Director-General and his senior staff have made these proposals on their own initiative, recognising the need to change the management structure to respond to the new needs of the astronomy programme.* It is recognised that such a major reorganisation is a painful and difficult business. At the same time, we applaud the determination of senior management to pursue these changes to make best use of the available manpower resources.

The Committee fully endorses the new Divisional and Departmental structure proposed for the NAOJ. It provides a forward-looking context within which the Observatory can tackle the very real challenges of the future programme. The new structure will require additional staff as the new programmes are approved. The Committee believes the manpower requests are reasonable.

The Committee considers that the scientific output of the Observatory, in terms of the numbers of publications in refereed journals, is reasonable and comparable to those of foreign institutions which have similar service roles to the NAOJ. It was noted, however, that there are significant differences in *the scientific productivity between the current divisions.* The Committee believes that the proposed reorganisation of the NAOJ will improve this situation and enhance the scientific motivation and productivity of the Observatory as a whole.

There remain some structural problems which need to be continually addressed:

- (i) The scientists are required to carry out a great deal of the work which would normally be carried out by support staff at other observatories. This has had a negative impact upon the scientific productivity of

scientific staff members, particularly the young astronomers. It has also inhibited the exchange of personnel between the Observatory and the Universities, since the Observatory scientists become indispensable to the operation of the national facilities. The ratio of technicians to scientists is much greater in the support of national and international facilities in the USA and Europe than it is in Japan. It is essential resolve these problems so that the astronomers can devote more of their effort to research.

- (ii) There remains the need to find the correct management and career structures for technicians and engineers. This is a problem throughout the Japanese research system, but it will not go away. The Observatory has dealt with the problem of a career structure for technicians by promoting some of them into academic positions. This is not, however, a particularly satisfactory solution, since academic posts should have rather different job descriptions from those of technicians. There remains a severe problem in determining a proper career progression for the majority of the technician/engineers.
- (iii) The Committee wishes to encourage the interaction of the Observatory scientists with the University community. In particular, it recommends that these scientists should be associated with the teaching programs of the Japanese universities so that they can give lectures and participate in the training of graduate students.
- (iv) The Committee was informed that research workers are spending a considerable fraction of their time in Committee meetings. Whilst we applaud their full involvement in the management of the program of the NAOJ, management should review how much effort it is reasonable to ask research workers, especially younger ones, to devote to management meetings with a view to releasing more of their time for research.

12. Astronomy in the Japanese Universities

It is generally agreed that the numbers of astronomers in Japan, and particularly in the Universities, is extremely low relative to other advanced countries and to the very major investments which have been made in astronomy. This problem reflects a lack of basic scientists, relative to applied scientists, in the Japanese Universities. The Committee wishes to see

every endeavour made to increase the numbers of professors involved in the astronomy programme in the Universities. There are very major problems with creating new professorships within the University system, but there may be creative ways of achieving this. In Europe, most Physics Departments have now become Departments of Physics and Astronomy as a means of encouraging more students to enter the physical sciences. The role of astronomy in all physics departments has noticeably increased in the UK, for example, and many more new lecturer and professorial positions have been created to meet these needs. A similar situation might develop in Japan.

The initiatives to create many more graduate student and post-doctoral positions have been an enormous success and the students whom the Committee met were highly motivated and enjoying their studies. There remains, however, the problem of finding positions for them at the end of their studies. This is a structural problem which needs to be tackled at a high level of government.

13. The Future of Existing Optical-Infrared Facilities

The Committee is in favour of keeping the 1.88-metre Okayama telescope in operation, its role being seen as supporting the activities of the Subaru project. Scientific projects using relatively standard instrumentation should be encouraged. The telescope can also act as a test-bed for R&D activities, but should not compete for resources with the Subaru project.

The Committee agrees with the proposal to close the Dodaira Observatory in the era of the Subaru and LMSA projects. It is hoped that the staff can be suitably redeployed in support of these programmes. The Committee favours handing over the Dodaira Observatory to local government for public education purposes rather than to a University, which should be involved in educating astronomers with advanced equipment, rather than with outdated facilities which have become surplus to requirements.

14. Public Education

The Committee reiterates the central importance of an active and out-going programme of Public Outreach. This generates enthusiasm among the public for astronomy and science in general and can play a role in encouraging bright students to embark on scientific careers. Public

education is an essential part of the activities of all large Observatories nowadays and, in a small way, pays back to the public the large investments which governments make in pure research.

Terms of Reference of the Visiting Review Committee for the National Astronomical Observatory of Japan

The Visiting Review Committee shall critically examine the documents sent separately and meet together in November 12 - 14 1997 for discussion, interview, inspection and drafting the review report at NAOJ as is suggested in the attached schedule. Basing upon the outcome of the Review, the Committee is expected to advise the Director General about the future steps to be taken by NAOJ for the sake of the sound development of science in Japan as well as in the world. The following points may deserve special attention in the review and the advice provided:

- A. Transfer of research divisions in the matured fields into those for most advanced fields, and restructuring the research department to match future activities.
- B. Increasing commitment of NAOJ to space astronomy (in relation to ISAS and NASDA, and the on-going Administrative Reform in Japan),
- C. R&D, construction, and operation of large-scale facilities such as Subaru and LMSA, in connection to
 - (i) Budget,
 - (ii) Engineering capacity, and
 - (iii) International collaboration,
- D. Improving public outreach of the scientific results, and levelling-up the activities in astronomy and astrophysics at Japanese universities, and

As a background of the above, the national value of scientific researches in the field of astronomy.

Proposed Schedule for the Visiting Review Committee of NAOJ
(1997 Nov. 12 - 14)

	9	10	11	12	13	14	15	16	17	18	19
Nov. 12 Wed.	→ ①	opening session ②	astronomy in Japan role of NAOJ ③	lunch ④	present and future of NAOJ ⑤	general discussion ⑥	coffee break ⑦	facility visit ⑧	reception ⑨	→	
13 Thur.	→	⑩	interview ⑪	discussion on individual subjects I ⑫	lunch ⑬	discussion on individual subject II ⑭	coffee break ⑮	summary policy ⑯	drafting session ⑰	→	dinner ⑱
14 Fri.		⑲	summary session ⑳	closing session ㉑	lunch ㉒	→					

→ transfer between NAOJ and the hotel or else

1997.10.6 Kodaira