Space Issue

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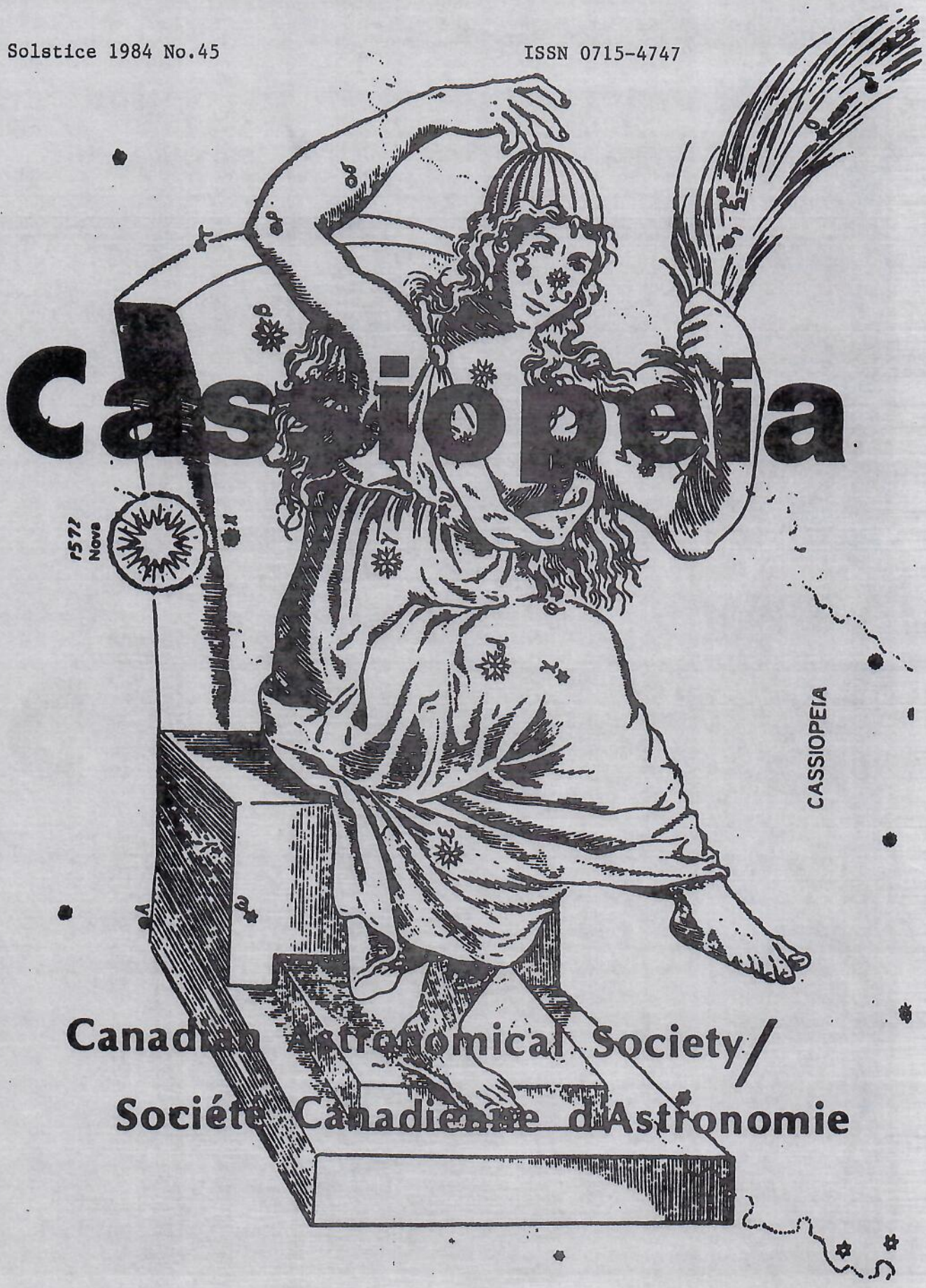

Cassiopeia

Canadian Astronomical Society/
Société Canadienne d'Astronomie

Cassiopeia

No.45 Winter Solstice 1984

CANADIAN ASTRONOMICAL SOCIETY

SOCIÉTÉ CANADIENNE D'ASTRONOMIE

Editor: Colin Scarfe, University of Victoria

Editorial

This issue seems to be largely devoted to astronomy from space, in particular to the efforts to develop a Canadian presence in this field. According to the latest information (p.49) STARLAB is shelved. But a proposal for a space astronomy centre (p.33) rises Phoenix-like from the ashes. We also have a full report of the work of JSSA, a description of the activities of CSSC and an outline of other countries' space astronomy projects.

Although readers may be overwhelmed by the amount of material on space, I should like to draw their attention to the notices re CFHT applications, the slow but steady progress of the CLBA, and an excellent account by Anne Underhill of the NASA Nonradiative Heating Workshop.

As can also be seen from Chris Aikman's report, the Directors have been working as hard as ever. Finally the plans for next June's meeting are well in hand. It will overlap with that of the PAC, and celebrate 50 years at the DDO; it should be an excellent meeting.

With best wishes to all for 1985,

Colin Scarfe

Deadline for the Vernal Equinox Issue will be March 15.

FOURTH MEETING OF THE CASCA BOARD

A regular meeting of the Board of Directors was held at the White House of the Dominion Astrophysical Observatory on December 3, 1984. The report that follows is a condensation of the minutes of that meeting.

Our Society continues to grow, and the following new members are welcomed to CASCA:

Ordinary members: Michael Bietenholz (Toronto), Peter Dawson (Trent) Bernadette Harris (UVic), Gerard Lelievre (CFHT), Henry Matthews (HIA-Ottawa), Marshall McCall (DDO), Raymond McLenaghan (Waterloo & CITA), Danny Summers (Memorial).

Student members: Rita Boreiko (Calgary), Arnold Gill (Queen's), Robert Hill (UWO), Judith Irwin (Toronto), Enrico Kindl (UBC), Raymond Laflamme (Cambridge, England), and Peter Leonard (Toronto).

In addition to the above new members, a number of student members have completed their studies and have been accepted as ordinary members of CASCA: they are Edwin Anderson (KPNO), Wendy Freedman (Mount Wilson & Las Campanas Observatories), Pierre Lacombe (Planetarium Dow), Robert Lamontagne (Montreal), Mary Lane (Toronto), Lorne Nelson (MIT) and Louis Noreau (Toronto).

With the above membership acceptances, membership stands at 218 ordinary, 34 student, 1 hono rary and 1 corporate members, for a total of 254 members. Since over 20% of the membership listings have changed since the last membership directory was issued in April 1984, it is hoped to reissue the membership directory in January 1985. This time care will be taken to insure better print quality, and initials will be included with names. Ordering will remain by rows rather than by columns, and titles will not be included, unless opinion strongly favours such changes. Without the constitution included, the directory will run to only half as many pages as last time, and is expected to cost about $250 to print. Listings have been checked against the just-issued AAS Directory (64% of our members also belong to the AAS),although it is often found that our address listing is more current than theirs.

Attention is drawn to the fact that our constitution allows up to nine hono rary members of CASCA to be named from distinguished foreign astronomers; at present we have no foreign hono rary members. Nominations for such hono rary members would be welcomed.

The question of adoption of committee reports at Annual General Meetings (AGMs), and how to turn the recommendations of those reports into Society policy, was dealt with at some length at this meeting. For some time, the conduct of the Society's meetings has been governed by Robert's Rules of Order, Newly Revised. However systematic these rules may be, it was felt that the infrequency of our meetings, combined with the need to respond quickly but with forethought to current issues at our annual meetings, dictates that somewhat different procedures be used at times. It was moved and adopted that:

"The Canadian Astronomical Society shall use Robert's Rules of Order as a guideline in the conduct of its meetings."

The essence of this motion is to replace the words "to govern" with "as a guideline in". New procedures were discussed and adopted with the aim of encouraging adequate advance notice of all motions to be brought before the AGM, while still allowing some flexibility to permit motions from the floor where appropriate. The procedures tentatively adopted will be published in the next issue of Cassiopeia.

Four applications were received for the CASCA Small Grants Program prior to the November 30 deadline; all four were for travel grants to the 165th meeting of the AAS in Tucson, Arizona in January 1985. Three of these applications may be viewed as extraordinary as they resulted from cancellation of approval by the Minister of Science for all HIA personnel travel to this meeting after several members had made firm commit ments to participate in an official

capacity. Grants of $300 each were made to Robert McClure (invited review speaker), Jim Hesser (AAS Board of Directors), and Sidney van den Bergh (AAS Publications Board), and a grant of $600 was made to Tom Stiff, a York University student.

A new Beals Award Committee of Vic Gaizauskas, Chris Aikman and George Mitchell was formed, to report back to the next meeting of the Board, for presentation to the AGM prior to a call for applications for the award. Matters to be reported on include cost of a travel grant to the November 1985 IAU General Assembly in New Delhi, suitability of such an award at a time when teaching members will be less free to travel from their duties, and alternative uses of the Beals Award compatible with the wishes of the original donors to the Beals fund. Some felt that the award might be used as an outright prize for excellence, rather than specifically to be used for IAU travel. The opinions offered by members at the last AGM in Ottawa seemed to indicate that the Award fund should not be allowed to exhaust itself, but should be ongoing. It was moved and adopted that the Beals Award fund be reimbursed up to a balance of $5000 to be placed in a term deposit or guaranteed fund.

A member has proposed that the Society sponsor an annual award for the best doctoral thesis in astronomy in the preceding two year period. Some concern was expressed that the Canadian astronomical community is too small for such an award to have an overall positive effect. No action is being taken at this time.

The Space Astronomy Committee presented a lengthy report, which is included in this issue of Cassiopeia. Similarly included is another presented report entitled "A proposal for the formation of a space-astronomy centre of HIA at the Dominion Astrophysical Observatory", which prompted much discussion. The following motion was passed as an endorsement of the concept of this proposal:

"Whereas space astronomy is a rapidly developing field which holds the promise of major breakthroughs in astronomical discovery;

"Whereas the membership of the Canadian Astronomical Society has expressed support for a data analysis and archiving facility for the Hubble Space Telescope in Canada, and specifically in western Canada;

"Whereas the optimum use of space-based and ground-based astronomical instruments is dependent upon continued innovation in instrument and detector development;

"The Canadian Astronomical Society strongly supports the formation of a space astronomy centre, such as that proposed for the Herzberg Institute of Astrophysics at the Dominion Astrophysical Observatory."

In other committee developments, CASCA has accepted the Associate Committee on Astronomy's Subcommittee on Optical Astronomy as its Optical Astronomy Committee. This means that this group, chaired by Gretchen Harris with Tom Bolton, Bruce Campbell, Anthony Moffat, John Rice and Gary Welch as members, will also report to our meetings. The Education, Manpower and Employment Committee has been reconstituted with John Percy as chairman and Roy Bishop, Richard Bochonko, Tom Clarke, Carman Costain, Jean-René Roy and David Turner as members. Reports were received at this meeting from the Education, Manpower and Employment Committee, the CLBA Planning Committee (published in this issue of Cassiopeia), the Radio Astronomy Committee, and the Committee for Theoretical Astrophysics. Persons wishing a voice on any committee are urged to let their interest be known to either the president or secretary of CASCA.

The other main item of business at this meeting concerned plans for future annual meetings. Plans for the 1985 meeting in Toronto are covered elsewhere in this issue.

Chris Aikman, CASCA Secretary.

CANADIAN ASTRONOMICAL SOCIETY - ANNUAL SCIENTIFIC MEETING 1985

The Department of Astronomy and the David Dunlap Observatory, University of Toronto, cordially invite you to attend the 1985 Annual Scientific Meeting of the CAS, to be held in Toronto from Monday, May 27 to Friday, May 31, 1985. May 31, 1985 marks the 50th anniversary of the David Dunlap Observatory, and there will be special celebrations to mark the occasion, as well as the usual stimulating and enjoyable events associated with CAS meetings.

Registration will take place on Monday, May 27, and the traditional Welcome Party will be held that evening. Tuesday morning will be set aside for committee meetings. On Tuesday afternoon, there will be a special session on Education in Astronomy, held jointly with the Planetarium Association of Canada. On Tuesday evening, the first annual Helen Sawyer Hogg Public Lecture will be given, followed by a reception for the CAS and the co-sponsoring societies: the Planetarium Association of Canada, the Royal Astronomical Society of Canada, and the Royal Canadian Institute.

The scientific sessions, beginning on Wednesday, will include special sessions devoted to ARO, CFHT and DAO, several invited review lectures including the R.M. Petrie Memorial Lecture, and adequate time for contributed oral and poster papers. We encourage poster papers, and we have set aside two-hour periods on two afternoons when posters can be viewed in a comfortable and unhurried environment. Oral papers, however, will not be discouraged.

Friday, May 31 will begin with a special session devoted to the history and work of the DDO. The afternoon will be set aside for the Annual Business Meeting of the CAS. The meeting will end with a tour and anniversary celebration at the DDO in the evening. The CAS Council will meet on Monday May 27 and the NRC Associate Committee on Astronomy will meet on Saturday June 1.

Accommodation will be provided in the University residences and at the Park Plaza Hotel. Further information, registration forms and a new standard abstract form for contributed papers will be provided before the end of March. The deadline for receipt of accommodation requests and abstracts will be May 1. Registration fees will be the same as last year, with a discount for those who pre-register.

John R. Percy
Chairman: Organizing Committee

EDUCATION IN ASTRONOMY

As part of the CAS Annual Scientific Meeting, there will be a special session on Education in Astronomy, held jointly with the Planetarium Association of Canada. Members of the CAS (or PAC) who wish to present short oral papers at this session should notify me as soon as possible, giving the topic of the paper, a brief summary of the content, and any special facilities required. Presenting a paper at this session does not prevent a CAS member from presenting a regular paper at the scientific sessions. I would also be grateful for suggestions about possible topics and speakers for this session.

John R. Percy
Chairman: Education Committee
Canadian Astronomical Society

PLANETARIUM ASSOCIATION OF CANADA CONFERENCE '85

News Release 12 November '84

From May 25th to 29th, 1985, the McLaughlin Planetarium will be hosting the biennial conference of the Planetarium Association of Canada in Toronto, Ontario. Planetariums in Canada range in size from the 23 meter dome of facilities like the McLaughlin, to portable Starlabs that can be set up at various locations. Conference `85 will reflect that diversity with paper sessions, workshops, field trips, demonstrations and formal and informal gatherings that will provide something for everyone in the field.

Conference accomodation is quite literally a stone's throw away from the McLaughlin Planetarium. At the Park Plaza Hotel, the cost of a single or double room is currently $70.00, plus $15.00 for a third (plus provincial sales tax). The Margaret Addison residences of Victoria College, University of Toronto, are minutes away by foot with the cost of a single room currently $28.00 and for a double, $39.00 (including breakfast and sales tax).

In addition, the conference immediately follows the annual meeting of the Canadian Museums' Association and immediately precedes the 50th anniversary of the David Dunlap Observatory and the conference of the Canadian Astronomical Society.

As if that weren't enough - the city that Fortune magazine called "the world's newest great city" is the home of countless attractions itself. From Roy Thompson Hall, to the Eaton Center, to the Royal Ontario Museum, the city provides a perfect opportunity to combine conference and vacation.

We in Toronto are very excited about hosting Conference '85 and anticipate with the participation of PAC members and our colleagues in Canada and abroad, a very rewarding event. For more information, please contact: Chris Sasaki, Conference Registrar, at the McLaughlin Planetarium (416-978-2630).

DAO telescope time assignments

Now that the DAO telescopes have been scheduled for the last quarter of the year it is possible to compare this year's time assignments to those of past years. Such a comparison is shown below:

Visitor Time Allocations at DAO

Year	1.8 m	1.2 m	Total
1982	35%	45%	40%
1983	49	37	43
1984	72	36	54

The table shows that, for the first time, visitor use of DAO telescopes exceeds that by DAO staff. Time allocation statistics demonstrate that the transformation of DAO into a National Facility has been accelerating in recent years.

For 1984 outside time allocations were distributed as follows:

User	1.8 m Nights	(%)	1.2 m Nights	(%)
Canadian universities	157	43	84	23
U.S. universities	82	11	30	8
U.K. universities	11	3	12	3
China (People's Republic)	13	4	6	2

Sidney van den Bergh

ANNOUNCEMENT

CHANGES IN THE DEADLINES FOR CANADIAN CFHT TIME APPLICATIONS

The CFHT Canadian Applications Committee (CAC) wishes to inform the community that it has decided to advance by two weeks the deadlines for applications for observing time at the CFHT, effective August 15, 1985.

The original deadline of March 1 for applications for the semester July 1 through December 31, will still remain in effect in 1985, but will be advanced to February 15 in 1986.

This modification has been made necessary by the improved and somewhat more involved selection procedure we are now following in assigning observing time to Canadian applicants. Firstly, we have increased the number of referees to a mean of 3.3 per proposal, including American referees, with the concurrent increase in mail distribution delays. Secondly, CAC would like to have the time needed to consult with applicants and referees, when necessary, after reception of the referees' reports.

CAC hopes that this announcement will have received widespread distribution by the time it becomes effective in August 1985. We reiterate that the original deadline of March 1, 1985, for the second 1985 observing session remains unchanged.

Canadian Applications Committee
December 1984

CANADIAN APPLICATIONS COMMITTEE OF THE CFHT

At its meeting of June 1 1985 the Associate Committee for Astronomy will consider suggestions for membership of the Canadian Applications Committee of the CFHT. The continuing members of the committee will be Drs W. Harris and J. Kormendy.

One of the most important factors in choosing members is the requirement that as wide a spectrum of interests as possible be represented within the CAC.

Please send your suggestions before the middle of May to Dr G. Michaud, Département de Physique, Université de Montréal, Montréal, Canada H3C 3J7. Please include a brief justification showing how your choices would lead to a balanced committee.

A CLBA UPDATE November 30, 1984

Since the AGM in June, the CLBA 'Collaborative Options' report has been accepted and approved by the CASCA Board of Directors. CASCA then forwarded copies of the document to NRC and NSERC, endorsing the CLBA (4-element array) as an option for the original CLBA. On Sept. 27, the report was presented to the Council of N.R.C., a meeting which I attended to answer questions about this new approach. Much of the discussion in my presence was about the industrial benefits, and the crucial importance of this aspect was repeatedly stressed.

The Council ultimately decided that it wants to keep the CLBA high in NRC's priorities, and that NRC should not abandon the 9-element array concept. The upshot is that the CLBA will be presented to the government (in due course) as a two-phase project. In phase I, four antennas would be built, and the CLBA would begin operations in this form, with U.S. and European cooperation. In phase II, 5 more antennas would be added to form the CLBA as originally envisaged.

The next step is for NRC to undertake negotiations with NRAO to develop something like a 'Memorandum of Understanding' to outline one or more models for cooperation with the U.S. An NRC committee will probably meet with NRAO early in 1985 after the new NRAO director takes up his duties in January. Evidently, NRC will not need to wait for these negotiations to proceed with a proposal to the Canadian government. What NRC will wait for, however, is a report from the CAS on the industrial benefits of the CLBA. It is widely perceived that the industrial aspect will be the most critical component of NRC's argument. The Planning Committee is developing a fairly extensive document now entitled "The CLBA: The Benefits to Canadian Industry". This document would be largely a compilation of other reports on this subject, but we are considering letting a contract to get more facts. The contract to a Canadian company would be for obtaining facts and figures on domestic and foreign markets for product spinoffs from the CLBA, for example.

As far as the recent government spending cuts are concerned, these have not affected the CLBA directly because it is not before the government at this moment. What the future holds is anybody's guess of course.

Meanwhile, our Planning Committee still has NSERC and NRC support to plod on, with the industrial report being now our main priority.

E.R. Seaquist
Chairman
CLBA Planning Committee.

THE JOINT SUBCOMMITTEE ON SPACE ASTRONOMY (JSSA)

Reporting to:

The Associate Committee on Astronomy (ACA)
The Associate Committee on Space Research (ACSR)
and
The Canadian Astronomical Society (CASCA)

SUMMARY OF ACTIONS TAKEN (SEPTEMBER 1984)

Contents

I. PARTICIPANTS AND SCOPE OF THE MEETING

The JSSA met on 24 (8:30 - 23:45) and 25 September 1984 (8:30 - 15:00) at NRC, Ottawa in an atmosphere of agreement that the next few months are unusually important, inasmuch as the new Federal Government will be reviewing its options and priorities in space science. Members and ex-officio members present were:

T.A. Clark, University of Calgary
G.G. Fahlman, U.B.C.
J.W. Glaspey, Universite de Montreal
J.E. Hesser, DAO, Chairman
J.B. Hutchings, DAO
J.C. McConnell, York University
I.B. McDiarmid, ex-officio, Director CCSS (present 24 September)
J. MacLeod, HIA, ex-officio (CASCA representative)
R.W. Nicholls, York University, ex-officio (ACSR Chairman; present 24 September)
M. Shara, Space Telescope Science Institute

B. Madore and G. Michaud (ex-officio) could not be present. Guests were:

G. Atkinson, CCSS (24 September)
E.D. Crook, CCSS and ACSR Secretary (24 September)
J. Halliwell, Director of NSERC Grants (24 September)
J.K. Pulfer, Senior Vice President, NRC Laboratories (24 September)
G.A.H. Walker, UBC, ex-Starlab Project Scientist
A.L. VanKoughnett, CCSS (24 September)

A group consisting of Fahlman, Glaspey, Hesser, Hutchings, McConnell, Shara and Walker also met with L. Kerwin, President of NRC, for an hour of discussions on 25 Sept.

The meeting format was informal. This report summarizes the final actions taken, and does not attempt to record the discussion which led to those actions. Topics for discussion arose from direct charges given to the JSSA by ACA; from the June, 1984 open session on The Future Of Space Astronomy sponsored by JSSA at the CASCA annual meeting; from a smaller meeting held with Mr. Pulfer at the DAO in August; from a memo distributed prior to the meeting by J. Glaspey; and from the excellent, frank interaction that took place between ourselves and our distinguished guests from NSERC, NRC and CCSS. Among the topics examined were:

- At its June, 1984 meeting ACA charged us with defining the scope of present NSERC support of Space Astronomy with the dual aims of: (1) identifying programmes in place that might be tapped more effectively by the astronomical community; and (2) formulating specific recommendations for changes we believe to be desirable.
- On 21 September G. Michaud, the Chairman of ACA, asked us to re-examine Space Astronomy priorities as part of an ACA review of the priority structure established in its January, 1983 report, "Astronomy in Canada in the 1980's".

- All input received by JSSA during its open session at the 1984 CASCA meeting and an informal session held with Mr. Pulfer at the DAO has stressed that basic science is only of secondary importance in the political decisions affecting funding of large science projects; what can we do, if anything, to alter the situation?

- How do we further encourage the establishment of the centres of excellence/specialization/leadership in Space Astronomy called for by CASCA in the third resolution adopted in June, 1984?

- How do we overcome the almost total lack of opportunity for young Canadians to become trained in Space Astronomy research and experimental techniques?

- The creation of a separate space agency and/or budget supporting major basic science programmes in space called for in our resolutions/recommendations adopted by CASCA and ACA in June, 1984 may only be realistically possible during the next few months while the new Government and its Ministers are re-examining the entire structure of Government. What is the next step for our group to encourage realization of this goal?

- Canada is expending $2M to investigate participation in the NASA space station, yet no contact has occurred between those responsible and the astronomical community; how can JSSA foster consideration of astronomical research opportunities and requirements by the relevant authorities?

- Are the present divisions of responsibility between NSERC and NRC for funding, especially of major Space Astronomy projects, seriously hampering development of such programmes and the participation of NRC scientists in them; and, if so, what do we recommend be done about it?

- How can we establish communication between the NRC-CCSS and the astronomical community to avoid such situations as the non-consultation of astronomers regarding experiments for the Canadian astronaut programme and the non-consultation of astronomers regarding possible Canadian interest in a space station/platform?

The following sections summarize the actions and/or statements formulated and unamimously adopted during the meeting.

II. PRIORITIES, FUNDING OF MAJOR SCIENCE PROJECTS, AND THE ESTABLISHMENT OF A CANADIAN SPACE AGENCY

CASCA and ACA passed resolutions/recommendations during their June, 1984 meetings (see Appendices 1,2) endorsing the concept of "...the creation of a single Canadian Space Agency having a significant and sufficient fraction of its budget permanently allocated for basic research" (CASCA Resolution 2, ACA Recommendation 3). In addition, ACA's second Recommendation states: "ACA feels that the criteria by which major science projects for basic space science research are judged in competition with applications and resource space projects must change: the current prejudice is displacing the basic research that is the foundation of science and future technology."

The September JSSA discussions elaborated these concepts as following:

This Committee notes that, under the present system of space science funding, it is impossible to support large Space Astronomy projects. They compete directly with 'applications' proposals which receive a higher priority because they more closely meet currently perceived national needs.

There is no mechanism either through the NSERC or the NRC to fund adequately nation-wide projects in excess of $10M. The delays and misunderstandings introduced by a total lack of contact between the scientists and the Ministry where funding decisions are made seriously limits our ability to participate in international collaborative ventures.

The establishment of a Canadian Space Agency in whose budget a sum is set aside for purely scientific projects might solve these problems. These funds should be available for the support of both Government and University scientists. If some modification is not made to the current system of funding and decision making, it appears that astronomers cannot consider involvement in major space projects.

In light of these criticisms we specifically recommend that Canada investigate a re-involvement in STARLAB which would cost Canada no more than $50M (1984$). The Management, Ministerial, industrial and scientific groups involved must work closely together. This exciting and internationally acclaimed project has the Committee's highest priority for Space Astronomy.

The JSSA asked G. Walker to attempt to establish contact with the new Minister of Science and Technology, Dr. Siddon, in order to present the above statement, and to ascertain whether encouragement is forthcoming for proceeding with a re-investigation of Canadian participation along the lines suggested in Walker's memo submitted to the JSSA (see Appendix 3).

III. NSERC POLICIES

In specific response to ACA's request, and with the excellent cooperation of, and information supplied by, Dr. Halliwell, the JSSA formulated the following summary of current NSERC support and recommendations for alteration therein:

Prologue: NSERC provides support for University-based scientists through a wide variety of programmes which are, for the most part, not specifically tailored to serve particular disciplines. The so-called Foundation Programmes, which include Operating Grants, Manpower Support Fellowships, and Infrastructure Grants designed to defray direct costs of research (equipment and infrastructure), provide support to astronomers at the level of $1.87M through the Astronomy and Astrophysics Grant Selection Committee. The Space Science and Aeronomy Grant Selection Committee provided awards totalling $1.27M although only a small fraction is at present allocated for Space Astronomy.

These programmes are designed to support individual scientists and small groups and are not geared towards big projects which might be undertaken in Space Astronomy as National or international facilities.

One mechanism which has been utilized by a number of space science groups, the CLBA Planning Committee, and the STARLAB Project Scientist, is the Collaborative Special Project Grant programme. In 1984-85, a total of $0.5M was awarded under this programme, with typical grants being of the order of $100K.

An alternative programme, the Project Operating Grant, has been tailored to the needs of the high energy nuclear physicists whose research requires the specialized facilities located in Canada (TRIUMF) and at foreign accelerators. The Institute of Particle Physics plays a key role in this programme.

Recommendations: The JSSA recommends that NSERC consider a granting scheme equivalent to the Project Operating Grants to support major Space Astronomy initiatives, while maintaining the standard operating grant procedures for most University astronomers. It is further recommended that ways and means be established to support nonUniversity scientists when they become involved in large-scale projects of this kind. The establishment of centres of specialization within Canada would probably facilitate the administration of Project Grants on behalf of the science teams.

In this overall scheme, it is envisioned that other NSERC programmes be utilized to support such projects. For example, Research Professorships and University Research Fellowships might provide highly qualified manpower, while necessary equipment would come from Major Equipment Grants. Collaborative Special Project Grants would support project development and instrument design, while Infrastructure Grants would partially finance the continuing overhead costs of the centre. These several individual approaches could probably be streamlined within a single Project Grant to reduce the overall administrative burden upon the granting agency and the centre.

IV. NRC AND SPACE SCIENCE FUNDING vs. GROUND-BASED ASTRONOMY FUNDING

One of the major reasons difficulties are experienced in securing funding for space science is that its unique experiments are much more expensive than experiments conducted in earth-based laboratories. This fact combined with the fact that CCSS is constituted within NRC to monitor contracts to industry for space science hardware rather than to conduct in-house development and/or research is of major concern to the JSSA. A specific case discussed was that of scientists at the DAO having been approached by American and European colleagues to supply from their optical shop and associated engineering creativity a small optical telescope to monitor objects under observation by the proposed Advanced Astronomy X-Ray Facility (AXAF). The only way CCSS can support Canadian participation in this, or any other project, is through a contract to Canadian industry. As a consequence of the fact that the DAO, with its world-renowned optical shop, could not, as an NRC lab, fulfill the desired role, the foreign scientists decided that the major optics would have to be built in the UK, instead. We also note with concern the difficulties of obtaining travel funding for NRC scientists' participation at any level in space astronomy projects. Accordingly JSSA approved the following:

> The JSSA notes that space science is an order of magnitude more expensive than ground-based astronomy, and, as such, needs to be adequately budgeted within NRC by appropriately designated funding. The present budget and CCSS charter do not allow NRC in-house developments, which severely restricts the participation of NRC personnel in space science.

V. EDUCATION OF CANADIAN SPACE ASTRONOMERS AND CENTRES OF SPECIALIZATION

The JSSA is deeply concerned with the lack of opportunities available to Canadian students and post-doctoral fellows in the area of Space Astronomy. Potentially, there are many ways to overcome this problem, but the lack of space astronomy expertise in Canadian universities makes significant progress unlikely in the foreseeable future unless remedial action is undertaken immediately. M. Shara brought to the meeting a specific proposal which had been discussed by him with senior management of the Space Telescope Science Institute (STScI), namely, that Canada provide persons with two or more years experience beyond the Ph.D. to work at STScI. Such persons would work with a specific team preparing for the 1986 August launch of ST; or, following launch, with data analysis and guest observer support. This specific suggestion, as well as the entire related issue of training for young Canadians, occupied much of the discussion at the meeting, from which the JSSA distilled the following:

The JSSA notes that the forefront of astronomical and astrophysical research is increasingly being defined by observations conducted in space. However, the JSSA also notes that no centre of expertise in Space Astronomy exists in Canada to provide a focus for such research. As a result, it is difficult for Canadian astronomers, in general, and for young astronomers, in particular, to acquire expertise in Space Astronomy. CASCA has passed a resolution (see Appendix 1) urging the establishment of a centre of expertise in Space Astronomy. Staffing of such a centre with people of appropriate expertise may pose problems as currently few trained Canadian personnel are available. Accordingly, as one means of providing trained personnel for such a centre and for Canadian Space Astronomy in general, we RECOMMEND the establishment by NRC, NSERC or some combination thereof, of visiting research fellowships with tenures of 1 to 3 years to be held at centres of excellence in Space Astronomy in other countries. Such centres would include the Space Telescope Science Institute, the Infrared Astronomical Facility data bank, the European Space Agency, etc., where Canadian participation has already received encouragement. In particular, we note that STScI, which is operated in Baltimore, Md., by the Association of Universities for Research in Astronomy under contract to NASA, encourages active participation by astronomers from foreign institutions, and has issued a specific invitation to Canada to send scientists to that institution. Indeed, Japan at present supports such a research associate of the type we are suggesting.

The astronomers benefiting from such experience would be well qualified to provide future leadership in developing Canadian centres of specialization in Space Astronomy upon their return to Canada.

VI. CANADIAN INVOLVEMENT IN THE SPACE STATION CONCEPT

Following the discussions between the JSSA, Mr. Pulfer and Dr. McDiarmid regarding the failure to seek the astronomical community's input to studies of possible Canadian participation in NASA's space station, the JSSA prepared and endorsed the following statement:

> The JSSA is concerned that the on-going studies into the Canadian involvement in the NASA space station concept have not yet included the potential needs of the future Space Astronomy experiments. We presume that the studies of such Canadian involvement includes communicating the needs of Canadian researchers to the appropriate authorities at NASA.

As an example of such future projects, part of our discussions concerned the proposal for continued Canadian participation in a revised STARLAB project. Discussions regarding STARLAB are continuing both within and outside of Canada. In the meantime, we have prepared a list of general requirements which we feel to be important on a possible space station system:

1. Inertial pointing capabilities (low noise background).
2. Low contamination environment (clean operating conditions).
3. Adequate electrical power (>=2.5 KW).
4. Long-term missions (6-12 months on orbit).
5. Servicing capabilities for repair and refurbishment.
6. Communications to ground control centre (possibly high bandwidth, depending upon the detectors).
7. Cryogenic capabilities to cool detectors and to dissipate electronically generated heat loads.

VII. IMPROVEMENTS IN COMMUNICATIONS WITH CCSS

The JSSA requests that CCSS communicate routinely the scope of its activities, as well as announcements of developing opportunities of possible interest. Specifically we request that the December 1984 issue of Cassiopeia carry such information targeted at Canadian astronomers, the majority of whom are unfamiliar with CCSS programmes, plans, etc., as well as being unfamiliar with the acronyms and related jargon of the CCSS Newsletters. The latter tend to be addressed to CCSS' established "clientele" of upper atmospheric physicists and planetary scientists, rather than towards disciplines such as ours, which are trying to become established in Canadian space science. We also request that CCSS arrange to have CASCA members (and any other scientists so wishing) placed on the NASA Announcement of Opportunity mailing list as soon as possible. Finally, we request that CCSS participate in the annual CASCA scientific meeting with either poster displays of on-going programmes and future plans, or with oral reports, depending upon the type of interaction deemed most desirable by CASCA Council and CCSS for each meeting.

VIII. CONCLUDING REMARKS

During the conversations with Dr. Kerwin, many of the above points (in particular the essence of items II,IV-VI) were discussed. Dr. Kerwin offered his assessment of the changes just now coming on line, as well as on some difficulties he believes STARLAB continues to face in Canada. He did not object to the action being taken (item II), however. He also offered encouragement to the community at large in its pursuit of the ambitious goals of establishing a Canadian Space Astronomy programme (both research and education) commensurate with the quality of its present ground-based ones. In particular, he commented that if a case strong enough to survive NRC's internal "Tournament of Champions" could be put together, one centre of specialization might be created within HIA, itself, perhaps at the DAO.

John Glaspey and the undersigned agreed to prepare a letter to be sent to CASCA members as soon as possible requesting information about any Space Astronomy related projects being proposed or conceived, in order to include them in the priorities ranking requested by ACA. The letter will also ask for opinions regarding the establishment in Canada of a repository for all data obtained with Space Telescope. John Hutchings agreed to prepare a report for the December Cassiopeia outlining all opportunities (of which he is aware) for Canadian astronomers to utilize Space Astronomy data archived in other countries. The JSSA also encouraged DAO staff to formulate a proposal for the development of a centre of specialization in space astronomy at that Observatory. Such a centre might also include a Space Telescope Regional Data Analysis Facility set up in such a way as to make it convenient for Canadian students and astronomers to access and analyze such data. The Chairman agreed to forward to Dr. Doetsch, the leader of the Canadian Space Station study, the contents of item VI, above, as well as a copy of the Science Requirements Document of the STARLAB programme, which specifies some parameters of interest to astronomers regarding the Space Station.

James E. Hesser, Chairman
Dominion Astrophysical Observatory
24 October, 1984

APPENDIX 1.

RESOLUTIONS ADOPTED (UNANIMOUSLY) AT THE ANNUAL GENERAL MEETING OF THE CANADIAN ASTRONOMICAL SOCIETY/SOCIETE CANADIENNE D'ASTRONOMIE (CASCA)

PREAMBLE: Major breakthroughs in astronomy are increasingly being made in space, both in scientific discovery and in instrumentation and technology. Canada has a proud record of astronomical achievement in both fundamental research and innovative instrumentation. This record is accompanied by a strong component of industrial and economic benefits through the high-technology expertise required to solve fundamental astronomical problems. If we are to remain in either of these forefront areas, as well as attract the very best people into our community, it is imperative that we develop a viable space astronomy program. Furthermore, major elements of this program will require decade-long leadtimes to reach maturity, signifying that our competence in this area at the turn of the century will be assured only if we act now to overcome our shortcomings.

RESOLUTIONS: Accordingly, the Canadian Astronomical Society/Societe Canadienne d'Astronomie (CASCA) resolves as follows:

1. CASCA deeply regrets the decision of the Canadian Government to terminate Canadian participation in STARLAB, an international scientific venture of fundamental and innovative nature. We urge the Canadian Government to re-establish a Canadian presence in the STARLAB project: total abandonment of effort and expertise must not be allowed to occur.

2. CASCA urges the creation of a single Canadian space agency having a significant and sufficient fraction of its budget permanently allocated for basic research. One of the things this agency should immediately undertake is to develop a centre of excellence to provide leadership in space astronomy.

3. CASCA views with urgency the need for Canadian institutions to establish a base of expertise in space astronomy and its associated techniques. Accordingly, we request that the Natural Sciences and Engineering Research Council, in close cooperation with Canadian universities, establish space astronomy oriented programs to fund staff from Canadian institutions to join international teams in developing and operating space observatories. As but one example, the participation of Canadian astronomers as active members of the Space Telescope Science Institute is to be strongly supported.

7 June 1984

APPENDIX 2

RECOMMENDATIONS ADOPTED AT THE JUNE, 1984 MEETING OF THE ASSOCIATE COMMITTEE ON ASTRONOMY/COMITE ASSOCIE D'ASTRONOMIE

PREAMBLE: Major breakthroughs in astronomy are increasingly being made in space, both in scientific discovery and in instrumentation and technology. Canada has a proud record of astronomical achievement in both fundamental research and innovative instrumentation. This record is accompanied by a strong component of industrial and economic benefits through the high-technology expertise required to solve fundamental astronomical problems. If we are to remain in either of these forefront areas, as well as attract the very best people into our community, it is imperative that we develop a viable space astronomy program. Furthermore, major elements of this program will require decade-long leadtimes to reach maturity, signifying that our competence in this area at the turn of the century will be assured only if we act now to overcome our shortcomings.

RECOMMENDATIONS: Accordingly, The Associate Committee on Astronomy (ACA) makes the following recommendations:

1. ACA deeply regrets the decision of the Canadian Government to terminate Canadian participation in STARLAB, an international scientific venture of fundamental and innovative nature. We urge the Canadian Government to establish a Canadian presence in the STARLAB project; total abandonment of effort and expertise must not be allowed to occur.

2. ACA feels that the criteria by which major projects for basic space science research are judged in competition with applications and resource space projects must change: the current prejudice is displacing the basic research that is the foundation of science and future technology.

3. ACA urges the creation of a single Canadian space agency having a significant and sufficient fraction of its budget permanently allocated for basic research. One of the things this agency should immediately undertake is to develop a centre of excellence to provide leadership in space astronomy.

8 June 1984

APPENDIX 3

Starlab: A renewed Canadian Involvement

A strong motion was made at the CAS AGM in Ottawa this summer urging Canada to find some way of rejoining the Starlab project.

Since our withdrawal, NASA and Australia have talked to other potential partners: France, The Netherlands, U.K., and Japan. The greatest financial interest comes from Japan with high scientific interest in one or more instruments from the other countries. In August 1984 Mt. Stromlo and Siding Spring Observatories received AS2M to continue their development of the ultra-large-format-photon-counting-array.

Despite this activity, the Canadian withdrawal has stalled real progress. Both the Australians and NASA feel the loss of our scientific input keenly enough that they are encouraging the continued involvement of the Canadian members of the JSWG at this complex stage.

It is still possible for us to return to the project. The scientific justification for, and the excitement over, Starlab have intensified in the past year and the political climate in Canada has changed. This offers an opportunity of exploring a more effective collaboration between the government decision making process, the government departments responsible for the realisation of scientific space projects, the space industry, and scientists. How could Canada make significant scientific and industrial contributions to Starlab at a price we can afford?

We suggest four steps:

1. A discussion between the new Minister or Minister(s) responsible for space projects and an astronomer and a representative from the space industry to consider the re-involvement of Canada in Starlab at a more modest level (say $50M). If there is encouragement, a time scale would be agreed on for the Minister(s) to receive a firm proposal from a small (4 person) task force drawn from science, industry, NRC, and the Ministry.

2. The task force, in consultation with their Canadian colleagues and Australian and NASA representatives would establish whether a useful contribution could be made at the level of the target budget in the context of scientific interest, industry, and Canadian 'goals'.

3. If significant savings are available by, for example, adopting an existing Fine Guidance System, then they should be made. Scientifically, a minimum of instruments should be defined; for example, Starlab is probably acceptable without the spectrograph.

4. We must make it clear to Australia and to NASA that they must send clear signals of support for our re-entry bid to the responsible Canadian Minister(s).

G.A.H. Walker
24 September 1984

APPENDIX 4

SYNOPSIS OF COMMENTS MADE AT THE JSSA MEETING OF SEPTEMBER 24th 1984

BY

R.W. NICHOLLS, CHAIRMAN, NRC ASSOCIATE COMMITTEE ON SPACE RESEARCH (ACSR)

I am very pleased to have been able to attend this meeting, and very much personally support the STARLAB concept.

As someone who has been personally involved in many aspects of astrophysical spectroscopy since 1945, and who has had the priviledge to have been active in this field in Canada since 1948, and in the Canadian Space Science programme since its inception in 1957, it will perhaps be helpful at the outset to place today's discussion in the historical context of Canadian developments in the field.

You may recall the Forsyth report on Canadian Space Science of more than a decade ago, which was the catalyst for the establishment of the Space Science Coordination Office (SSCO) of NRC which itself was the precursor of the Canada Centre for Space Science (CCSS). In that report Peter Forsyth rightly defined Space Science (and Canadian activities in it) as Science FROM Space (e.g. Space Astronomy, and Earth Observations), Science ON Space (e.g. Ionospheric and Magnetospheric studies) and Science IN Space (e.g. microgravity studies and physics, chemistry and the life sciences performed in a space environment. This set of definitions provide an important framework from which to examine all Canadian Space Science activities, past and present.

Following the acceptance of the report by NRC, the SSCO was set up with Peter Forsyth as director. As part of the operation of that office he established a number of working groups, one on each important aspect of space science and its technology. From the point of view of this meeting, the working group on Space Astronomy, which I chaired, is perhaps the most germane. As at that time I also served on the ACA and the ACSR, it was possible to get both associate committees to agree that the working group on Space Astronomy should serve as the Space Astronomy sub-committee of each associate committee.

Bluntly it was very difficult to get enthusiastic input from the astronomical community, most of whom were understandably more involved in the then new facility of the CFHT. The one exception to this was Gordon Walker who had a proposal for a Canadian Space Telescope which our working group studied. We also established a number of small (funded) study tasks, one of which (performed at UBC) involved the proposed Canadian Space Telescope and one of which (performed at York) involved the development of a phosphor which shifted VUV wavelengths into the red where silicon photodetectors are most responsive.

The only space astronomy which was incorporated into the Canadian Space Science programme was Alan Clark's fine balloon and aircraft observations on the solar IR spectrum and the York rocket work on solar eclipses and the solar coronal spectrum.

Shortly thereafter some Canadian astronomers began to become involved in the IUE observatory programme, and in the planning of ST. There was understandable great reluctance of most Canadian astronomers (with the exception of the UBC group, and some at the DAO), to become seriously involved with the hardware and the engineering design of space astronomical facilities.

It has to be realised that such activities are a major deviation from the traditional Canadian style of high quality "LITTLE SCIENCE" (to quote Derek de Solla Price) on which most of us had been brought up. In such, the principal investigator in government, universities or (sometimes) industry is entirely responsible for the conception of the project, the carrying of it through (perhaps with a very few graduate students/PDF's), and its published completion. The elapsed time from inception to completion can be as little as a few months, or at the most a (very) few years. This is well suited to the NRC and, more recently, NSERC grant support practices.

Those colleagues who for nearly 30 years have been active in the Canadian (Aircraft, Balloon, Rocket and Satellite) Space Science Research Programme, coordinated by NRC, expanded their activities through the imperatives of engineering design and project management in "MEDIUM SCIENCE" (e.g. a nationally coordinated rocket campaign in which perhaps a dozen senior investigators as well as their research students are involved. The project time then increased to a few years from inception to completion. Further, if one then becomes involved in satellite and other spacecraft activities, one has moved into "BIG SCIENCE", with project times of a decade of more, and megabuck budgets. Much of one's creative energies go into proposal writing, and, if approved, project management for a number of years before one has a chance to do real science with the facility in question. The "BIG SCIENCE" style of high energy nuclear physics is quite comparable.

Real career gambles are taken in big science, and none of the Canadian universities, nor the granting agencies, have yet accommodated themselves to the realities of the personal and financial commitments which are necessary. Any Canadian space astronomical endeavour would be in the "BIG SCIENCE" category.

One of the problems of "BIG SCIENCE" is the political visibility of the budgets ($M). This means that approval channels inevitably involve public policy issues, in which most scientists are real novices. In undertaking the proposal of a "BIG SCIENCE" project, a necessary condition is, of course, an excellent, well-prepared and scientifically imaginative proposal. The conditions of sufficiency are, however, more "fluffy". They involve other Government priorities (in science and in

other activities), national economic and industrial policy, international implications, etc. The magnetospheric physics community nearly a decade ago proposed (in naive innocence) a fine project called POLAIRE (which involved satellite measurements of most aspects of energy deposition, transport and budget in the whole atmosphere. More than 100 people worked for more than a year to put the scientifically excellent proposal together. It was rejected at the policy level because, as I remember it, a communications satellite was perceived to be a more important national need. So heartbreak is not new to the space science community of Canada. And the time and writing effort spent on developing proposals does not win one "brownie points" from NSERC grant selection committees of one's peers.

A Few Facts of Life

When promoting a "BIG SCIENCE" project which will be reviewed at top levels by non-science policy committees, the whole space science community must speak in unison with one voice that THE project is unanimously THE TOP PRIORITY of everyone. It is not enough for one narrow discipline (magnetospheric physics, stratospheric chemistry, or galactic astronomy) to speak with one voice. A large space science project must have the vote of the community as a whole.

Narrow disciplinary interests must be merged in the interest of the whole if the community does not want to be beaten by the classic divide-and-conquer method. Public fights between atmospheric physics/chemistry, earth observation science/astronomy will ensure that all are the losers, and the space money will go into engineering (which is very good for Canadian industry) and into applications (like communications satellites).

Remember that a space science (in contrast to space applications) project has first to be given top priority in NRC and then to win top priority in the Interdepartmental Committee on Space (of MOSST) on which sit representatives of all "user" Departments (e.g. Industry, Trade and Commerce, Energy Mines and Resources, Environment, NRC, Communications, DND, External Affairs, DSS, etc.). Science may well be our whole life, but it does not rate highly in the priorities of these Departments, the representatives of which are sincere, and quite bright people.

One has to understand the boundary conditions which, whether we like it or not, constrain support for "BIG SCIENCE" in Canada, and most other countries. But we have a small scientific and technological community and thus do not have a large clout. Shrill complaining about the imagined unfairness of the system will gain us nothing, and will probably lose us a lot of credibility in the eyes of the policy makers.

The "object of the exercise" is to gain one's ends - that is the approval of a big project which will enable us to do world-class science. The way to get this is to not only impress the policy makers with the aesthetic beauty of understanding the Universe and cosmological evolution. One also has to show them a high probability of success, high industrial spinoff (and have industry behind one), a high degree of collaboration between the inter-university groups, government and industry; and if there is some good international collaboration to cut down expenses, so much the better!

Space Station

I should like to conclude my remarks by making a very brief review on what I have learned from my involvement over the past few months as Canadian observer on the NASA Task Force On Scientific Uses Of Space Station.

As most of you will know, NASA has plans to construct in space by the end of this decade a permanently manned space station system (for $8-12 billion which is 20% of the Apollo budget!). The US scientific community had some reservations on this and on the perceived scientific facilities which it would serve, derived from a NASA in-house study (the von Bun report) which was the basis of the recently released request for proposals for Phase B studies by US industry. As a result, NASA established a task force, chaired by Prof. Peter Banks of Stanford, to review the whole matter and to make recommendations. A National Academy of Sciences committee is doing a similar job under the chairmanship of Prof. Donahue. The Banks Task Force has met in Washington, at the Johnson Space Flight Center, and for a week's summer study at Stanford in August. I attended the last two of these meetings. The Stanford meeting had more than 100 attendees from the US and ESA, as well as from Canada and Japan.

It was configured into a number of discipine groups:

* Astronomy and Astrophysics
* Solar System and Planetary Studies
* Solar-terrestrial and Magnetospheric Studies
* Earth Observation Studies
* Life Sciences
* Microgravity and Physics and Chemistry in Space
* Man in Space
* Platforms
* Space Station Configurations
* Communications and Information Systems

Members of all of these groups worked very hard and respected the science and applied science done by their colleagues in other groups. An excellent multidisciplinary ethos was maintained. At the next meeting of the ACSR, I shall propose the setting-up of a modest Canadian version of these working groups so that we can at least consider what options, if any, exist for Canadian scientific use of Space Station. The imperatives of the current Canadian space station programme involve (praiseworthy) industrial involvements. The time is now ripe to see what science might be done by our graduate students a decade from now when they are professional space scientists!

Space Station (SS) will use the Shuttle as a prime transport system for personnel and equipment. It will undoubtedly have a major role in the construction, repair and refurbishment of spacecraft of all types (e.g. ST).

The major recommendations of the Astronomy and Astrophysics Working Groups were:

* The choice of activities is to be based on the already established goals and priorities of US astronomy (e.g. the Field Report) including the use of astronomical spacecraft like ST and SIRTF.

* Most astronomical missions which use Explorer Class or Observatory Class spacecraft are well suited to the use of simple mission-reusable platforms which can be serviced from space station facilities using orbital manoeuvering vehicles (OMVs).

* SS must include facilities for assembly and deployment and checkout of large astronomical instruments, some of which will extend to 50 m dimensions.

* The IOC (initial operation configuration) of SS should accommodate those experiments, particularly in solar physics and cosmic ray physics which can benefit from the services of a human observer or operator.

* Level 4 integration should be done in space.

* To guarantee the effective thrust to the IOC, immediate acceleration of support of research and technology is essential for provision of new instrumental development, training and operation experience based on balloon, rocket and shuttle class payloads.

* It is vital to simplify interface and documentation requirements for Shuttle and SS experiments to facilitate low-cost payload developments by university groups.

* The potential contamination levels for instruments on SS should not exceed those at the current level for Shuttle experiments.

* NASA should encourage strong international collaboration for the IOC.

* The technical requirements for SS experiments should be developed interactively between NASA SS systems engineers, and NASA project and study managers supported by science working groups.

CANADA CENTRE FOR SPACE SCIENCE

Introduction

The Canada Centre for Space Science (CCSS) provides major facilities and a significant fraction of the funding for Canadian space science programs. Given the increasing interest in space astronomy in Canada, this report has been written to more fully acquaint Canadian astronomers with the role of CCSS and thereby assist their present efforts to devise a space astronomy program for Canada.

Subsequent to preparation of this report, it was learned that the scientific sounding rocket and balloon components of the CCSS program will largely be terminated effective April 1985 as part of the restraint measures announced by the Government on November 8, 1984.

CCSS Purpose and Organization

CCSS is a division of the National Research Council of Canada with headquarters in Ottawa. The division is designated as a "National Facility" with responsibility for provision of major facilities required for Canadian space science programs. Facilities include the Churchill Research Range (Churchill, Manitoba) which is used predominately for launch of sounding rockets and a facility at Gimli, Manitoba which forms the base for scientific balloon activities. The definition of facilities also includes multi-user space-borne instruments and associated ground-based equipment. At the present time, two instruments are under development for flight on the Shuttle/Spacelab system, three instruments for free flying satellites are in progress, and a network of ground-based magnetometers, riometers, photometers, and imagers is being implemented. With the exception of the sounding rocket and balloon area, all projects are internationally collaborative in nature.

Unlike similar organizations in some other countries, the mandate of CCSS is limited to the provision of facilities. CCSS does not fund the salaries or other expenses of scientists who are involved in the development and use the facilities. CCSS contracts with Canadian industry for the development of facilities, has no "in-house" laboratories, and serves a scientific community which is external to CCSS.

In a typical project scenario, a Principal Investigator and a team of scientific co-investigators is established which has responsibility for defining the scientific performance requirement of an instrument or system. CCSS, through in-house engineering studies or by contract with industry, produces engineering specifications and mission plans which are then used as the basis for contracts with industry to develop the required instrument or facility. The science team monitors the development activity, plans and participates in or directs mission operations, and is responsible for scientific data analysis.

Project Selection Processes

CCSS provides a broad planning framework for space science which includes activities in the following areas:

- space plasma physics
- upper atmosphere chemistry and physics
- microgravity research (e.g. materials processing in space)
- space astronomy

The order of the above list does not reflect any priorities but is indicative of the present program emphasis.

Proposals for specific projects usually originate in the scientific community rather than in CCSS. In general, proposals pertain to either "national" or "international" projects. The first category includes principally sounding rocket and balloon activities and does not require an international cooperative partner. For this category of projects, CCSS issues an annual invitation to submit proposals and organizes an annual meeting to discuss and coordinate possible proposals. Proposals received are reviewed by external referees and feasibility and costing studies are carried out by CCSS. A CCSS Science Advisory Committee (with the same membership and the NSERC Space Physics and Astronomy grant selection committee) reviews the proposals, referees' comments, and feasibility and cost data and recommends a rank ordered list of projects to the Director of CCSS who approves as many projects as the available budget will permit.

Proposed projects in the "international" category are considered separately. The possibility of such projects usually arises at irregular intervals due to opportunities to participate in a foreign program. The opportunity may be presented formally as in the case of a NASA "Announcement of Opportunity" or may arise informally through contacts with foreign scientists or agencies by Canadian scientists or CCSS. Proposals to respond to such opportunities are reviewed by CCSS from scientific, technical, management, schedule, and budgetary perspectives and the degree of scientific interest in Canada in the proposed activity is determined. If the proposed project is feasible, has good scientific merits, is of broad interest, and can be accommodated within the uncommitted portion of the CCSS base budget, the project is approved. The number of opportunities for such projects in general significantly exceeds financial resources to support them. Due to the irregular timing of the generation of such proposals and the short response time typically required, it is usually not possible to consider proposals in this category in competition with each other.

CCSS Budget

CCSS has an on-going budget of approximately $18M annually. The "national" component of CCSS activities is allocated $5.5M annually. Of this amount, $3M is required for maintenance and operation of rocket and balloon facilities at Churchill and Gimli, leaving approximately 2.5M to support the incremental costs of approved projects. Individual project costs in this category range from a few tens of thousands of dollars to a maximum of $1M. Typically 3 or 4 sounding rocket projects and 4 or 5 balloon projects are approved each year.

The remaining two-thirds of the annual budget is allocated to the "international" project category. Costs of projects in this category range from a few hundred thousand dollars to a maximum of the order of $10M for a complex instrument for Spacelab or a free-flying satellite. In order to achieve an acceptable balance of activities within the available budget, the maximum total multi-year cost of an individual project is restricted to approximately the annual budget available for this project category. Given typical 4-year development cycles, this permits spending peaks of 3 or 4 major projects and a number of those of lesser expense to be accommodated at the same time within the available budget.

Projects which are too costly to be funded from the CCSS budget can be proposed by NRC to form part of a submission to Cabinet which annually considers new proposals for space activities. The content of such submissions is coordinated by the Interdepartmental Committee on Space and includes communications, remote sensing, and space technology components in addition to space science. Such space science proposals thus complete for funds with all other areas of federal involvement in space activities. This procedure was followed in the recent unsuccessful attempt to secure Phase B funding of the Starlab project.

Present Projects

a) Sounding Rockets

Six sounding rocket launches are planned for the winter 1984/85. Two are in support of magnetospheric physics experiments proposed by Dr. A. W. Yau and NRC's Herzberg Institute of Astrophysics, one involves a cosmic background experiment of Dr. H. Gush of University of British Columbia, another concerns an ozone experiment proposed by Dr. E.J. Llewellyn of the University of Saskatchewan, and the remaining two launches (sponsored by NASA) support auroral and whole air sampling experiments of Dr. E. Zipf.

The approved rocket program for the winter of 1985/86 includes two ionospheric/magnetospheric physics experiments of Dr. B.A. Whalen (NRC/HIA), an aeronomy experiment of Dr. J. McConnell of York University, a radar aurora investigation of Dr. A.G. McNamara of NRC/HIA and four launches sponsored by NASA.

b) Balloons

Four balloon launches are planned for the summer of 1985. These are in support of a stratospheric composition investigation of Dr. J. Drummond of University of Toronto, a solar astronomy experiment of Dr. T.A. Clark of University of Calgary, an atmospheric composition experiment of Drs. H. Schiff and D. Hastie of York University and an x-ray astronomy experiment of Dr. D. Venkatesan of the University of Calgary.

c) Spacelab Instruments

Two spacelab instruments are under development for flight in 1987/88. One is a "Wide Angle Michelson Doppler Imaging Interferometer" for which Dr. G. Shepherd of York University is the principal investigator. This limb-viewing instrument will measure upper atmosphere wind velocity, temperature and emissions intensities.

The second is a "Waves in Space Plasmas" facility for which Dr. G. James of the Communications Research Centre of the Department of Communications is the Principal Investigator.

d) Instruments for Free-Flying Satellites

Three instruments for free-flying satellites are in various stages of development. The flight model of an Ultra Violet Auroral Imager is about to be delivered for integration with the Swedish "Viking" magnetospheric physics satellite which will be launched in October 1985. Dr. C.D. Anger of the University of Calgary is the principal investigator for this experiment.

The definition phase contract recently commenced for a Wind Imaging Interferometer which will be supplied by Canada (with assistance from France) to NASA and form part of the instrument complement on the Upper Atmosphere Research Satellite which will be launched in 1989. Dr. G.G. Shepherd of York University is the principal investigator for this instrument.

Preliminary studies are also underway concerning an ion mass spectrometer for flight on the Japanese EXOS-D magnetospheric physics satellite. Dr. B.A. Whalen of NRC/HIA is principal investigator for this experiment.

e) Ground-Based Facilities

A ground-based facility (CANOPUS) is under development to gather data complementary to that obtained in space for space physics experiments. The facility includes a Bistatic Auroral Radar (Dr. A.G. McNamara, NRC), a network of magnetometers and riometers (Dr. J. Walker, EMR), optical instruments (Dr. D. McEwen, University of Saskatchewan), and a data analysis network (Dr. J. Koehler, University of Saskatchewan). The facility is partially in place and will be completed in one year.

f) Get Away Special Experiments

The NASA Space Transportation System includes "Get Away Specials" which are small, self-contained, canisters for experiments. Three GAS experiments are presently being supported by CCSS. These are: a materials processing experiment of Dr. R. Smith (Queen's University); a night glow experiment of Dr. F. Harris (NRC/HIA); and a meteor experiment of Dr. C. Anger (University of Calgary).

Personnel

Senior personnel of CCSS include:

I.B. McDiarmid	Director	(613) 990-0928
A.L. VanKoughnett	Assistant Director	990-0799
G. Atkinson	Head, Scientific Planning and Evaluation Group	990-0788
R.S. Gruno	Head, Instrumentation Section	990-0787
R.D. Hendry	Head, Engineering Section	990-0800
B.L. Wetter	Head, Operations Section	990-0809

SPACE ASTRONOMY DATA

The following is a brief summary of space-based astronomy data and observing opportunities presently available, to my knowledge. The list is intended to remind Canadian astronomers of these facilities, and help increase Canadian awareness of them, in preparation for future missions, such as ST, EUVE, FUSE, SIRTF, ROSAT, AXAF, and, hopefully, Starlab. (Write your local JSSA member for details on these).

NSSDC. The U.S. National Space Science Data Center/World Data Center A contains data from many satellite observatories, still of use in current research. The centre will send copies of such data for the cost of the tapes, to anyone requesting them. You need to fill in a form they provide. They will send a catalog of their holdings and facilities on request. Principal data are OAO-A and IUE archives, the latter including all European data too. Write to W.Warren, N.S.S.D.C., Astronomy data center, Code 601, Goddard Space Flight Center, Greenbelt,MD 20771.

IUE. This spectacularly successful UV spectroscopy satellite is now in its 8th year of operation and is well known to most astronomers. Proposals are due annually at the end of October, and an instruction package is sent out annually. Write Keith Kalinowski, Operations Scientist, Code 684, Goddard Space Flight Center for details. IUE has frequent newsletters and an updated catalog of all observations issued on microfiche. NASA time is available to all, but no funding is provided to Canadians. ESA/SERC time is also available but tends to be more heavily subscribed than NASA time.

IUE has two Regional Data Analysis Facilities, at GSFC and JILA, Colorado. Visitors are welcome at both places to use software and full IUE archive, as well as your own data. Make an appointment as it takes a day or so to get the data on disk, and sometimes they are crowded. Call Randy Thompson at GSFC (301-344-8800) and Ed Brugel at Boulder (303-492-8207).

The GSFC facility also has phone-in lines to enable you to work from your home institution if you have the right terminal. Call them to get set up. Also, they have on their computer a UV flux catalogue based on all the low dispersion data, which is a valuable addition to their browse files and script library.

EINSTEIN X-ray Observatory. The data archives of this satellite are very extensive. The imaging data are now nearly all reprocessed and are being put immediately into the data bank. Data are available on request (strictly, by 'proposal'), usually at no cost for the standard output. The data reduction facility and archive are at CFA, and visitors are well supported if they go there for special reductions. There is a catalogue (the yellow book) of all Einstein observations. Contact Fred Seward or Dan Harris at CFA for details. A NASA AO of Jan 1983 describes the proposal formalities.

IRAS. A catalogue of all (250,000) IRAS sources will shortly be available on magnetic tape. Proposals may be submitted to use IRAS data (see NASA AO of Oct 12 1984), but the only part of interest to Canadians is use of the Infrared Processing and Analysis Center (IPAC) at JPL. This facility is available free of charge. There has been a series of IRAS circulars giving positions of sources, during the spacecarft operating lifetime. Details on all this available from Nancy Boggess at NASA headquarters in Washington (202-453-1469). Data also available from the NSSDC.

EXOSAT. This is the European X-ray satellite currently in operation. The spacecraft has a variety of instruments, in various degrees of health. Its 4 day orbit period makes it particularly suited to long pointing for variability studies. Observing time open to all, with deadlines announced by ESA AOs. Latest deadline just passed. Details are available from ESTEC, Postbus 299, 2200 AG Noordwijk, Netherlands. You can also get Exosat newsletters, and there is a data bank. There are nominally standard output products, but in practice you may have to go there to get the results you want.

TENMA. This is the Japanese X-ray satellite, and they are also hot on variability stuff. They will also do guest observer proposals, on an informal collaboration basis. Write M.Oda for details (Inst. for Space and Aeronautical Science, Univ of Tokyo, Komaba, Tokyo). I dont know if they have a data bank.

VOYAGER. This spacecraft spends most of its time travelling between planets, when it is used for looking at stars in the far UV and EUV. Small detector but very long exposures. Ron Polidan at LPL is the person to contact about what has been done, and for input for future observations.

COPERNICUS. The Copernicus data bank contains high resolution and high signal-to-noise spectra of many bright (<6m) stars. They are available from Princeton (Astronomy dept, Peyton Hall) and may also be available from the NSSDC.

Addresses and phone numbers not given above are in the AAS directory.. I apologise if I have forgotten or left out your favourite spacecraft. I have not attempted to cover the many planetary missions, and Gamma ray detectors as they are rather specialised. There are also published catalogues of ANS, OAO Celescope, Copernicus, Skylab and IUE data which are or should be standard references.

J.B. Hutchings
December 1984

National Research Council Canada | Conseil national de recherches Canada
Herzberg Institute of Astrophysics | Institut Herzberg d'astrophysique
Dominion Astrophysical Observatory | Observatoire fédéral d'astrophysique

File Référence

11 December 1984

TO: Members of the Canadian Astronomical Society

Dear Colleagues:

Following a suggestion made by the Joint Subcommittee on Space Astronomy (JSSA - see their report elsewhere in this issue), the DAO staff have enthusiastically prepared a proposal to develop a centre of Space Astronomy at DAO. In view of the changes occurring in Ottawa these days, we were advised to submit our proposal this Fall. During the writing stage we interacted closely with colleagues at the universities represented on the JSSA, and we were fortunate to have an opportunity to discuss the proposal's aims with the CASCA Board of Directors, but we could not reach everyone in the community before the documents had to be submitted in early November. The following pages contain the proposal defended at the 7 December 1984 meeting of NRC's internal priorities committee, the Program Selection Committee.

In reading our proposal we ask that you bear in mind the following:

- To undertake programs such as we have outlined requires new, innovative staff to lead the efforts: the programs cannot be created out of the present resources of the DAO. However, to undertake such programs, we must first convince NRC to give us "slots" for new positions: we cannot ask for money and then use that "grant" to hire new staff, as a university professor can do (at least for technical and post-doctoral support) with an NSERC grant.
- The instrumentation group proposed is comparable in size to the groups that have originated the conceptual designs for all successful astronomical satellites and would have access to the engineering and fabrication talent already on staff. Once the new group working in consort with the community has secured funding for a particular space astronomy hardware project, the bulk of the actual fabrication work would be performed in industry with the proposed DAO group performing a leadership, oversight and testing function. Until such time as the community could be consulted more widely, we preferred to have the instrumentation portion of the proposal address general rather than specific needs. Likely first projects the DAO group might work on include a proposed small optical monitor for the Advanced X-Ray Astronomical Facility and large-format CCD detectors for the CFHT and DAO telescopes. Canadian participation in FUSE and Spartan missions are also being considered.

Even if the Program Selection Committee gives our proposal a high rating, it is not clear that NRC will actually be able to support such projects in the current climate of restraint. We will keep you posted through Cassiopeia. Constructive criticism, welcome at any time, should be directed to John Hutchings (604-388-3909).

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Canada

A PROPOSAL FOR THE FORMATION OF A SPACE-ASTRONOMY CENTRE OF HIA AT THE DOMINION ASTROPHYSICAL OBSERVATORY

SUMMARY: We present a two-pronged proposal for the development of a space astronomy facility at the Dominion Astrophysical Observatory (DAO). Strong collaboration and participation of all Canadian astronomers, particularly those in Western Canada, is anticipated, and this interaction could be facilitated through a standing advisory group. This proposal consists of:

1. A national Space Telescope data analysis and archiving facility. The launch of the Hubble Space Telescope (ST) by NASA in 1986 will open new frontiers and revolutionize astronomical research. The centre will be designed to encourage use of ST data by all Canadian astronomers and students, as well as to promote continued development of quantitative image-processing techniques. An important aspect of the centre will be to help train young scientists in space-borne astronomy.

2. An astronomical space instrument design group. A "world-class" leader and a small group of associated specialists in instrument and detector development added to the DAO's existing competence in optical and mechanical design will allow us to provide innovative leadership in the application of rapidly developing technology to Canadian astronomical instrumentation needs. In particular, this group would form the nucleus of a space astronomy instrumentation team capable of coordinating development of specific Canadian concepts for future space astronomy initiatives. Where possible, prototype space astronomy instrumentation would initially be tested on Canadian ground-based telescopes (including the Canada-France-Hawaii Telescope) and used to make observations in support of ST and other spacecraft, thereby helping to provide state-of-the-art instrumentation for Canadian ground-based telescopes, as well.

Both aspects of the proposed program build upon the existing scientific research strength of the DAO and the interest of its scientists in seeing Canada play its rightful role in space astronomy, and upon a CASCA (Canadian Astronomical Society) resolution calling for the creation of centres of expertise in space astronomy. A strong emphasis is to be placed on providing training opportunities for young Canadian scientists both through the activites and facilities at the DAO, and also through a Research Associate (RA) program associated with both aspects of the proposal. We propose that this RA program be designed to allow qualified individuals to divide their time between the DAO facilities and appropriate space astronomy and/or instrumentation centres in other countries. A close interaction with Canadian universities is envisioned.

The proposal addresses acknowledged needs for maintaining the desirable high level of Canadian astronomical research. The need for a Space Telescope data centre has been widely endorsed by a nation-wide poll of the professional astronomers, and both aspects of the proposal have been supported in writing by the Board of Directors of the Canadian Astronomical Society and by individuals in several university departments of astronomy across the country. The proposal therefore aims to serve well perceived nation-wide needs.

INTRODUCTION

The DAO is currently one of the most active centres of astronomical research in North America. Its astronomers use a broad range of data obtained from facilities all over the world, as well as some orbiting observatories. Its activities, and those of Canadian astronomy in general, however, are principally centred on ground-based data. The frontiers of astronomy are increasingly being defined by space-based facilities, and this will be especially so after the launch of the Hubble Space Telescope in 1986.

Upon recommendation of the Joint Subcommittee for Space Astronomy (JSSA), the Canadian Astronomical Society unanimously passed a resolution in June 1984 recommending that Canada attempt to enter more directly into the field of space astronomy, by establishing one or more centres of expertise in the field. In September 1984, JSSA further suggested that the DAO would be a natural place to create such a centre. For several years, Canadian astronomers have been involved in the planning stages of the STARLAB orbiting observatory, and are still hoping to be a partner in its eventual construction and operation. Canadian scientists have become increasingly involved in space astronomy, as users of (foreign) facilities such as IUE, HEAO-B, and EXOSAT, and as users of data bases from these and other satellites such as IRAS and SAS-C. Canadians have also played a part in the design and definition of instruments for IUE, VIKING, SPACE TELESCOPE, FUSE and AXAF. Many of these activities have involved DAO scientists.

With the impending launch of ST, all of astronomy is about to undergo a revolution. This is therefore an extremely opportune time for the creation of a space-astronomy group in Canada. This proposal suggests that it should be established as a group within and part of the HIA, and located at the DAO. The DAO is currently at an appropriate stage of development and expertise for such a move, and is planning a building extension, which could house the proposed facilites. A western location is also desirable for other reasons, as discussed below. The space astronomy activities should be planned to allow full interaction and cooperation with interested university and industry groups. We propose that the group have two main activities, which will build to full strength over the next few years. Overall, about 13 new positions will be required, with appropriate new facilities. Some of the present staff would be expected to shift a fraction of their activities to the space astronomy group. The two new areas are:

1. A national data archive and reduction centre for all observations from the Space Telescope.

2. An astronomical instrumentation group to formulate plans and designs for instrumentation in space as well as upon ground-based telescopes, and to oversee its development and testing. The construction of space-qualified instruments themselves would be contracted out (through CCSS) to Canadian industry. Initial testing and application of such instrumentation on ground-based telescopes is expected to occur, and might greatly enhance our present facilities. The ground-based instruments will be designed for support and follow-up of ST, AXAF, SIRTF and possible future space platform observatories.

These two areas are ones of specific need in Canada, and their work will help bring Canada to the forefront of space astronomy, both in direct research results and ground-based exploitation of discoveries made from orbiting instruments. We now look at these two activities in more detail.

SPACE TELESCOPE DATA

All data from the Space Telescope will become public one year after acquisition, in the form of copies of the original data tapes and standard processed results. These observations are certain to have much importance for many years, exceeding in quantity, quality, and astrophysical interest, the data banks of IUE, HEAO-A and B, OAO-A, etc. which are still extensively used. ST data will be made available by NASA on a per-cost basis. The European community is establishing a centre for ST data in Munich, and there is a possibility that one may also be set up in Australia. There is no centre presently planned in North America other than the Space Telescope Science Institute in Baltimore. The data centre that we are proposing will need computing facilities similar to, but in addition to, those presently in place or planned at DAO, and it will require adequate storage for magnetic tapes or video disks. The centre will generate considerable research activity and will require personnel to run it, and working space for visitors, of whom there would be several present at any time. The DAO building extension currently approved should be planned to accomodate these facilities when they come on-line in ~1987. A national data centre will represent a logical but considerable extension of the ST High Resolution Spectrograph data from its first year's operation, to be acquired through J.Hutchings, who belongs to the HRS instrument team. Thus, there will be an initial nucleus of data and software at the DAO.

The choice of the Dominion Astrophysical Observatory for this centre will facilitate negotations with NASA who require the setting up of national facilities of this kind to be carried out at, or through, a federal government agency. Locating the centre on the West coast will help western (Canadian and US) astronomers using ST and ST data by avoiding travel expenses and time to go to Baltimore. The Space Telescope Science Institute is already overcrowded and is expected to become more so after launch. Astronomers from northwestern US already are extensive users of DAO facilities, and a data centre will further assist Canada to partially repay the generous allocation of observing received on US-funded telescopes.

The centre would undoubtedly serve as a stimulus to Canadian astronomers to become more involved in space astronomy. The data centre will be open to all qualified users, and will be a centre of competence in quantitative image processing, with widespread applications in all areas of astronomical research, and beyond. A users group will be

charged with ensuring that programs and initiatives relevant to Canadian research interests are pursued. Close cooperation with the Canadian Institute for Theoretical Astronomy (CITA) and the proposed CLBA data centre will also be important. Through cooperative graduate student programs with Canadian universities and through the Research Associate program, the data centre will play a significant role in the training of young Canadian scientists. In the case of students, thesis work could be carried out in ways which already have precedent in ground-based work. In this way we can inject into Canadian science a young population of people interested and highly qualified in space-based astronomy and astrophysics.

An essential prelude to the formation of the centre is the training of suitable personnel. The JSSA and CASCA have recommended the establishment of fellowships for Canadians to work at the Space Telescope institute. We specifically suggest that the HIA and the DAO establish and oversee new Research Associate positions for 1 or 2 astronomers to be held partially at the ST institute. During their term, and afterwards, such people could contribute in a major way to the running of the data centre, as well as taking part in ongoing research projects. Canada currently lacks a pool of suitably experienced young scientists in this area. Since no other data centre is planned in North America, it is likely that the DAO data centre will attract scientists from western USA, and, indeed, the whole world. Interaction with these visitors will stimulate and enhance the research activities not only at the DAO but in all of Canada.

We envision requiring a dedicated computer (new generation VAX or more than one small VAX) and image processing units as well as a minimum of ~5 people to run it. This staff would most likely consist of a secretary, an archivist, three programmer/astronomers and 2 RAs.. The centre will naturally be a vehicle for acquiring and developing up-to-date software (the ST software will be freely available), which can and will be used for ground-based data as well. The centre will provide instruction and support in the sophisticated data analysis packages which are required for state-of-the-art research. The requirement for such a facility was clearly identified by the Associate Committee on Astronomy in its forecast "Astronomy in Canada in the 1980's". Suitable space for computers, image processing and storage should be planned for in the DAO building extension (or a later addition). Since this building extension is approaching the detailed planning stage, this needs to be done soon.

Considering the impact that ST will have on all of astronomy, there is little doubt that this data storage and analysis centre will have an important effect in raising the profile of Canadian astronomical research and activity, at a very reasonable cost. However, it is also essential that the centre be properly supported, as it is beyond the present resources of the DAO to run it. Note also that the ST data are <u>in no way</u>

a substitute for STARLAB (or any other new astronomy satellite). STARLAB is a separate investigation that will in part discover objects for ST to observe. The data centre would, however, be a suitable nucleus for STARLAB processing and archiving as well.

SPACE ASTRONOMY INSTRUMENTATION DESIGN GROUP

The DAO has long played a leading role in telescope optics developments, but has never assumed a leadership role in instrumentation and detector development. This area is one of great importance in realizing the full potential of fine telescopes and optical instruments. In the past decade the quantum detective efficiency of digital detectors has increased from a few percent to over 50 percent, and they have grown in size from a few hundred to about one million pixels. Detectors have therefore effectively increased the light gathering power of telescopes by huge factors at a very small fraction of the cost of the telescopes themselves. The use and development of the best available detectors makes the difference between doing and not doing research at the forefront of astronomy. Many institutions in other countries are working hard in this area, and Canada needs to keep up. In particular, Canada needs to have a group whose mandate is to apply the best modern detectors to astronomical instrumentation for space. State-of-the-art instrumentation employing new solid state detectors is also badly needed on the DAO's own telescopes, and the Canada-France-Hawaii Telescope (CFHT), as well as other Canadian telescopes.

Considerable experience and resources pertaining to detector development already exist nearby at UBC and the University of Calgary. Close cooperation with these groups, as well as with the new electronic engineering faculty at UVic, will be essential. While demonstrating their expertise and acquiring experience on on ground-based instruments, the proposed DAO space instrumentation group would begin exploration of specific space astronomy instrumentation concepts, in response to ideas generated within the Canadian astronomical community, within the group itself and/or as a result of "announcements of opportunity" from foreign space agencies. Instruments destined for space would be built by Canadian industry under standard CCSS procedures, with the DAO group performing a supervisory, evaluation and testing role; prototypes might be built at the DAO to prove concepts. We envision that instrumentation in regions of the electromagnetic spectrum from IR to X-ray might fall within the group's domain.

The existing DAO electronics group is not large enough to undertake more than the necessary maintainance of present equipment and a very modest amount of new development. A separate small group of people with experience in new detector technology and hardware is required to complement existing expertise in optical, mechanical and electronic instrument design. A dynamic, innovative person to lead the group and

assume overall responsibility for its program and the completion of projects is essential. Although this group will initially be quite small, it should grow modestly over a few years as it gains experience and starts tackling more demanding projects; we suggest 6 new people - at least one of them with an astronomical background - are needed to run such an effort. To ensure a supply of qualified Canadian instrumentalists for the future, we propose to have one Research Associate position associated with the group. Depending upon specific needs, that individual might spend a portion of his or her term working with a foreign group having the technological know-how relevant to a Canadian project. The development of new astronomical instrumentation by such a group could lead to a larger Canadian contribution to ground-based definition and follow-up of space astronomy experiments. Areas ripe for development now are the use of larger two-dimensional detectors for various wavelengths: far UV, ground-based UV, visible, and infrared.

Initial projects for such a group might involve two-dimensional photon counting detectors, or implementation of the recently-announced Tektronix low noise CCD arrays. Another new area of increasing relevance for the science Canadians want to pursue both in space and from the CFHT is the use of IR array detectors. The combination of spatial and spectral resolution in a single detector and instrument is a concept which may form the basis of the next generation of astronomical instrumentation. This is a field in which a suitably able group could assume a world leadership role. Our vision is that the group will start with simpler, but needed, projects and gradually increase its capabilities. Interactions with an advisory committee will be essential in identifying which instrument or area has the highest priority.

At present, Canada has no experience in building space-qualified astronomical hardware. In order to gain the necessary experience for the fullest participation in future large projects such as STARLAB, the proposed group would strive to coordinate Canadian efforts to develop designs and concepts for space astronomy missions, to join in collaborative ventures with scientists in the US or other countries, and to work with CCSS to supervise Canadian industrial fabrication once project funding is secured. Possible collaborative projects are FUSE, AXAF, SPARTAN, and ST second-generation instruments. DAO scientists are already involved in proposal stages of several of these. Once again, the leadership of a suitably motivated scientist is essential to the success of the instrument design group.

SCHEDULE AND PERSONNEL

We should start to look for suitable staff as soon as possible. The instrument group can begin activities within a year from now, and might expect to have improved laboratory facilities in the new DAO wing within another year. We stress the importance of appointing a leader for this group. Our plan would be to initiate a search as soon as possible.

The Space Telescope Science Institute will welcome postdoctorate workers seconded from Canada, at any time, and we should appoint the first of these as soon as possible. The filling out of the rest of the personnel in the two groups would occur throughout the next two to three years, as the facilities and data need them. The approval of the proposal at the earliest possible time would facilitate the proper planning of the building, incorporating the necessary computers, terminals, offices, storage areas, and laboratory space while the present building extension is being defined. The necessary extra building space can be accomodated on the existing and planned office site. The overall extra cost of building will be minimised by incorporating it into the new extension, but will require extra money over that currently approved: we estimate of order $0.5 million. The extra computing facilities for the data centre will also cost about $0.5 million. Operating costs for the two new facilities will include archiving hardware (tapes or video disks) and the cost at ST of generating them, and materials and equipment for the instrumentation group. Thus, the overall budget of the DAO must be augmented adequately to operate these new functions effectively and without impacting on the present research and national centre activities. Without full and adequate support, we cannot consider running the facilities we propose here. The operations described will cost of order $250,000 over the existing DAO budget, in addition to salaries. The cost of providing data tapes/or optical disks to the ST data centre would have to be negotiated with NASA.

CONCLUSION

Without doubt, the strongest potential for making major discoveries in astronomy lies in experiments conducted in space. Therefore, in order for Canada to maintain its outstanding record of scientific achievement in astronomy, it is necessary to become more involved in space astronomy, and strong ground-based support of space astronomy, both observationally and in the use of space-based data. This proposal is made to provide a centre of activity, training, and expertise, within an appropriate existing scientific environment, for Canadian space astronomy. The Centre will be available to all Canadian scientists, and will foster scientific and engineering exchange at national and international levels.

The DAO Staff
November, 1984

MEETING REPORTS:

ASSOCIATE COMMITTEE ON SPACE RESEARCH (ACSR)
and
INTER-DEPARTMENTAL COMMITTEE ON SPACE (ICS)

ACSR (13 November 1984)

Alan Clark, John Glaspey and I participated in this meeting chaired by Ralph Nicholls. The meeting was dominated by discussions of the impact of the decision announced five days earlier to cancel CCSS's rocket and balloon program(~$4M/yr), described by Roy VanKoughnett elsewhere in this issue. Dr. Ross Pottie, NRC Vice-President for Regional Laboratories, described the atmosphere in which the NRC cuts were prepared. Deletion of the highly successful R+B program severely undermines continued participation by university and government researchers in upper atmospheric and space physics. Industrial representatives argued that ~$4 M in export business and ~60 jobs connected with the Black Brant program would be lost. The committee passed a resolution lamenting the decision, which has been sent by the chairman to relevant agencies in Ottawa.

Dr. Kostash (MOSST) indicated that CCSS's budget level for space science, which had been set - prior to the R+B loss - at 15% of the total spent by Canada on space-related activities, will be subject to close scrutiny as the new government struggles with its definition of Canadian space policy.

Dr. Karl Doetsch (Aeronautical Establishment) reported that a decision will be taken by the Canadian government in early 1985 regarding whether or not to proceed with Phase B studies of possible Canadian participation in the US Space Station. In my opinion, basic science does not presently play a significant role in this predominantly engineering exercise. Since many people in Ottawa seem to feel the Space Station is likely to be the "only show in town", we basic researchers must learn to live with it. Small study groups are being organized by Ian McDiarmid and Ralph Nicholls to analyze, within the Canadian context, the scientific usage of the Station for space physics, atmospheric physics and chemistry, space astronomy, and microgravity (including life sciences, and physics and chemistry in space). The JSSA is expected to fulfill the astronomical needs.

The ACSR Chairman, Ralph Nicholls, was an invited observer on a committee chaired by P.M. Banks (Stanford) to assess for NASA the scientific uses of the Space Station for astronomy and astrophysics. Some of the salient points of their report are:

"1. The selection and timely implementation of astrophysics missions should be based on scientific goals and priorities.

"2A. The most important new capability to be provided by the Space Station Program for astrophysics is the routine maintenance and repair of co-orbiting facilities.

"2B. A large fraction of astrophysics missions, ranging in size from Explorer-class to observatory-class (e.g., AXAF or SIRTF), are well suited to single-mission platforms that can be serviced by the Space Station with the Orbital Maneuvering Vehicle.

"2C. The Space Station must have facilities for the assembly, deployment, and checkout of large astronomical instruments; this capability should extend to 50-meter dimensions at some time after the Initial Operational Capability.

"2D. The Initial Operational Capability of the Space Station should accommodate those experiments, particularly in solar physics and cosmic-ray research, which can benefit from the presence of human observers or operators and long exposure to space.

"3A. To guarantee effective transition to the Initial Operational Capability, immediate acceleration of supporting research and technology is essential for the provision of new instrument development, training, and operational experience based upon balloon-, rocket-, and Shuttle-class payloads.

"3B. It is vital that the interface and documentation requirements be simplified to permit low-cost instrument development.

"3C. The potential contamination of the instruments in the Space Station environment should in general not exceed the levels set for Spacelab.

"3D. NASA should encourage international collaboration on all levels in developing scientific programs for the Space Station.

"3E. Technical requirements for scientific missions should be defined interactively by NASA Space Station system engineers and NASA project and study managers supported by science working groups.

"4. CONCLUSIONS. The disciplines of astronomy and astrophysics have the potential of deriving real advantages from the development of the Space Station. As discussed above, these advantages will initially be in the area of facilitating programs that are already "in the queue" in one form or another. However there is a bright future for activities that could not be accomplished without the special facilities and resources of the Space Station and its personnel. It is most important during the decade before Initial Operational Capability to encourage frequent and flexible use of the Space Transportation System for experiments and observations. A smooth transition period from Space Shuttle to Space Station will be essential in maintaining a high quality of science in astronomy and astrophysics."

Finally, the ACSR discussed, modified, and then passed two resolutions brought to it by the JSSA:

1. ACSR deeply regrets the decision to terminate Canadian participation in STARLAB, an international scientific venture of fundamental and innovative nature. We urge the re-establishment of a Canadian presence in the STARLAB project; total abandonment of effort and expertise should not be allowed to occur.

2. ACSR strongly recommends that the Canadian space program must always include a strong and continuing component of basic space science research.

Again, Chairman Nicholls has passed these resolutions onto relevant NRC and Ministry officials.

* * * * *

ICS (14 November 1984)

Seven members of the scientific community were asked to share their views with the ICS (the group of Deputy Ministers, etc. that failed to recommend STARLAB to the Minister earlier this year), chaired by Dr. David Low. The individuals were R.W. Nicholls (York), G. Rostoker (Alberta), G.G. Shepard (York), R. Smith (Queen's), D. Watt (McGill), D.F. Williams (Chemistry, NRC) and the undersigned. Fields represented ranged over the mature magnetospheric physics and upper atmospheric physics communities to the emerging life sciences and materials processing communities, in addition to space astronomy.

We collectively decided before the meeting to emphasize to the ICS the importance of establishing in any revised space policy the goal of doing basic research in and from space. That message was delivered forcefully to them. We also emphasized the importance of establishing Canadian credibility in the international arena by conducting basic research in space. If Canada does not contribute to the body of basic knowledge that leads to eventual technological development, then the much balleyhooed "technology transfer" element in the national economic policy will dry up. Strong emphasis was also placed on the importance of training the brightest young Canadians in basic research. All areas but life sciences had decided independently that their communities would benefit from the formation of centres of excellence, such as called for in CASCA's June resolutions. The lack of new positions in universities and government labs to attract the brightest people to these disciplines was lamented.

I was particularly impressed with the documentation that G. Rostøker presented showing that since the magnetospheric physics community started keeping records about 7 or 8 years ago, the number of permanently employed persons doing that type of research has declined 50%, reflecting demographic trends (primarily aging), and the lack of new positions. All other disciplines asking for ICS support of their basic research efforts can point (with documentation) to more practical applications than we are used to associating with basic astronomical research. As best I could, I pointed out that people trained in advanced astronomy research share with physicists, chemists, etc. the same sorts of talent (imagination, problem solving ability, mathematical training, etc.) that enables them, when they so choose, to attack other problems very creatively (examples: remote sensing, atomic and fusion power, etc.). While astronomy never should attempt to justify its existence in such terms, many of the groups upon whom our current and future support exists think predominantly in such engineering or economic terms. In turn, this led me to suggest to CASCA's Board (at its December meeting) that it might be valuable for our community to conduct a manpower survey of astronomy graduates (B.Sc., M.Sc., Ph.D.). My suspicion is that the results would show that an education in modern astronomy equips people for much broader participation in Canadian society than we may generally realize.

The ICS said they expect to hold similar meetings with active researchers in the future, which all of us encouraged. Only time will tell, however, if the messages we delivered were accepted and, in turn, transmitted effectively to the Minister for inclusion in Canada's space policy.

James E. Hesser

IAU MEMBERSHIP: A REMINDER

Those who wish to apply for IAU membership or for invited participant status at the IAU General Assembly in New Delhi should do so as soon as possible. For more information, see Cassiopeia #44, Autumnal Equinox 1984, page 12, or write to me. Note that application forms should be endorsed by at least one and preferably two members of the IAU.

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Goddard Space Flight Center Workshop

The Origin of Nonradiative Heating/Momentum in Hot Stars

June 5-7, 1984

reported by Anne B. Underhill
Laboratory for Astronomy and Solar Physics
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This international workshop, sponsored by the National Aeronautics and Space Administration (NASA) and by the American Astronomical Society, achieved its purpose of bringing together specialists in the fields of stellar atmospheres and stellar spectra for three days in order to discuss questions related to the origin of nonradiative heating and momentum in the atmospheres of early-type stars. The sessions were attended by about 35 to 40 people from various disciplines. Most participants stayed for the three days, but there was a varying flux of persons employed in the Washington, D.C. area and able to attend for only a few sessions.

Often one heard expressions such as "Isn't this fun!" "I am learning a lot." Probably a good number of the participants had never enjoyed the pleasures of a small scientific meeting where time for ample discussion was deliberately scheduled and people from related disciplines actually talked to each other.

As one of the chief organizers of this workshop, I was pleased to find solar people talking to stellar people, hot-star people to cool-star people, theoreticians to observers. Put in a nutshell, the accomplishment of the conference was to make it clear that accounting for the origin of nonradiative heating and the deposit of nonradiative momentum in a stellar atmosphere raises problems in physics which are to be recognized in the cases of many different types of star. The value of the Sun as a well observed standard object was emphasised, and arguments were presented in favour of the idea that the actions of relatively small magnetic fields in the low-beta plasmas which probably occur outside the photospheres of most stars may have much to do with creating the spectra which we observe.

Six invited reviews as well as a summary talk were scheduled, and there were 27 contributed papers. The contributed papers emphasised different facets of the problems studied each day. The far-ranging discussion was recorded, and appropriate sections of it are published after each paper. On Day 1 the topic was evidence for nonradiative activity in stars; on Day 2 the topic was theories concerning the origin and distribution of heat/momentum in stars; on Day 3 the topic was the problems of stars of spectral type B and earlier.

J. P. Cassinelli presented a thoughtful review of the evidence for nonradiative heat and momentum in the atmospheres of hot stars. He noted the evidence pointing towards the actions of magnetic fields as well as that

pointing towards the actions of radiatively driven turbulence in the winds of hot stars. J. L. Linsky reviewed the evidence in the case of cool stars. He noted similarities and disagreements with the picture evolving for the hot stars.

The main threads of the theory of the heating of the solar chromosphere and corona were reviewed by C. Chiuderi. He steered stellar people through the maze of solar details with masterly precision. In the second review paper of the day, L. Golub concentrated on the significance of the observation of X rays, mostly from stars of type A and later. He emphasised the importance of dynamos and of how dynamos are related to the internal structure of the star, particularly to the differences in rotation which occur as one considers deeper and deeper layers in the star.

The sessions on the third day started with a review by A. G. Hearn of the theory of instabilities in radiatively driven winds. Hearn demonstrated the significant areas of success of such theories. The effects of magnetic fields, particularly for modifying the flows in the outer atmospheres of stars, were reviewed by Y. Uchida. Whenever the observational evidence suggests the ejection of material in a few well defined directions (for instance, bipolar flows from small hot objects), it seems that the actions of magnetic fields may be inferred.

The afternoon workshop sessions were organized by D. J. Mullan, J. A. Ionson, and L. H. Aller.

The conference concluded with a summary review by A. B. Underhill. In her paper Underhill noted that when the spectroscopic observations of early-type stars over the range from X rays to radio wavelengths are compared with the predictions from the best available (radiative) theory, there are 9 areas of significant discrepancy. Underhill discussed how postulating the presence of weak, locally distributed magnetic fields, as in the solar corona, can substantially reduce these problems.

The Proceedings of the workshop will appear in the NASA CP series of reports. A copy may be obtained by requesting one from Anne B. Underhill. At the time of writing the present report (October 1984), the Proceedings are in the publishing process.

CANADIAN ASTRONOMY PREPRINTS

SEPTEMBER 10 TO DECEMBER 7, 1984

The following file contains a list of preprints written by Canadian astronomers. All preprints were received at the Astronomy Library within the dates as stated above.

The file is arranged in alphabetical order according to the surname of the first listed author of each preprint. Originating institution and date of receipt at the library are listed.

If you have distributed a preprint and would like it to be included in this list, please send it to:

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Barker, Paul K., J.D. Landstreet, J.M. Marlborough, and Ian B. Thompson. A search for magnetic fields in Be stars. UWO. 84.10.29.

Barker, Paul K., J.M. Marlborough, and J.D. Landstreet. Superionized species and winds in low luminosity B and Be stars. UWO. 84.10.29.

Barker, Paul K. and J.M. Marlborough. Carbon IV absoprtion troughs in the ultraviolet spectra of Be stars: gone with the wind? UWO. 84.10.29.

Borra, E.F., M. Beauchemin, R. Arsenault, R. Lalande. Optical shop testing of liquid mirrors. U Laval. 84.09.11.

Brodie, J.P. and D.A. Hanes. Metallicity determinations for globular clusters through spectrophotometry of their integrated light. AAO. 84.11.20.

Campbell, Bruce and R.F. Garrison. On the inclination of extra-solar planetary orbits. DAO. 84.11.05.

Clement, Christine M., Peter Ip and Normand Robert. A new investigation of the variable stars in the globular cluster Messier 9. DDO/U of T. 84.09.10.

Cowley, A.P., D. Crampton, J.B. Hutchings, I.B. Thompson. On two W-R stars in the LMC: the high velocity of BR 52 and a newly discovered WN star. DAO. 84.09.24.

Edwards, Geoffrey, Ermanno F. Borra, Eduardo Hardy. On the extendedness of faint ultraviolet excess quasar candidates. U Laval. 84.09.11.

Hanes, D.A. and J.P. Brodie. The metallicity of globular clusters associated with the giant elliptical galaxy NGC 4486 (M87). AAO. 84.11.20.

Hrivnak, Bruce J. A photometric study and analysis of XY Leonis. DAO. 84.11.27.

Kronberg, P.P. Discovery of an entire population of variable radio sources in the nucleus of M82. U of T. 84.09.18.

Kwok, Sun. High resolution radio observations of compact planetary nebulae. Rothney Astrophysical Observatory / U Calgary. 84.10.16.

Kwok, Sun, C.R. Purton, H.E. Matthews and T.A.Th. Spoelstra. Radio synthesis observations of M2-9, the Butterfly nebula. Rothney Ap. Obs. / U Calgary. 84.10.16.

Lowe, R.P., J.M. Moorhead, W.H.. Wehlau, Paul K. Barker, and J.M. Marlborough. Interpretation of the spectrum of gamma Cassiopeiae from 1 to 1.7 micrometers. UWO. 84.10.29.

McClure, Robert D., J.M. Fletcher, W.A. Grundmann and E.H. Richardson. The DAO radial velocity spectrometer and recent results. DAO. 84.11.27.

Morbey, Christopher L. Luminosities of first-ranked galaxies. DAO. 84.09.24.

Morbey, Christopher L. and Robert D. McClure. NGC 3557 and its globular clusters. DAO. 84.09.24.

Percy, John R. A note on two RS Canum Venaticorum stars: LX Persei and SZ Piscium. DDO/U of T. 84.09.19.

Pritchet, C. and Sidney van den Bergh. Observations of two novae in M87. DAO. 84.10.19.

Stryker, L.L., James E. Hesser, Graham Hill, Graham S. Garlick and Lucy M. O'Keefe. The binary frequency of extreme subdwarfs revisited. DAO. 84.11.05.

Vallee, J.P. and A.F.J. Moffat. Search for radio-continuum emission from galactic O-type and Wolf-Rayet stars off the plane. HIA. 84.12.05.

van den Bergh, Sidney and Andy Lafontaine. A search for F and G supergiants in galactic open clusters. DAO. 84.09.24.

van den Bergh, Sidney and Andy Lafontaine. Are halo carbon stars associated with dwarf spheroidal galaxies? DAO. 84.09.24.

van den Bergh, Sidney and Karl Kamper. Optical studies of Cassiopeia A. VII. Recent observations of the structure and evolution of nebulosity. DAO. 84.10.19.

van den Bergh, Sidney. Globular clusters and galaxy evolution. DAO. 84.11.27.

VandenBerg, Don A. and Bruce J. Hrivnak. The age and helium content of the eclipsing binary AI Phoenicis. DAO. 84.11.27.

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Institut Herzberg d'astrophysique
Observatoire fédéral d'astrophysique

File Référence

13 December 1984

* * * STARLAB NEWS FLASH * * *

Ian McDiarmid participated in a meeting between NASA and Australian officials, held on 10-11 December. It has proven impossible to find a partner to replace Canada. Accordingly, NASA and Australia have decided to shelve STARLAB indefinitely, and to pursue studies jointly with ESA to develop a far-UV spectroscopic experiment with emphasis on the 900-1200Å range. They expressed interest in having Canada join in this new venture, for which they plan to complete initial studies in 1986. Launch would not be before 1992.

On behalf of JSSA and all of us who worked throughout this year to save STARLAB, I'd like to express our gratitude for the strong support received from CASCA, ACA, ACSR, CCSS and many individuals across Canada during the past few months.

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