



Australian Academy of Science

Program of International Scientific and Technological
Collaborations, funded as part of DISR's International
Science and Technology Networks

A REVIEW

16 March, 2001

Response to an invitation to comment on
The Technology Diffusion Program

A Review of the International Exchange Programs of the Australian Academy of Science

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Executive summary

The Australian Academy of Science International Exchange Programs play a critical role in assisting Australian scientists gain access to knowledge and innovative technologies developed in the international environment.

Scientific papers by participants in the Academy International Exchange Programs that were jointly authored with an international collaborator were cited in the international literature more than twice as often as Australian papers with national co-authors.

Collaborations initiated in international exchanges are ongoing, as attested by a high continuing rate of international co-authorship of scientific publications.

The practical transfer of technologies, skills and expertise from host institutions to Australia is central to the Academy International Exchange Programs. Evidence from participants demonstrates a very high level of transfer of knowledge and know-how to Australia.

The Academy International Exchange Programs improves Australia's image by strategic demonstration of Australia's capacity in leading-edge skills and technologies. This is being achieved during the international visits by mid-career and young ambassadors for Australian science and is reinforced through presentation of research seminars. Importantly, the visits often lead to ongoing involvement in international research collaborations, through invitations to join editorial boards of international journals, to attend international conferences, and to join international research consortia.

Adding value to the Academy International Exchange Programs and Workshops has been a key feature of the Academy's administration of Commonwealth funds provided under the Technology Diffusion Program for International Science and Technology Networks (ISTN). ISTN funds have been leveraged by a factor of 7.7.

Introduction

The Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering conduct activities forming the International Science and Technology Networks (ISTN) element of the Commonwealth Government's Technology Diffusion Program.

The Australian Academy of Science (AAS) will receive \$714,500 in Commonwealth support in FY2000-2001, to administer programs of support for international collaboration in Europe, North America and North East Asia. The primary objective of the Academy's international collaborations is to improve Australian access to global science and technology. The Academy uses the following performance indicators to determine the effectiveness and efficiency of the activities:

- the number of international workshops, missions, fellowships, collaboration projects and exchanges achieved under the program;
- the number of overseas science, technology and industry contacts established or maintained through Academies-sponsored activities funded by ISTN;
- the number of papers, presentations and exhibits sponsored by the Academies resulting from ISTN funded activities;
- the number of contacts made with international science, technology and engineering academies and learned societies resulting from activities funded by ISTN;

- the extent to which it secures appropriate access to global science facilities for Australian researchers, including gaining access to equipment and data that may not be available in Australia, or is more advanced than that available in Australia;
- the extent to which it facilitates the development of international institutional agreements and exchanges, including the exchange of postdoctoral fellows;
- the extent to which it facilitates long term international collaborations;
- the number of joint papers published resulting from ISTN funded activities.

The Academy has reviewed its International Exchange Programs according to these performance indicators, but has structured the document according to the key elements of the Innovation Access Program, as announced by Minister Minchin on January 29, 2001. The Innovation Access Program will replace the Technology Diffusion Program from July 2001.

It is evident from the Review of the AAS International Exchange Programs that many of the goals of the Innovation Access Program can be met by supporting young and mid-career scientists in international networks. In the pages that follow, it is clear that a comparatively modest investment by the Commonwealth in the AAS International Exchanges Program has yielded very substantial rewards indeed.

Assisting researchers gain access to knowledge and innovative technologies developed in the international environment

The AAS International Exchange Programs have assisted many mid-career and young Australian scientists to gain access to knowledge and innovative technologies developed in international research institutions and universities.

The average ages of participants in the ISTN-funded exchanges with Europe and North America are given in Appendix I.

Participants in the AAS International Exchange Programs are required to file with the Academy a Final Report on their research experiences and outcomes, following their return to Australia. In order to ascertain the pattern of access to knowledge and technology, the Final Reports of participants in exchanges with the United Kingdom, Germany and Japan for a sample period of travel (1997/98 and 1998/99) were assessed. For France, the years 1990 to 1998 were selected in order to obtain a sufficiently large sample size for analysis.

The Final Reports were assessed to determine the primary nature of the collaboration. Collaborative activities included access to innovative techniques and apparatus, access to collections, access to major equipment and access to computer software. In some cases, the visits involved maintaining an Australian presence in international research consortia through exchange of data, standardising scientific nomenclature, gaining access to knowledge (as distinct from “know-how”) or building on existing links to complete jointly authored publications. These latter activities have been called, collectively, “links” in Table 1.1 (page 6).

Table 1.1 gives the distribution of the basis of the collaborative activity of Australian participants in International Exchange Programs, according to host

country. Access to innovative technologies and unique apparatus developed in the international environment has clearly been an important part of the international travel.

Table 1.2 (page 7) lists the primary research activity of Australian participants in visits to the United Kingdom in 1997/98 and 1998/99. The access to emerging techniques and specialised apparatus, as well as to expensive equipment, has been critical in maintaining the competitiveness of Australian research. As one participant said, *the experience has now placed me in an invaluable position to initiate investigations in my own laboratory. Such experience would only have been obtained after prolonged experimentation (trial and error) in my own laboratory over a year.*

In many cases, it was possible for the Australian participant to transfer the new ‘know-how’ or knowledge to Australia, as described in Section 3. Long-term collaborations were forged through shared reagents or software or intellectual property with the host researcher. The overwhelming impression from assessment of the Final Reports is that the Australian participants struck equal partnerships with their colleagues, bringing unique samples or innovative materials or fresh ideas into the international collaboration.

Conclusion

The AAS International Exchange Programs play a critical role in assisting Australian scientists gain access to knowledge and innovative technologies developed in the international environment.

Table 1.1

Purpose of visit: access to innovative techniques, major equipment, computer software, specialised collections or international collaborative links.

Host country	Techniques	Equipment	Software	Collections	Links	Total
UK	7	5	2	3	2	19
France	7	3	1	4	17	32
Germany	10	4	2	1	3	20
Japan	3	2	0	2	8	15

Table 1.2 Scientific Visits to United Kingdom:
Basis of Collaboration

Access to innovative techniques and experimental apparatus

- Patch clamp technology in guard cell protoplast electrophysiology (*University of Cambridge*).
- Access to a photonic circuit called an optical wavelength converter/regenerator (*University of Bristol*).
- Learning optical spectroscopy techniques to complement other DNA-binding assays (*University of Warwick*).
- New skills in genetic analysis of domestic livestock (*Roslin Institute*).
- Novel methods for measuring serum levels of follistatin proteins (*Oxford Brookes University*).
- Access to in vivo microscopic techniques to visualise leucocyte migration (*Imperial College*).
- Apparatus for testing the reflectivity of highly nonlinear alpha-gallium films developed at the ANU (*University of Southampton*).

Access to Collections

- Comprehensive scale insect collections held at *National History Museum (NHM), London*.
- Midges (flying insects) collected from the gondwanan regions of South America, southern Africa and south-east Asia housed in *Zoologische Staatssammlung Munchen* and the *NHM, London*.
- Unique reptile collection for skeletal anatomy, external traits and internal soft anatomy. (*NMH, London*).

Access to Major Equipment

- Laser-ablation Inductively Coupled Plasma Mass Spectrometer (LA-ICPMS). (*British Geological Survey, Nottingham*).
- Real-time nuclear magnetic resonance (NMR) facilities to monitor protein folding (*Oxford University*).
- Use of a confocal microscope to produce profiled-, and protein- selected geometries in photosensitive polymeric thin films (*The Chart, Oxted*).
- Access to a VFTB (variable field translation balance) based on a magnetic coil rather than on an electromagnet (*Oxford University*).
- Use of the Automated Plate Measuring Machine to measure historic astronomical plates (*University of Cambridge*).

Software

- Access to sophisticated computer code to interpret heavy-ion induced reactions (*University of Surrey*).
- Sharing software and data processing developments in a large collaborative project on surveys of radio pulsars (*University of Manchester*).

Collaborative International Links

- Astronomy (*University of Cambridge*)
- Entomology (*Imperial College*)

SOURCE: Final Reports of Awardees of Travel Grants, 1997-98 and 1998-99.

Forging strong and ongoing international collaborative links that are vital to Australia's innovative system

Bibliometric Analysis: Scientific Papers Published by Participants in the Australian Academy of Science International Exchange Programs

Introduction

It is premature to review publication outcomes for ISTN funded visits to overseas research institutions in years 1999 and 2000, as many publications can be expected to be either in press or in preparation. Nevertheless, an email questionnaire (Appendix II), sent on February 29, 2001 to Australian participants in Europe and East Asia (Japan, China, Korea, Taiwan) International Exchange Programs included a request for lists of publications either jointly authored with the host institution or else arising from the ISTN visit. As at March 13, 2001, responses were still being received, so data are incomplete, but lists of publications received thus far are indicative of high productivity arising from the ISTN visits. The publication lists are attached in Appendix III, for Europe, and in Appendix IV for North East Asia.

Bibliometric analysis was confined to three longer-term AAS Exchange Programs, from inception until 1998. The Programs reviewed here are the *Royal Society Exchange Program* (United Kingdom), for visits between years 1991 and 1998, the *Bede Morris Fellowship Scheme* (France) for visits between years 1990 and 1998, and *Scientific Visits to Germany* for visits in 1997 and 1998.

Scientific papers co-authored by collaborating scientists

Scientific papers co-authored by collaborating scientists provide objective indicators of productive partnerships. Have Australian participants in the AAS Exchange Programs entered into scientific collaborations with colleagues in the host country that have resulted in joint publications of research findings?

The Institute of Scientific Information (ISI), Philadelphia, maintains an electronic data-base, the "Web of Science", which lists scientific publications according to Authors, Title, Journal, Date of Publication and Addresses of Authors. In order to record the extent of collaboration between Australian participants in the AAS Exchange Programs and colleagues in the host country, the ISI electronic data-base was searched for jointly authored scientific papers.

The methodology was to search for the name of the Australian participant (eg Taylor J*) and the joint occurrence of Australia AND <host country> (eg Australia AND France), for papers published since 1990. This approach may underestimate the extent of collaboration, if some publications are not captured in the data-base, and does not capture other publications arising from the visit that are not jointly authored.

Jointly authored papers published prior to the year of travel were not excluded, because the visit was often used to enhance ongoing collaborations. Comments by participants in their Final Reports suggest this is appropriate methodology. For example, (UK£133) *The time spent in Cambridge has provided a unique opportunity to technically and conceptually advance an important ongoing and collaborative research project;* and (UK£136) *I have been collaborating with Dr S.C. since 1994 (past four years). During this time we had never met and all interactions were by email or fax.* These comments suggest that for some participants the international travel is part of a continuum of collaboration.

Table 2.1 (page 11) shows that the 154 Australian participants in the AAS Exchange Programs to Europe between 1990 and 1998 have published 504 scientific papers in partnership with colleagues in the host countries. On average, 3.3 joint papers per participant have been published, clearly indicating productive collaborations. Many of the collaborations are ongoing, with 55 papers published in year 2000 or in January, 2001. These recent papers were co-authored with colleagues based in the United Kingdom (30), France (8) and Germany (17).

Citation Analysis

Citation records of authors, research institutions and journals are increasingly seen as quality indicators by the authors themselves, by research managers and by science policy makers. The number of times a publication is referred to, or "cited", by subsequent papers is one, but only one, indication of the importance of the publication. Citation data are collated by ISI and have recently become widely accessible through the electronic data-base, "Web of Science".

Citation data can be wrong, misinterpreted or even manipulated¹ and the Royal Society (UK) has expressed concerns² about citation data having the potential to undermine the peer review process. The AAS shares these concerns. Nevertheless, we have examined the publications associated with the AAS International Exchange Programs in order to determine their import as indicated by citation analysis.

It is a consistent observation (REF) that papers jointly authored by international collaborators have higher average citations per paper (CPP) than those jointly authored by collaborators within a nation, an institution, or a research group, and have higher average CPP than papers with a sole author. This is true also for Australia. Table 2.2 (page 11)

shows CPP for Australian papers with international co-authorship compared with CPP for Australian papers with national co-authorship (or with more than one institutional address). (L. Butler, personal communication).

Table 2.2 gives the number of international and national Australian publications for the period 1990 to 1998. Because citations, by definition, lag behind publication dates, citations were counted from year 1990 to 1999, the most recent data available to Ms Butler. In all disciplines, international papers are cited, on average, more often than national papers, with 11.3 CPP compared with 8.1 CPP. Overall, there is an increase of 39.5 per cent in CPP score for papers with international co-authorship. (NOTE: Australian papers with international co-authorship comprise about 16 per cent of the total of Australia's scientific papers (P. Bourke and L. Butler, 1995); more than 60 per cent are generated within a single research institution.)

We have determined citations for papers from Australian AAS International Exchange Programs participants, for papers jointly authored with collaborators based in the host country. For comparison with the Australian data, publications were counted from year 1990 to 1999 and citations were counted from year 1990 to 2000. That is, 55 papers published in year 2000 or in January 2001 were excluded from the analysis.

The methodology for examining the "Web of Science" ISI electronic data-base was to search for the name of the Australian participant (eg Taylor J*) and the joint occurrence of Australia AND <host country> (eg Australia AND France). All retrieved papers were checked for validity with respect to the Australian address and field of study, and the citation score was recorded.

¹ Reedijk, J. (1998) *New J. Chem* 767-770

² Lachmann PJ and Robinson, J.S. (1997) *Sci Public Affairs* Winter, 8

Citation scores are dependent, in part, on time since publication. For this reason, papers by Australian participants visiting the United Kingdom have been divided into two categories according to the year of travel, as 1991 to 1994 and 1995 to 1999. Although visits to France commenced in 1990, there was only one visit per year until 1993, two in 1994, increasing to six in 1995. For Germany, visits under the AAS Exchange Program commenced in 1997.

Table 2.3 (page 11) shows that papers co-authored by participants in the AAS Exchange Programs were cited more often than other Australian papers with an international co-author, with 18.3 CPP compared with 11.3 CPP, an increase of 63 per cent. The AAS Exchange Program papers (18.3) have more than double the CPP for Australian national papers (8.1 CPP). The country of destination had minimal influence on CPP when adjusted for year of travel, with comparable figures for France (13.5), Germany (15.3) and United Kingdom (14.1). Papers for Australian participants travelling to the United Kingdom between 1991 and 1994 had a higher CPP value of 21.9.

The high CPP scores for participants in the AAS Exchange Programs may reflect in part the high calibre of the successful applicants in the competitive International Exchange Programs. But they reflect also the importance of publications arising from collaborations between Australians and their colleagues overseas.

Conclusions

- For 154 Australian participants in the AAS Exchange Programs with Europe between 1990 and 1998, the average number of scientific papers published jointly with a collaborator in the host country is 3.3.
- Collaborative research by Australian participants in the AAS Exchange Programs with Europe between 1990 and 1998 are in many instances continuing, with 55 jointly authored scientific papers published in years 2000 or in January 2001.
- Australian scientific papers jointly authored with an international collaborator have higher citations per publication (CPP) than national papers in Mathematics, Physical Sciences, Chemical Sciences, Earth Sciences, Biological Sciences and in Medical Science. Overall, there is a 40 per cent increase in CPP for international compared with national papers.
- Papers jointly authored by participants in the AAS International Exchange Programs were cited 62 per cent more often than other Australian papers with an international co-author.
- Papers jointly authored by participants in the AAS International Exchange Programs were cited more than twice as often as Australian papers with national co-authors.

Table 2.1

Total and average number of papers by Australian participants in AAS exchange schemes co-authored with collaborators in host country

Host country	Year of travel	Number of participants	Jointly authored papers	
			Number	Mean
UK	1991-94	49	255	5.2
UK	1995-98	46	106	2.3
France	1990-98	32	67	2.1
Germany	1997-98	27	76	2.4
Total		154	504	3.3

Table 2.2

Citations per paper (CPP) for Australian scientific papers* with an international co-author or with a co-author at another national institution.

Field of Science	International			National		
	Papers	Citations	CPP	Papers	Citations	CPP
Mathematics	1916	8078	4.2	2787	9391	3.4
Physical	6455	62889	9.7	9597	65954	6.9
Chemical	3497	28433	8.1	9191	64254	7.0
Earth	3106	28689	9.2	5720	3762	6.6
Biological	8930	118465	13.3	21959	202337	9.2
Medical	11030	142160	12.9	37061	323428	8.7
All fields	31261	351847	11.3	77143	624797	8.1

*Papers published 1990-1998, citations in 1990-1999.

Table 2.3

Total and average number of citations for papers* by Australian participants in AAS exchange schemes co-authored with collaborators in host country.

Host country	Year of travel	Number of papers	Citations Total	CPP
UK	1991-94	237	5187	21.9
UK	1995-98	94	1326	14.1
France	1990-98	59	794	13.5
Germany	1997-98	59	903	15.3
Total		449	8210	18.3

* Papers published 1990-99, citations for 1999-2000.

Participants in the AAS International Exchange Programs have facilitated the practical transfer to Australia of technologies, skills and expertise. The transfer of technology and expertise from overseas institutions to Australian laboratories is a key feature of responses to the questionnaire (Appendix II) sent to participants in ISTN funded exchanges. Almost every participant who described access to innovative technologies and unique apparatus responded positively to Question 2 "What elements of newly acquired knowledge and technology did you transfer to your home institution?" Technology transfer included transfer of unique reagents, transfer of computer software, incorporation of new ideas into graduate lectures, initiatives in organising national teams of scientists in bids for major equipment, building experimental apparatus and instructing Australian colleagues in innovative techniques. Technology transfer is a key feature in the following excerpts from responses to the questionnaire.

Transfer of technologies and expertise

I had access to a unique set of monoclonal antibodies to parasite antigens and I learned how to implement a new animal model for the disease that I work on. I established the new animal model for disease (in my home institution) and I established the techniques used for confocal microscopy. I also obtained the set of monoclonal antibodies as part of an ongoing collaboration with the overseas group.

I became very familiar with the technique known as wavelet transform analysis. This was applied to time accurate surface heat transfer data obtained in the Imperial College gun tunnel. Since my return to UTS, I have applied this technique to a range of other experimental data obtained in Australia and the UK. The knowledge gained from the experience, ie the computer code

written to perform the wavelet transform analysis, was electronically transferred from Imperial College.

I had access to a special system, laser intensity modulation method (LIMM) for measuring polarisation distributions in polymer films at the University of Wales in Bangor. It was very useful for me to see it in practice. We have subsequently set up the system at Macquarie University and have been able to avoid some of the pitfalls that the system at the University of Wales equipment has.

I made use of unique equipment in Germany. The equipment in question was a target station on the HMI accelerator and other supporting hardware in the laboratory. I am now chief investigator on an ARC REIF (2001) grant that involves building apparatus in our lab in Australia akin to that I used in Germany, but which adapts and improves it for new avenues of research.

I used a fast automated astronomical plate measuring machine at the Institute of Astronomy, Cambridge University. This enabled scanning of some historic astronomical photographic plates from the period 1892-1920. The plates originated from the Sydney Observatory collection held at MacQuarie University. The software has been installed now at Macquarie University to enable the analysis of the results of the plate scanning to be carried out in Australia.

I had access to Variable Field Translation Balance (VFTB) for environmental and rock magnetic studies. CSIRO has acquired a similar instrument in collaboration with Macquarie University, UNSW and the University of Newcastle. Many students in Australia are now familiar with this instrument and its ability to trace magnetic particles in the environment as proxies for processes otherwise difficult to track. As environmental issues become increasingly

important this technology will enable a range of problems to be addressed. This is the only VTB in the Southern Hemisphere and CSIRO is in a position to offer courses to scientists from neighbouring countries.

Transfer of skills

Dr M. of the Atmospheric Environmental Department, National Institute for Resources and Environment, has been developing a highly compact and sophisticated reactor for photocatalytic degradation of soil contaminated with polyaromatic hydrocarbons. I was given complete access to this equipment and helped in testing the design. Dr M. taught me the finer details of breakdown product identification using HPLC. I also had exposure to novel photocatalytic reactor design concepts (compact, modular designs), which will help me in my own research back in Australia.

From a research animal care perspective, the practices in Denmark were different to ours with many new ideas being beneficial here. The effects of applying these practices were immediately obvious and beneficial upon my return.

Further, the stimulation and recording techniques used by the researchers in Denmark on neurostimulation of paralysed limbs was directly applicable for my own vision system stimulation research. Having never been present at a neurostimulation of paralysed limb experiment, the technique of doing this was found to be not very complicated from an implementation perspective and will be duplicated here. Methods of measuring electrode impedance were provided. The methods of fabricating thin-film electrodes were described and since my visit have been duplicated here.

Conclusion

The practical transfer of technologies, skills and expertise from host institutions to Australia is central to the AAS International Exchange Programs. Evidence from participants demonstrates a very high level of transfer of knowledge and know-how to Australia.

Promoting Australia's image by strategic demonstration of Australia's capacity in leading-edge skills and technologies

Participants in the AAS International Exchange Programs have taken the opportunity to give seminars and lectures in the host institutions, enhancing the reputation of their own work and at the same time promoting the profile of Australian science. In order to assess the extent of this activity, Final Reports of participants in exchanges with the United Kingdom, Germany and Japan for a sample period of travel (1997/98 and 1998/99) were assessed. For France, the years 1990 to 1998 were selected in order to obtain a sufficiently large sample size for analysis.

Table 4.1 (page 16) gives the number and average number of seminars given in the host country by participants in the AAS International Exchange Programs. Presentation of research findings in seminars is a normal part of the scientific endeavour and, as shown in Table 4.1, the expectation that participants would profile their research in this way has been met.

In response to Question 5 in the Questionnaire (Appendix I), "Please describe how your visit may have helped promote Australia's profile in research and innovation", respondents were generally satisfied that they had helped promote Australia's image by demonstrating their personal capabilities in basic research. This had been achieved not only through presentation of seminars but also through demonstration of particular capabilities and knowledge. The outcomes included invitations to join editorial boards, to attend future conferences, or to enter into international research collaborations. Some examples of responses to the questionnaire are given below:

A seminar was presented to the Department of Earth Sciences, Oxford entitled "Equatorial Proterozoic Glaciations: Global Refrigeration versus

High Obliquity". Since then this subject has become recognised as one of the most important unsolved puzzles in Earth Sciences. The answers bear on the question of the origin of complex life and the Precambrian/Cambrian boundary problem. My AAS grant helped me to keep Australian research at the forefront on Proterozoic glaciations.

The Danish research team was very impressed with the UNSW neurostimulator that was demonstrated. A German research group was also there to demonstrate their own stimulator during the same experiment. Their stimulator has six electrodes, UNSW has 100 – more than any commercially available neurostimulator and (to my knowledge) the only neurostimulator in existence that has demonstrated this high quantity of functional electrodes in a physiological stimulation situation. In order to change stimulation to different electrodes, the German stimulator took several hundred milliseconds to configure itself and had some 'rules' for stimulation that required certain (perhaps unwanted) stimulation events to take place in order to change configuration. The UNSW stimulator has no restrictions on stimulation events and can configure itself in less than one millisecond (about 250 microseconds). In my opinion, the Danish researchers were not expecting the Australian device to perform as well as it did (I was pleasantly surprised myself). It clearly outperformed the German device that was demonstrated afterwards.

I gave a seminar at the University of Bonn, and afterwards met two students who expressed an interest in PhD studies in Australia. They were both subsequently offered places at the University of Melbourne, the Australian National University and possibly elsewhere. They have now enrolled in the Division of Botany and Zoology, ANU.

The international exchange resulted in participation in a new Cooperative Research Program (2001-03) funded by International Atomic Energy Agency.

My interaction with scientists overseas has been strengthened and I have been invited to give a paper at the 26th EGS ASSEMBLY in Nice on March 25-30, 2001, in a session jointly organised by my Oxford. This trip is partly paid for by Helsinki.

I have been invited on the organising committee for an international meeting.

I have been invited on the editorial board of an international journal.

It is a sad fact that Australia has somewhat of a reputation internationally as being a sort of 'technical backwater'. When commercial entities cannot or will not 'carry the banner' of Australian technology because of past reputations and thus enable a change in the preconceptions of Australia and Australian technology, who then will? This is where the role of the international exchange program is absolutely essential. With programs such as the international exchange program, the Australian research can be brought to the places where it is most important to be – at the forefront of international research. The Australian researchers can meet, face-to-face with researchers of other nations and say, "look at this – in the first instance this is the best technology anywhere on the planet and in the second instance, it was made in Australia".

I believe that researchers at NIRE (Japan) were impressed by the quality of research journals I have had papers published in and also by my knowledge of photocatalysis. The open, hands-on, collaborative research approach in Australia differed significantly to the often highly competitive inter-departmental research I witnessed at NIRE. Researchers from my host organisation had a kangaroo and "snag on the barbie" view of Australian culture and had no appreciation of the cultural diversity and

scientific prowess of Australian research. I think (and hope!) that my visit changed that perception.

The fact scientists are supported by the Australian government to visit other laboratories in other countries is good for Australia's profile. Few scientists get many opportunities to travel often – we are isolated in Australia (geographically). The visit will instigate a node in Australia investigating these (new) mechanisms in parasites – not previously studied here and an important aspect of parasite interactions.

My link with National Institute for Environmental Studies (NIES), Japan, was, I believe, a key ingredient in our research profile that prompted our invitation to join the EU funded project: "Development of amelioration strategies to reduce environmental deterioration and agricultural production losses in water repellent regions" (FAIR CT98-4027; 1.798 million ECUs for 3 years). This project involves the collaboration of the following organizations: Europe – Alterra (Holland), University of Wales (UK), University of Aveiro (Portugal), and Democritus University of Thace (Greece), USA - University of Minnesota and Cornell University; and Deakin University (Australia). We are the only Australian partner.

Conclusion

The AAS International Exchange program improves Australia's image by strategic demonstration of Australia's capacity in leading-edge skills and technologies. This is being achieved during the international visit by mid-career and young ambassadors for Australian science and is reinforced through presentation of research seminars. Importantly, the visits often lead to ongoing involvement in international research collaborations, through invitations to join editorial boards of international journals, to attend international conferences, and to join international research consortia.

Table 4.1

Presentation of seminars and lectures in host country.

Host country	Number of participants	Number of seminars	Mean	Range	One or more %
UK	19	50	2.5	0-6	74
France	33	69	2.1	0-8	85
Germany	20	56	2.8	0-9	85
Japan	15	30	2	1-4	100

In 1998-99 the Academy supported nine workshops, sponsored three delegations and facilitated 12 bilateral visits, as shown on Table 5.1 (page 19).

A summary of each of the nine workshops and the outcomes of those workshops is given in Appendix V.

Bilateral Activities 1998-1999

Europe

Meeting with Sir Robert May, 8 July 1998

Academy officials met with Sir Robert May to discuss the Dearing report, New Images program, the changes to the 1851 Scholarship scheme, and the pattern of scientific exchange between the UK and Australia.

Meeting with The Royal Society, London, August 1998

The Academy's Foreign Secretary, Professor Michael Pitman, met with Professor Brian Heap, Foreign Secretary of The Royal Society, London.

Meeting with the Department of Science and Transport, Austria, August 1998

The Academy's Foreign Secretary, Professor Michael Pitman, met with Mr Raoul Kneucker, Department of Science and Transport, Austria. Mr Kneucker is responsible for the coordination of EU Presidential functions. Discussions included Australia's participation in the Framework program, developing long term cooperations between Austria and Australia, and priority areas in Austria.

Lecture by Professor M Serres from France, 5 August 1998

A successful public lecture titled "Ethics in Science" by French philosopher, Professor Michel Serres, member of the Académie Française and chair of the History of Science at the University of Paris-Sorbonne, was held at Becker House.

EU Public Seminar, 3 March 1999

The Academy and ATSE presented a public seminar titled 'Australia and the EU – a marriage of science and technology – the Fifth Framework Programme in Action', held at Becker House, Canberra. The seminar was in conjunction with a visiting EU delegation headed by Professor Jorma Routti, Director General of the European Commission's Directorate General for Science Research and Development.

Asia

Hosted staff member from the Japan Society for the Promotion of Science, October 1997 – November 1998

The Japan Society for the Promotion of Science requested the Academy to host a JSPS staff member for a total of twelve months from October 1997 - 8, to learn about Australian science and technology. Ms Mayuko Tada spent six months in Sydney studying English, then spent a total of nine months in Canberra, after her stay was extended.

Delegation from the Chinese Academy of Sciences, 1 June 1998

A delegation from the Chinese Academy of Sciences met with the Foreign Secretary, Professor Michael Pitman. The delegation was in Australia to attend a Technology and Science seminar at the Open Training and Education Network institute.

1998 Dr Ranjeet Bhagwan Singh Memorial Lecture, Malaysia, July 1998

Professor Sir Gustav Nossal was invited to Malaysia to present the 1998 Dr Ranjeet Bhagwan Singh Memorial Lecture. Professor Nossal met with the President of the Academy of Sciences Malaysia, Tan Sri Datuk Dr Omar Abdul Rahman for discussions regarding collaborations between the two Academies.

Participation in the ASEAN S&T Week, Hanoi, 12-15 October 1998

The Academy's Foreign Secretary, Professor Michael Pitman, attended the ASEAN S&T Week held in Hanoi, at the invitation of the Department.

Delegation from the Science and Technology Agency, Japan and the First STA Alumni Meeting, 12-14 November 1998

The Academy hosted a delegation of senior Japanese scientists and officials from the Science and Technology Agency, the Japan Science and Technology Corporation and the Japan International Science and Technology Exchange Centre. The delegation met with Academy officials for a review of the four international collaboration programs administered by the Academy, and to hold the first STA Alumni Meeting. Seven Australian researchers who have previously participated in the STA programs attended the meeting. The delegation also participated in the Japan reception held on 13 November 1998.

Japan Reception, 13 November 1998

In conjunction with the National Science and Technology Centre's (Questacon) tenth anniversary celebrations, the Academy held a successful reception at Becker House. The reception was to recognise, strengthen and celebrate the links between Australian and Japanese scientists. AAS administered this activity with assistance, including financial support, from ATSE.

Delegation from the Academy of Sciences, Malaysia, 18 November 1998

A senior delegation from the Academy of Sciences, Malaysia visited the Academy of Sciences for discussions on general science policy issues and the Academy's *Primary Investigations* and internet sites. Officials from the Department, representatives from ATSE, the Australian Research Council, CSIRO and the Malaysian High Commission attended the meeting.

Signing of MOU with the Academy of Sciences, Malaysia, 23 November 1998

A joint Memorandum of Understanding was signed between the Australian Academies of Science and Technological Sciences and Engineering, and the Academy of Sciences, Malaysia.

Delegation from the Japan Society for the Promotion of Science, 1 March 1999

A delegation from the Japan Society for the Promotion of Science visited the Academy to review the quota of the exchange program and to discuss issues related to future collaborations.

Biannual Meeting with the Korea Science and Engineering Foundation, 18 March 1999

The Academy hosted the biannual meeting between the Australian Academies of Science and Technological Sciences and Engineering, and the Korea Science and Engineering Foundation. Discussions included a review of the Memorandum of Understanding to allow more flexibility in the annual quotas of the exchange program, potential topics for future workshops, a revision of the number of workshops from two annually to one annually which will alternate between countries, and an analysis of the APEC Postdoctoral Fellowship.

Meeting with Dr Po-lun Liu, Representative, Taipei Economic and Cultural Office, 19 March 1999

The Academy's President, Professor Brian Anderson, met with Dr Po-lun Liu, Representative, Taipei Economic and Cultural Office, for discussions regarding Australia-Taiwan collaborations, particularly activities that the Academy has supported with the National Science Council.

Australia-Malaysia Science and Technology Policy Workshop, 22 March 1999

A joint Australia-Malaysia workshop on Science and Technology Policy was held at the Academy. ATSE administered this activity with assistance, including financial support, from AAS. *Details are reported in the ATSE Report on International Activities 1998-99.*

Signing of MOU with the National Academy of Science and Technology, Philippines, June 1999

The Australian Academy of Science signed a Memorandum of Understanding with the National Academy of Science and Technology, Philippines, in June 1999.

Society, Professor George Petersen, visited the Academy to meet with the Academy officials. Discussions included the 1998 ASEAN Meeting, AAS's websites, the RSNZ Conference database, and science relations between the two countries.

Other

Meeting with the Royal Society of New Zealand, 18 June 1998

The President of the Royal Society of New Zealand, Sir John Scott, and the President of the Academy Council of the

Signing of MOU with the Israel Academy of Sciences and Humanities

The Academy and the Israel Academy of Sciences and Humanities signed a scientific and technological cooperation agreement in December 1998.

Table 5.1

Number	Activity	Country participation
9	Workshops	Korea, Japan and Taiwan
3	Delegations	China, Malaysia, Japan
3	Memorandum of Understanding	Malaysia, Philippines, Israel
12	Bilateral activities	EU, UK, Austria, France, Japan, China, Malaysia, Taipei, Philippines, Vietnam, New Zealand, Israel
1	Multilateral	ASEAN

Adding value to those Commonwealth funds provided for the AAS International Exchange Programs and Workshops has been a key feature of the Academy's administration of the funds. Value has been added in three ways. First, the Academy has attracted additional international support for the International Exchange Programs and Workshops, more than doubling the Commonwealth investment in the Scheme. Second, the costs of administering the International Exchange Programs have been kept to a minimum, with assessment of applications and allocation of travel grants undertaken by Fellows of the Academy *pro bono*. Third, in the case of the International Exchange Programs there have been contributions, sometimes substantial, by the host as well as by the home institution.

Support for the International Exchange Programs and Workshops

The Academy has added value to those Commonwealth funds provided for the AAS International Exchange Programs and Workshops by attracting additional international support, from both public and private sectors, as shown in Tables 6.1 (page 22) and 6.2 (page 22).

Evolution of the Bede Morris Fellowship Scheme

The Bede Morris Fellowship Scheme was launched in 1989 in honour of Professor Bede Morris' contribution to science and French-Australian relations. The late Professor Morris was a pioneer of immunology in Australia, establishing the first Department of Immunology in Australia in 1969 at the John Curtin School of Medical Research at the Australian National University. The BMF Scheme falls under the accord for scientific cooperation between the

Australian Academy of Science and l'Academie des Sciences de l'Institut de France. It is supported by donations from colleagues and friends of Bede Morris.

The BMF Scheme has attracted support from other sources with ties to France. They include the pharmaceutical company Rhone Poulenc, the Australia-France Foundation and the French Embassy in Canberra, so that seven Australians now visit France each year under this scheme.

Additional funding for exchanges with India has also come from the Australia-India Council and the British Council has supported a Centenary of Federation Fellow to the UK.

Minimising the costs of administration of the AAS International Exchange Programs

The costs of administering the AAS International Exchange Programs have been kept to a minimum, with assessment of applications and allocation of travel grants undertaken by Fellows of the Academy *pro bono*. Peer review of applications is critical in ensuring successful applicants are of a high calibre, are undertaking collaborative projects of a high standard that will strengthen Australia's international collaborative links and enhance the nation's standing in science and innovation.

Four expert peer review panels comprise twelve Fellows of either Academy, ARC nominees and the S&T Counsellor from the French Embassy. Each research application is assessed by three members of the panel prior to the meeting of panel members. Forty-eight Fellows provide 14 hours *pro bono*. The value of time given to the assessment process is estimated as **\$120,960.00 per annum**.

Contributions by the home and host institutions to research projects supported by the AAS International Exchange Programs

The home institutions of Australian participants in the AAS International Exchange Programs have almost invariably provided salary support to the participant during the period of international collaboration. Together with salary on-costs, this amounts to an average contribution by home institutions of about \$8000 per participant, or a total of approximately **\$800,000 per annum**.

In addition, more than 80 per cent of participants extended their stay at their own expense to take advantage of conference attendance or other professional opportunities, with an average personal contribution of about \$1,000, or a total of approximately **\$80,000 per annum**.

The costs of undertaking collaborative research are met by the host institution. The host institutions have provided office accommodation, access to laboratory, library and computing facilities, access to major equipment and special apparatus, and have supplied expendable reagents and technical assistance, as well as the time and expertise of the host researcher. The average in-kind and direct contributions provided by the host institution for an Australian participant in the AAS International Exchange program for a period of 42 days is conservatively estimated at \$20,000, or a total of approximately **\$2,000,000 per annum**.

In many cases, the in-kind contributions of host institutions are substantial. Some examples are:

- *One month's access to unique laser facilities for the efficient production of carbon nanotubes, involving use of two lasers, each worth \$US500,000 (Instituto de Carboquimica, Zaragoza).*

- *Access to beef cattle pedigree records that would cost more than UK£2 million to replicate in Australia.*
- *Use of novel 'thin film' electrodes that are expensive and complicated to manufacture in Australia and prohibitively expensive to purchase. Access to trial these electrodes enabled me to have a high level of confidence that money spent on our own design of thin film electrodes would be successful and worth while.*
- *Australian researchers have been successful in winning large amounts of observing time on facilities included in the NASA Great Observatories Program. For example, I myself have won 200000sec of observing for the first year of the massive new X-ray telescope, the Chandra Observatory; a five year mission costing some \$3 billion. On a user pays basis, this observing time is worth \$5 million. Likewise, since 1990, Australian researchers won between 5 and 10% of the total Hubble Space Telescope (HST) resource either as Principle Investigators or as Co-Investigators of International teams. The Australian share has remained large simply because we have been better able to make world-beating proposals in open competition. The value of this Australian observational resource is worth about \$20-40 million per year - more than the total of all expenditure in all astronomy programs in Australia! Yet, access to these facilities costs Australia nothing.*

Conclusion

Adding value to the AAS International Exchange Programs and Workshops has been a key feature of the Academy's administration of Commonwealth funds provided under the Technology Diffusion Program for International Science and Technology Networks (ISTN). ISTN funds have been leveraged by a factor of 7.7.

Table 6.1

ISTN contribution to AAS international activities, FY 1998-99.

Activity	No.	No. funded in part by ISTN	ISTN contribution	No. of participant days	Value of leveraged days
No. of scientific visits by Australian researchers	99	66	\$281,296	12,926	\$1,792,920
No. of scientific visits by overseas researchers	33	33	\$173,487	1,999	\$59,400
No of bilateral workshops	9	98	\$95,305	596	-
No of delegations visiting Australia under AAS sponsorship	8	46	\$7,022	64	-
Administration			\$85,000		

Table 6.2

International contributors adding value to the Commonwealth ISTN funds for scientific visits.

Country	No. of Australian participants	Contribution ISTN	Contribution Host country
Canada	6	\$30,265	
China	6	\$9,427	\$10,450
France	8	\$10,000	\$30,540
Germany	13	\$74,132	
Italy	1	\$2,802	
Japan	34	\$13,582	\$1,682,634
Korea	5	\$6,467	\$51,440
Mexico	1	\$6,000	
Sweden	1	\$4,881	
Taiwan	3	\$3,645	\$17,856
The Netherlands	1	\$4,400	
UK	12	\$64,010	
USA	8	\$51,685	
Total	99	\$281,296	\$1,792,920

**Average ages of participants in some
AAS exchange programs**

Destination	Year of travel	Number	Average Age	Range
North America	1999-2000	14	40.3	35-49
North America	2000-2001	19	40.9	31-50
USA young researchers	2000	11	29.5	24-34
Europe	1999-2000	17	43.3	35-57
Europe	2000-2001	21	44.5	31-65
Europe young researchers	2000	8	30.9	24-42

Australian Academy of Science
International Exchange Programs
Evaluation of Outcomes

This survey relates to the outcomes of your research carried out under the Australian Academy of Science's International Exchange Program, as explained in the covering letter. Please send responses by 9 March 2001 to:

io@science.org.au

NAME:

INSTITUTION:

1. Access to knowledge and innovative technologies in the host country

Please describe access to:

- a) unique equipment
- b) reagents
- c) software
- d) collections in the host country
- e) Did you learn any innovative techniques?

2. Transfer of knowledge and innovative technologies to Australia

What elements of newly acquired knowledge and technology did you transfer to your home institution?

If some elements could not be transferred, what were the barriers to this?

3. Research outcomes: publications and patents

- a) List any publications jointly authored with the host institution
- b) List any other publications arising (in part) from the international exchange
- c) List any anticipated publications
- d) List any patents arising or anticipated from the international exchange
Other research outcomes

4. Other outcomes

Other outcomes of the international travel might include commercial outcomes, invitations to future conferences, increased ability to attract research support, consultancies and so on. Please describe other outcomes of your visit. Give dollar estimates where possible.

5. Promoting the profile of Australian science

Please describe how your visit may have helped promote Australia's profile in research and innovation.

6. Strengthening Australia's international collaborative links

Is the collaboration with the host institution continuing? Please describe the nature of the collaboration (eg email exchange, student exchange, access to reagents, visits).

7. Supplementation of the AAS travel grant

The AAS travel grant is only a small component of the total cost of your collaborative research. Supplementation of the travel grant can take various forms, in terms of contributions from the home institution (eg salary) and the host institution (eg access to equipment, reagents, software). Please describe the extent of supplementation of the travel grant, giving dollar estimates if possible, by:

- a) home institution
 - b) host institution
 - c) personal contribution
 - d) other
-

8. Long term benefits of international exchange

Please describe any other long-term benefits of the international exchange program (realised or anticipated), either for yourself, your home institution or for the nation more generally.

9. Improving the AAS International Exchange Programs to capture benefits for Australia

Please provide any suggestions on how the international exchange program might be improved to boost Australia's access and participation in the global innovation system.

Thank you for your cooperation

Publications arising from scientific visits to Europe 1999-2000 and 2000-2001

(ISTN Funds)

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**Publications arising from scientific visits to
Japan, Korea, China and Taiwan
1999-2000 and 2000-2001**

(ISTN Funds)

A - Publications jointly authored by an Australian participant in scientific visits to East Asia in 1999-2000 or 2000-2001 and the host institution, as at February 2001.

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Workshops

Joint Australia – Taiwan Symposium “Science and Policy Working Together in Catchment Management”, 4 - 8 November 1998

Catchment management is an issue of some considerable importance in both. The aim of the symposium was to provide a venue in which Australia and Taiwan could discuss approaches to catchment management, especially related to the formulation and delivery of policy, role of science, and access to scientific information.

Eighty delegates, including six Australians supported by the Academy, attended the symposium.

Outcomes:

- it was agreed to establish an informal group on Integrated Catchment Management, which would sponsor short courses for government agencies;
- promote visits between Australia and Taiwan by young scholars;
- develop research projects in this field;
- interactions between the participants of the symposium provided a basis for future interactions and a number of projects of mutual interest were discussed;
- the symposium proceedings have been published in the monograph series of the Interdisciplinary Program in Australian Studies at National Taiwan University.

Second Joint Australia-Korea Workshop “Manufacturing Technology on Steel Processing”, 5 – 9 April 1999

The program for the one-week visit enabled the Australian delegation to meet a wide variety of researchers from Korean universities, government instrumentalities and industry and provided the opportunity to visit a number of manufacturing operations.

The Australian-Korean Workshop on Manufacturing Technology, held at POSTECH was successful, with eighteen complementary papers presented by the Australian delegation and by Korean participants drawn from major institutions. The papers confirmed the commonality of interest and R&D approaches in the area, and, therefore, the opportunities for greater interaction.

Outcomes:

The Workshop highlighted the opportunity for increased interaction and cooperation in a number of areas – those include:

- a more constructive use of the bilateral Australia-Korea Exchange Agreement on an annual basis to develop and maintain significant institutional interactions on a strategic basis;
- encouragement of greater Australian participation in utilising the facilities of the Pohung Light Source at POSTECH under the ARC-KOSEF bilateral agreement;
- greater interaction and bench marking between the Australian Co-operative Research Centres’ program and the KOSEF Centres of Research Excellence program, as well as

the development of Memorandum of Understanding between similar Centres in the two countries, as appropriate;

- increased interaction between CSIRO and Korean government instrumentality such as KIMM and KAIST as part of the Korean and Australian involvement in the international Intelligent Manufacturing Systems program;
 - encouragement of Australian academics to participate in the Korean initiatives to increase the percentage of programs delivered in English. This provides opportunities for both the joint preparation and delivery of programs and the provision of distance education materials;
 - the development of Memorandum of Understanding between Australian universities and Korean institutions for staff and student interchange and joint programs in specific areas.
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Joint Australia – France Symposium “Scientific Frontiers in Molecular Biology and their Impact on 21st Century Medicine and Agriculture”, 27 February – 5 March 1999

The workshop was designed to develop future networks between young scientists in Australia and France. The topic was selected in order to encourage contact between a broader range of people than might be at the usual specialist meeting and because both countries have a strong economic and cultural association with agriculture and tradition in medical research.

Half of the delegation of young French researchers visited the Walter and Eliza Hall Institute of Medical Research in Melbourne to participate in a Symposium, while the remainder of the delegation visited Canberra to participate in a Plant Molecular Biology Colloquium at CSIRO Plant Industry.

Outcomes:

- the French and the Australian groups joined at Corowa to continue discussions on mutual interests and to identify potential areas of future collaborations;
 - presentations and discussions were held on world population and food demand, mapping and isolating genes, *Arabidopsis* gene database, and overviews of research in Australian and French institutes;
 - the symposium provided an opportunity for the Australian and French scientists to recognise potential areas for future collaboration and it is expected that the symposium will result in various joint activities.
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Australia-Japan Marine Science Workshop, 16 – 20 November 1998

The Academy and the Japan Society for the Promotion of Science sponsored an Australia-Japan workshop on Marine Science, held in Hobart, Townsville and Canberra.

The group discussed areas of existing and potential future collaboration for work in the Southern Ocean. The workshop drew together a delegation of Japanese scientists from the National Institute of Polar Research and Hokkaido University with scientists from the Australian Antarctic Division, Antarctic CRC and CSIRO Marine Research.

Outcomes:

- the workshop identified several areas of existing collaboration that would be profitable to continue well into the future and new areas of endeavour that can readily be started;
 - several other areas of mutual interest were discussed, but would need further discussion before implementation was possible;
 - other areas, specifically marine geosciences and modelling, were considered to be highly relevant and achievable but need further discussion involving scientists who were not at this workshop;
 - specific individual scientists were tasked with further discussions with colleagues both in Australia and Japan;
 - in addition to the Australian and Japanese links, other collaborations to achieve a bipolar perspective were considered important.
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Australia-Korea Ceramic Workshop, September 1998

The Academy supported two Australian researchers to attend the Australia – Korea Ceramic Workshop held in Seoul. Participants of the workshop were from the Korean Ceramic Society and the Australasian Ceramic Society.

This activity was funded jointly by the Academy and the Korea Science and Engineering Foundation under the MOU between the Australian Academy of Sciences and Technological Sciences and Engineering, and the Korea Science and Engineering Foundation.

Second Australia-Korea Polymer Melt Workshop, 5 – 10 July 1998

A successful Second Joint Australia-Korea Polymer Melt Workshop was held at Seoul National University, Korea.

Outcomes:

- it is expected that a number of direct collaborations in research will result from the workshop;
 - a strong relationship has been built between the Korean and Australian rheological communities and has led to the establishment of a confederation of rheological societies in the Asian region.
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Australia-Korea Regional Deposition Processes in the Atmosphere Workshop, 18 – 25 October 1998

The Academy supported five Korean researchers to attend the 4th International Joint Seminar on the Regional Deposition Processes in the Atmosphere, held in Melbourne. The initial component consisted of a special stream of the 14th International Clean Air and Environment Conference, and was followed by a site visit to the Latrobe Valley.

Outcomes:

- the joint seminar was highly successful in terms of enabling the continuation of existing, and the establishment of new, joint research programs;
- incorporation of activities of cultural value.

This activity was funded jointly by the Academy and the Korea Science and Engineering Foundation under the MOU between the Australian Academy of Sciences and Technological Sciences and Engineering, and the Korea Science and Engineering Foundation.

Australia-Taiwan Research Symposium in conjunction with Oz-Tech 99, 6-10 April 1999

On behalf of the Australian Commerce and Industry Office (ACIO), the Academy, with assistance from ATSE, administered a two-day Research Collaboration Symposium. The Symposium brought together leading scientists from Australia and Taiwan.

Outcomes:

- through the exchange of presentations on recent research, the Symposium identified areas of complementarity and fostered future collaborations;
- Australian Nobel Laureates Professor Peter Doherty, FAA was one of the presenters at the symposium.

Thirty Australian participants were able to receive living allowances from the National Science Council.

Australia-Taiwan Aquaculture and Fisheries Resources and Management Workshop, 1 – 8 November 1998

The second Joint Australia-Taiwan Aquaculture and Fisheries Resources and Management Workshop was held in Taipei between 1 – 8 November 1998.

Outcomes:

- the establishment and/or enhancement of scientific collaboration and interaction among Taiwanese and Australian aquaculturists and fisheries researchers and managers were discussed at length;
- a series of discussions and visits to explore the strengths, weaknesses, opportunities and threats with respect to coastal fisheries and aquaculture in the Asia-Pacific region, with an emphasis on the role to be played by Taiwan and Australia were discussed;
- opportunities for future projects that could be undertaken jointly and the establishment of linkages to ensure rapid and effective information exchange were analysed.

This activity was funded jointly by the Academy and the National Science Council under the MOU between the Australian Academy of Sciences and Technological Sciences and Engineering, and the National Science Council.

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