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Author Biography:

Dr. John Maxwell joined the Geological Survey of Canada in 1952 following studies at McMaster University and the University of Minnesota. He was appointed Head, Analytical Chemistry in 1958 and this was followed by other management appointments as Division Chief, Central Laboratories and Central Services (1971-74), Director, Central Laboratories and Administrative Services (1974-81) and Director, Central Laboratories and Technical Services (1981-84). He authored two textbooks on the analysis of geological materials, and was one of five GSC scientists who acted as Principal Investigators for studies of lunar material returned by the Apollo Lunar Missions. He retired in 1986 and died in Ottawa on October 26, 2006.

FROM THE EARTH TO THE MOON

The Geological Survey of Canada's
Participation in the Apollo Lunar
Missions, 1967-1975

by

John A. Maxwell

Coordinator, Lunar Crust Project.

The Invitation and Response

In May, 1966, a copy of a letter from the United States National Aeronautics and Space Administration (NASA) to the National Research Council in Ottawa was forwarded to the Geological Survey of Canada for consideration. The letter contained an invitation from NASA to submit a proposal for scientific study of lunar material when, and if, such material was returned to earth by the first Apollo Manned Lunar Mission. This invitation had been sent by NASA to national academies of science throughout the non-Communist world in a seemingly altruistic desire to sponsor a concerted international detailed study of the moon's surface.

The writer was asked by the then Director, Dr. Y. O. Fortier, to convene a meeting of GSC scientists having some expertise in the study of extraterrestrial material, e.g. meteorites and meteorite craters, or having an interest in extending their studies of terrestrial rocks and minerals to those of another planet. The meeting was held on May 31, 1966, with nine scientists present¹.

It was agreed that it would be nice to receive samples of lunar material but it was recognized that any proposal must go beyond mere curiosity and offer a significant scientific contribution to the overall study, bearing in mind the very modest nature of the GSC extraterrestrial program as compared to that of other organizations, especially those in the USA. It was also agreed that such a study was outside of the Survey mandate, and that any participation should utilize only existing scientific facilities. The group

¹ W.R.A. Baragar, C.K. Bell, K.L. Currie, J.A.V. Douglas, W. Dyck, T.N. Irvine, J.A. Maxwell, L.W. Morley, R.K. Wanless.

was not unanimous in its willingness to participate, but a five-part proposal was prepared and submitted, with the Director's approval, to NRC in June, 1966 for transmittal to NASA. The proposal, with the participants, was as follows :²

A. Petrological and Mineralogical

Principal Investigator -	J.A.V. Douglas
Co-Investigators -	K.L. Currie
	R.J. Traill
	A.G. Plant
	M.R. Dence ³

To determine the identity, density, composition, textural relations, distribution and origin of minerals and mineral phases by means of optical microscopy, x-ray diffractometry, electron microprobe analysis, electron microscopy and specific gravity measurements.

B. Magnetic Properties

Principal Investigator -	A. Larochelle
Co-Investigator -	E.J. Schwarz

To investigate the nature of the remanent and induced magnetization of the lunar material by determining the magnetization dependence in high magnetic fields under differing conditions, the measurement of magnetic susceptibility and of natural remanent magnetization, using an automated recording Curie balance, a susceptibility meter and an automated biastatic magnetometer.

² The original proposal contained only the names of the proposed Principal Investigators. The Co-Investigator names were added in response to a telephoned request on December 22, 1966, from Dr. V.R. Wilmarth, Chief of Planetology, Office of Space Science and Applications

³ From the Observatories Branch, EMR, April 1, 1967, with the approval of Dr. J.H. Hodgson, Director.

C. Electrical Conductivity

Principal Investigator - L.S. Collett

Co-Investigator - D.A. Becker

Measurement of the electrical conductivity will be made over the audio frequency to 10 MHz range, using a small cylindrical core sealed under vacuum in a special glass tube.

D. Elemental Concentrations and Isotopic Abundance Ratios

Principal Investigator - R.K. Wanless

Co-Investigators - R.D. Stevens
W.D. Loveridge

Determinations will be made of the concentration of such chronologically important elements as argon, potassium, rubidium, strontium, lead, uranium and thorium, and of the isotopic abundance ratios of strontium and lead. This will involve vacuum fusion and extraction, isotope dilution techniques and ion exchange separations, in addition to mass spectrometric measurements in both gaseous and solid source high sensitivity instruments.

E. Chemical Analysis

Principal Investigator - J.A. Maxwell

Co-Investigators - S. Abbey
W.H. Champ

The determination of the major, minor and trace element contents will be made by chemical (gravimetric, titrimetric and spectrophotometric), x-ray fluorescence, optical emission and atomic absorption spectroscopic methods.

It was emphasized from the beginning by Survey management that no special preparations would be made for the study of lunar material and no special equipment would be purchased for this purpose. This

stemmed from a genuine concern that this departure from the Survey's traditional mandate could engender criticism from senior departmental managers, and it was carefully pointed out that our 130 years of expertise in the study of terrestrial material, coupled with the equipment in our current laboratories, equipped us to deal with whatever the moon would provide. As further justification for participation in the lunar program it was pointed out that one objective of the continuing study of the Canadian Shield, a very important aspect of the Survey program, was to understand the geological factors that govern the existing distribution of mineral deposits in the Shield, a task made very difficult by the agents of erosion over many eons; the moon, having been spared this, might resemble a youthful Canadian Shield in some aspects and thus provide missing information of value to our scientific understanding of the metallogenic processes.

Selection of the GSC Proposals

It is not very surprising, in view of our somewhat tentative submission, that there was little expectation that we would receive any lunar material. It was, therefore, something of a shock when I was awakened in March, 1967, by an early Saturday morning telephone call from Peter Calamai of the Ottawa Citizen, who told me that NASA had just released to the wire services the list of selected Principal Investigators for the Apollo 11 Mission and that our five proposals had been accepted! On March 13 Dr. Fortier received a confirmatory letter from Dr. Homer E. Newell, NASA's Associate Administrator for Space Science and Applications, and individual letters of welcome and preliminary instructions for each Principal Investigator. A detailed list of all approved Principal Investigators and their proposed investigations was also received.

There were about 400 proposals submitted for consideration, of which 130 were selected by NASA to receive lunar samples. We were the only Canadians to be included at first but when the list was later increased to 142 Dr. David Strangway, a geophysicist who transferred to Erindale College, University of Toronto from MIT, became the sixth. Of the chosen 142, only 36 Principal Investigators were from the following countries outside of the USA:

Great Britain	- 15
Canada	- 6
West Germany	- 6
Australia	- 3
Japan	- 3
Belgium	- 1
Finland	- 1
Switzerland	- 1

Only three Geological Surveys were included, those from Canada, Great Britain and Finland.

First Conference of Principal Investigators

On August 21, 1967, letters were received by the Principal Investigators (PI) from Wilmot N. Hess, Director, Science and Applications, NASA, advising of a meeting of all PIs at the Manned Spacecraft Centre (MSC) in Houston, Texas, on September 18-20, 1967. At this time the Lunar Receiving Laboratory (LRL) was nearing completion and those in charge wanted to get feed-back on the handling and distribution of samples, on contractual relationships, and the adequacy of the techniques and instrumentation of the LRL to meet the requirements of the PIs. Attendance was urged, in order to be familiar with the information that would govern all future dealings on lunar matters. Further information on the probable nature of the conference was obtained by telephone from Dr. Elbert King, Curator of lunar material at the LRL, in order to decide upon the extent of GSC participation. A further package from the MSC on September 1, 1967,

contained hotel information,RSVP forms and biographical information sheets for completion and return, and general conference information which promised the interesting prospect of a tour of the MSC facilities.

It was decided that Messrs.Collett,Douglas,Schwarz (representing Larochelle) and Maxwell would make up the GSC delegation (Wanless was unable to get away) and reservations were made at the Nassau Bay Hotel (at \$9/night for a single room!),located within sight of the MSC. We arrived on Sunday evening,September 17, and on Monday morning had our first look at the MSC spread out in front of our hotel. The meetings of the Conference of Principal Investigators for Lunar Samples were held in Building #1 Auditorium and identification badges were required wear at all times on the MSC premises. Shuttle buses made runs at 15-minute intervals between the MSC and the conference hotels. The agenda was as follows:

Monday,September 18,1967

9:00 AM	Welcoming Address (Hess)
9:15	Conference Information
9:30	Ground Rules for Lunar Sample Distribution(Hess)
10:30	Intermission
10:45	Apollo Mission Profile (Wiseman)
11:45	Apollo Lunar Surface Experiments Package(Moke)
12:45 PM	Lunch
1:30	Lunar Geological Equipment(Carraway)
2:15	Lunar Sample Containers (Wilkinson)
3:00	Intermission
3:15	Lunar Module(LM) Configuration and Surface Scientific Activities(Schmitt)
5:00	Adjournment

Tuesday, September 19, 1967

9:00 AM Lunar Receiving Laboratory Facilities and Operations
(Bell and King)

10:30 Intermission

10:45 Lunar Receiving Laboratory (continued)

12:45 PM Lunch

1:30 Tour of MSC Facilities

5:00 Adjournment

Wednesday, September 20, 1967

9:00 AM Post-Apollo Lunar Exploration Plans (King)

10:00 Intermission

10:15 NASA-Principal Investigator Business Relations

12:45 PM Lunch

1:30 NASA-Principal Investigator Business Relations

5:00 End of Conference

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It was a fascinating conference . We met colleagues from many countries and there was a discernible atmosphere of excitement and of participation in a unique occasion. There was, of course, the ambience of the conference setting and the many exhibits of pre-Apollo space hardware, but the major attraction was the opportunity to hear at first hand about the preliminary plans for the handling of the lunar material both on the lunar surface and at the MSC. This included a demonstration by an appropriately suited 'astronaut' of the equipment (tongs, hammer, scoop, sample bags) that would be used to collect samples, and another detailed explanation of the special boxes in which the samples would be sealed. Questions were

4 Not everyone was happy. A reporter from the Houston Chronicle was asked to leave the Monday afternoon sessions because the preliminary nature of the program was not at a stage conducive to public discussion. The report in the Tuesday edition of the Chronicle was headed "Foreigners meet ^{at} MSC; Press Barred!". The Houston Post was more restrained in its comments.

invited, and there were many from the US scientists, but I think the rest of us felt that as we were along for a free ride it behooved us to keep quiet. The description of the Lunar Module, and of the activities that would be carried out on the lunar surface by the Apollo XI astronauts, engendered in the audience a sense of anticipation of wonderful things to come approximately two years from then. The description by Drs. Bell and King of the layout of the LRL and of the way in which the lunar samples would be processed from the preliminary viewing, through detailed study, to preparation for distribution to PIs, was equally thought-provoking and stimulated much interest in the tour of the LRL facilities that followed. This was preceded by a tour of the Mission Control Centre, soon to be a frequent picture on television screens around the world.

During the Wednesday sessions on business relations we were given the guidelines that would govern the distribution and use of lunar material:

- the samples would be quarantined at the LRL for 30-60 days before release;
- the samples would be studied first by a preliminary examination committee in the LRL during the quarantine period;
- the committee would release an internal document on its findings at about the time the samples were distributed, and prepare a preliminary paper for publication in a scientific journal;
- PIs were not to publish results of their studies until after a general meeting called by NASA to receive them;
- the samples remained the property of the US government at all times;
- only PIs and their named co-investigators could study the

- samples, and further subdivision of the samples was prohibited;
- studies were not allowed to deviate from the approved proposal without NASA permission;
- at the conclusion of the study all sample material and any residues from destructive treatment were to be returned to NASA.

I think it is a reasonable assumption to say that this conference dispelled most of our lingering doubts⁵ about the likelihood of lunar samples being returned to earth. The MSC teams had ready answers to most questions (usually "we tried it and it wont work") and were prepared for just about any foreseeable emergency.

The stimulation of the September meeting at the MSC was dulled somewhat by an interregnum of about nineteen months during which the Lunar Project was relegated to the back burner. However, each PI was assigned a Project Number and Instruction for 1968-69 were issued on CG48B Forms as usual.

A paper in Science, November 3, 1967, by Turkevich, Franzgrote and Patterson, was of much interest to me. They presented the analytical data obtained by an instrument on board the Surveyor V craft that soft-landed in the Mare Tranquillitatis in September, 1967. The technique used was that of alpha-scattering, and the derived chemical composition (chiefly C, O₂, Na, Mg, Al, Fe, Si) was similar to that of a silicate of the basaltic type. Two other papers from Science (June 7 and October 4, 1968) described the alpha-scattering data obtained by the Surveyor VI and VII landings in the Sinus Medii and near the crater Tycho; both analyses confirmed the basaltic nature of the surface at these sites. Turkevich et al summarized the results of

⁵ Some doubt about the chance for a successful mission arose when the elevator I was on in the Mission Control Centre would not work properly in going from the ground to the second floor!

the Surveyor V-VII missions in a paper in American Scientist(56, (4), 1968), as did Jackson and Wilshire in Journal of Geophysical Research (73(24), December 15, 1968). These publications represented a major step forward in understanding for those of us contemplating the analysis of samples of heretofore unknown composition.

The Waiting Period - 1968- April, 1969

Letters were exchanged with NASA over several months to clarify and finalize the original proposals (e.g. I was given approval to include atomic absorption spectroscopy as an instrumental technique) and we were asked to specify what scientific photographic support, to be obtained from onboard Apollo imaging sensors, we required for our investigation (none in my case). We were advised on August 20, 1968, that the LRL was almost ready for business, and that any proposed changes to the equipment then on hand in the LRL for preliminary study of the samples had to be submitted for consideration by October 1, 1968. A letter from Wilmot Hess on December 6 marked a significant increase in the level of activity and forced us to consider more specific administrative details connected with the project. Dr. Hess announced the establishment of two teams that would play major roles in the future LRL activities:

- Lunar Sample Analysis Planning Team (LSAPT);
- Lunar Sample Preliminary Examination Team (LSPET);

and also reported that PIs were now to be grouped under four headings denoting common interests:

- A. Mineralogy and Petrology;
- B. Chemical and Isotopic Analysis;
- C. Physical Measurements;
- D. Bioscience and Organic Analysis;

it was hoped that this would encourage the discussion of mutual problems by scientists in the four groups. The guidelines for PIs

that were discussed at the September, 1967 MSC meeting had evolved further, and it was necessary for us to clarify with whom NASA would deal, since Canada did not have a Space Agency and NASA did not want to deal directly with the GSC. The PIs met on December 20 and Len Collett undertook to talk to NRC about this. Dr. R.S. Rettie had succeeded Dr. Rose as Chief, Space Research Facilities and he advised that we use their direct line of communication with NASA's International Affairs Division; he particularly recommended that we avoid dealing through the Defense Research Board. It was recommended to Dr. Hess that the Space Research Facilities of NRC be regarded as our equivalent of a National Space Agency for US/Canada formalities. Three months later we were informed that our recommendation had been referred to the Office of International Affairs in Washington for action. It was stated that, on completion of the final work statements, an agreement between the PI, the appropriate Canadian agency and the Office of International Affairs would be completed which would be in effect an agreement between the PI and the Canadian agency.

Second Conference of Principal Investigators

On January 20, 1969 another letter from Dr. Hess announced the scheduling of a meeting of all lunar sample Principal Investigators at the MSC, April 28-30, and this was followed by a detailed letter on March 18, with a preliminary agenda. Emphasis would be upon feed-back from the assembled scientists regarding both NASA operational plans, and information about PI laboratory capabilities and requirements for samples. Again, attendance by the PI or Co-investigator was urged; it was decided that Collett, Douglas and Maxwell would represent the GSC.

In the interval before the April meeting various communications were received from NASA. It was estimated that, assuming a successful

mid-July Lunar Flight, the distribution of samples could begin in September. We were asked to submit a one-page statement indicating the technical capabilities of our laboratories as of both now and in eight months time, to list the expected precision of chemical and isotopic analyses and the contamination level of our procedures. A tentative allocation of samples based on this information (assuming a nominal sample return of 20 kilograms) would be made in a few weeks time, but emphasis was placed on the uncertainty of the amount of material that would be available. NASA hoped to provide reference samples to aid investigators in determining the levels of contamination that would be incurred with standard LRL handling procedures. In this latter regard I passed along an idea suggested by Lee Peck (USGS) and agreed to by Birger Wiik (Finland Geol. Survey) that the splitting of the samples to be analyzed jointly by us be done by Lee Peck in Denver because he had the necessary equipment and experience, rather than have the LRL set up special facilities to do this.

The atmosphere of the Second Conference was very different from that of the first one. Nearly eighteen months had passed during which many scientists had made major commitments to the lunar project and they came prepared to argue any decision that might affect these commitments. The Three-day program was as follows:

Monday, April 28, 1969

9:00 AM	Welcoming Address and Introductions (Hess)
9:15	Purpose, Schedule of Events, General Overview of Lunar Sample Program and General Apollo Schedule (Hess)
9:45	Coffee Break
10:00	Lunar Surface Activities (Lind)

- 11:00 Surface Sampling Procedures-Contingency, Preliminary, Documented; Types of Containers, Design and Tools (Simmons)
- 11:45 Photography and Field Geology Information (Shoemaker)
- 12:00PM Lunch
- 1:30 Lunar Receiving Laboratory-General Status, Simulation Results and Mission Operations (Bell and Erb)
- 2:30 LRL Tour and Group Meetings
- 5:00 Adjourn

Tuesday, April 29, 1969

- 9:00 A.M. LRL- Sample Processing, Photography, Types of Data, Catalogue of Data, Contingency, Preliminary and Documented. Samples, Lunar Sample Preliminary Examination Team (LSPET), Sample Containers. (King, Bell, Warner)
- 10:30 Release Scheme for Samples, Interagency Committee on Back Contamination (ICBC), Quarantine and Biotest (Kemmerer).
- 12:00 Lunch
- 1:00 PM Guidelines (Hess)
- 2:00 Lunar Science Institute (Rubey)
- 2:30 Summary of American Chemical Society Meeting (O'Kelle)
- 3:00 Separate Meetings of Principal Investigator Groups (US and Foreign) (Barnes)
- 5:00 Adjourn

Wednesday, April 30, 1969

- 9:00 AM Meetings of Principal Investigator Groups & Subgroups
- 5:00 PM Adjourn ;

The highlights of the Monday morning session were the presentations by Don Lind and Gene Simmons on what would be done on the lunar surface and how it would be done. Practically every step and every procedure was questioned, especially by members of the Bioscience and Organic Analysis Team who exhibited a paranoic obsession about the possibility of terrestrial contamination of the samples. For example, we were told that the contingency sample, scooped up by the first astronaut immediately after stepping on the surface, would be placed in a plastic bag and then stuffed into a pocket of the astronaut's pants. The need for this was strongly questioned on the grounds of terrestrial contamination but Lind said with a straight face that it was necessary because, in the event of an emergency requiring the astronaut to return to the lunar module in a hurry, it was a safe assumption that whatever else the astronaut might leave behind he would still be wearing his pants! The nature and handling of the sample boxes and other containers came in for rigorous examination. The afternoon briefing on the readiness of the LRL and the subsequent tour of the facility were much less contentious.

In spite of the data collected by the Surveyor missions it was apparent that no one was prepared to say categorically just what kind of samples would be collected. The concensus was that the astronauts would probably land on a featureless plain covered to an unknown depth by a layer of fine 'dust' containing, it was hoped, some fragments of lunar rocks and would bring back about ten kilograms for study. This caused many scientists to wonder just how they would adapt their procedures to handle only fine material.

The decision to place the lunar material under quarantine was

explained in detail but in essence it boiled down to the fact that those responsible for releasing the samples could not say with certainty that there was zero risk of some extra-terrestrial and possibly unfriendly life-form being distributed along with the samples .A⁶ quarantine period of fifty days was proposed and this drew howls of protest from scientists who were champing at the bit to get started. There was also a muttered suspicion that the quarantine period would give LSPET scientists a solid head start over others. One scientist went on record with an offer to eat some of the dust just to prove that there was no danger!

One of the four PI Groups mentioned previously, Chemical and Isotope Analysis (B), was further divided into five subgroups:

- a) Rare Gas;
- b) Macroanalysis;
- c) Solid Source Mass Spectroscopy;
- d) Radionuclides;
- e) Activation Analysis;

and meetings of the Subgroups were held on Wednesday, April 30. I was 'appointed' Chairman of the Macroanalysis Subgroup and eight of us

⁶ PIs received three NASA publications on this subject. One, dated August 24, 1967, was titled "Protection of the Earth's Biosphere from Lunar Sources of Contamination", and was an Interagency Agreement between NASA and the Departments of Agriculture; Health, Education and Welfare; Interior, and the National Academy of Sciences. The Agreement set up an Interagency Committee on Back Contamination and this body issued the two other publications that outlined in detail the steps of the quarantine procedure.

met to discuss our sample preparation and distribution requirements. Recommendations were made on the treatment of chips and fines, and on the type and cleaning of sample containers. It was suggested that Charles Annell (USGS) send purified quartz to the emission spectrographic section of the LRL for grinding and distribution to macroanalysts, and that the crushing, grinding and homogenization of the lunar samples be done at the LRL. This was done and was used by the LRL to evaluate the extent of the contamination likely to be introduced by the preparation procedures into samples to be analyzed spectrographically by the LRL laboratory. A separate fused quartz sample, provided by the LRL, would be put through all the steps of the sample preparation and packaging procedures and aliquots would be sent to PIs as required. It should be emphasized that it was NASA policy to have duplication of the various investigations among the PIs in order to enhance the validity of the accumulated data; Lee Peck (USGS), Birger Wiik (Finland) and I were scheduled to receive splits of one or more samples. Shortly after the meeting we received more information about the four basic lunar sample containers to be used - plastic vials, metal vials, aluminium vacuum cans and stainless steel vacuum beakers, and how these would be packaged for transport. For example, the plastic vial containing the sample would be wrapped in aluminium foil and packed into an outer plastic vial; this latter, filled with dry nitrogen, would have a screw top capable of holding an air-tight seal.

A meeting of GSC PIs was held in June to finalize plans for dealing with the collection and subsequent handling of the lunar samples. It was recognized that the critical period would be July-September and arrangements were made to cover off PI absences in

the field, at conferences and on vacation. It was decided that stringent security precautions for the safety of the samples would be necessary and Keith Pollitt agreed to transfer a large safe from the carpenter's shop to one of the basement vaults. The combination lock on the door of the vault and safe would be changed and made known only to the PIs. We also discussed the possibility of mounting a display of lunar material prior to beginning our investigations. A letter was received from the LRL asking us to provide them with information on our whereabouts and by what means we could be reached in the event of a sudden need for consultation.

Correspondence with Richard Barnes, NASA Office of International Affairs, Washington, succeeded in settling the question of the appropriate signatures for the NASA Agreements. The latter arrived on July 14, shortly before the date of the lunar landing; they spelled out in detail the provisions for the investigation, the availability and release of lunar material, its receipt, safeguard, return and documentation of its use, the reporting of results and the requirements of the two progress reports to be submitted. Mr. Frutkin also asked that NRC assist the GSC by facilitating free customs and health clearance for the lunar samples. An Annex to the documents contained the approved program of work to be done. The Attachments were duly signed by the Principal Investigator, Yves Fortier and Dr. Rettie on behalf of NRC, and then forwarded to Arnold W. Frutkin, Assistant Administrator for International Affairs, NASA, Washington. Dr. Fortier assured Dr. Rettie that NRC was not committed in any way to the funding of the project; Dr. Rettie emphasized to Mr. Frutkin the need to ensure that all credit for Canada's participation in the lunar project would go to the GSC only, and none to NRC.

Importation of the Lunar Samples

It was then realized that the importation of the lunar samples would be subject to customs regulations. I telephoned Dr. Alex Campbell, Assistant Director-General (Food and Drugs), Food and Drug Directorate, Department of National Health and Welfare, for advice and he in turn contacted Dr. L. B. Pett, Deputy Director-General, Health Services Branch, who discussed it with several officers and concluded that this was a matter for the Department of Agriculture which had strict regulations about the importation of biological materials as well as soils. These required Customs Officers to hold such material unless appropriate advance clearance had been certified. Dr. Pett recommended that we obtain the assurance of NASA, based on their tests to be done during the quarantine period, that the samples were free of biological contamination.

On August 7, while the lunar material was under quarantine in the LRL, Dr. J. M. Harrison, Assistant Deputy Minister, EMR, wrote to Mr. J. G. Howell, ADM (Operations), Customs and Excise, Department of National Revenue, to explain the quarantine procedures, and the way in which the samples would be transported. I had already determined from Mr. A. R. Hind, Customs and Excise, that because the samples would remain the property of the US government, they could enter duty-free under Tariff Item 70800-1, and Dr. Harrison emphasized the need to protect the samples from terrestrial contamination, i.e., we did not want to have to open the containers! Mr. George Martin, Chief, Facilitations Division, Port Administration Division, Customs and Excise, wrote on behalf of Mr. Howell to Mr. R. N. Handy, District Collector of Customs and Excise, Ottawa, giving him the above information and Mr. Howell's direction that under no circumstances would the containers be opened. It would only be necessary for inspectors to establish that the

containers originated with NASA and to accept my signed certification that these were indeed lunar material. The Canada Department of Agriculture issued a news release on August 22, giving details about our request, the first of its kind received by the Plant Protection Division, and stated that the way had been cleared by the import control section for entry to Canada of the samples whenever they were released by American authorities. The final step was a Permit to Import (No.25711) issued to me under the Destructive Insect and Pest Act for one importation only. The exporter was NASA, the country of origin was listed as "Lunar Surface" and I was allowed to bring in five samples of lunar soil and rock "without further documentation insofar as regulations under the Destructive Insect and Pest Act are concerned.

Arrangements to Collect the Lunar Samples

NASA had emphasized our responsibility for the safety of whatever samples we were assigned because of their uniqueness should there be no further lunar landing missions. The assigned samples had to be picked up by the Principal Investigator or a certified alternate and there was concern among us that commercial flights offered too many opportunities for theft or loss⁷. It may be that we were overly concerned but we did not want to put Canada in the embarrassing situation of having to explain to NASA that we had lost the precious samples. In any event Yves Fortier persuaded Dr. Claude Isbister, the Deputy Minister of EMR, to ask the Department of National Defence to provide us with direct transportation to Houston and back. The request was addressed to Mr. E.B. Armstrong, Deputy Minister, and on his advice to Mr. J.L.G. Morisset, Chairman, Air Transport Committee, Canadian Transport Commission.

⁷ No samples were available to Communist-dominated countries and the rivalry between the USA and the USSR was at its peak.

The Secretary of the Air Transport Committee replied that they would have no objection to DND providing the necessary transportation.

Mr. Armstrong, DM/DND, informed Jim Harrison on August 12 that a Falcon jet aircraft could be provided for the job at \$2800 per round trip, and we were referred to a Captain Carr for final details.

I was in Europe at this time and John Douglas wrote me on August 24 to say that Dr. Fortier refused to pay the \$2800 and DND was notified that other means would be used. The Director asked Peter Hood if the Survey's Queenair prop-driven aircraft would be available. The estimated cost would be about \$300 for gasoline and it could take two or three passengers, but it would be a 10-hour flight with one intermediate stop. Len Collett objected and the Director was convinced that it would be better to use a commercial airline. Peter Hood and Larry Morley bore down on Len Collett and convinced him in turn that the publicity for the GSC from the use of the Queenair plane would be worth the long flights, but the Director stuck to his decision to use a commercial flight. George Hobson added his voice to those pushing the use of the Queenair and a letter from John Douglas written on August 27 informed me that the decision about the Queenair was in abeyance until Yves Fortier recovered from having torn back muscles while lifting something heavy at his cottage! He also told me that Dr. David Baird, Director of the Museum of Science and Technology, was putting pressure on the GSC to display the lunar samples at the Museum. In a PS dated September 2 I learned that Dr. S.C. Robinson, as Acting Director, had approved the use of the Queenair.

A final letter from John Douglas on September 10 contained much

⁸ We were referred to as the "Geographical Survey of Canada".

news. The Queenair plan was still in force and word was received that the samples would be released in late September (quarantine would end on September 12). Dr. Dan Anderson replaced Dr. King as Curator of the LRL on September 1; we would be informed by telegram when our samples were ready. A rumour was rife that Dr. J. Tuzo Wilson was planning great things for Dr. Strangway's sample, including a \$3000 special display case from Birks Jewellers, and a series of 'moon' receptions! The Director remained adamant that there would be no display but John Douglas felt that something would have to be done. Carl Mayhew of EMR's Public Relations and Information Services Branch, opened discussions on plans for press coverage of the arrival of the samples and the newspapers were telephoning daily for information.

At this point the situation underwent a dramatic change because of the entry on the scene of the Honourable J. J. Greene, Minister, EMR. Mr. Greene, aware of the potential publicity that would result from the arrival of the lunar samples, decided that the Department would pay the cost of the DND flight and Dr. Isbister wrote to Mr. Armstrong on September 28 to renew the request, citing the Minister's concern for the importance of the project and the security of the samples. Mr. Greene, through W. B. Wilkerson, his Special Assistant, wrote to Brigadier General H. B. T. Doucet, Executive Assistant to Mr. Cadieux, Minister, DND, to support the request. On September 25 Mr. Hamill from the Deputy Minister's Office informed the GSC that Lt. Colonel Richardson, DND, telephoned to confirm the availability of the Falcon jet at half-price (\$1400)!

I was back in Ottawa by now and was able to inform the Director that final arrangements were complete for the flight to Houston by Drs. Douglas, Larochelle and Maxwell on Monday AM, October 6 and return on Tuesday, PM, October 7. Dr. Strangway was invited to go

along but he made other arrangements. A news release was given to newspaper, radio and TV people. On September 29 a copy of the directive from Col. Richardson, Canadian Forces Headquarters, to 'CANLIFTCOM ATOC and CANLIFTCOM MOV" was received confirming the above arrangements. In the meantime John Douglas had sent NASA letters from the PIs designating a representative to collect their samples in the event they would not go in person.

The Samples Are Collected!

It is necessary to backtrack in time somewhat in order to pursue the matter of the sample readiness. Dr. Hess wrote to all PIs on September 3, 1969 to explain NASA's policy on the publication of papers. He announced that a Conference of Lunar Sample Principal Investigators would be held at the MSC on January 5-10, 1970 and that the 1800-word papers which would be turned in at the beginning of the Conference by each PI would be published in a leading scientific journal. Longer papers (up to 12000 words) would be published about three months after the conference in a NASA Special Publication and also as a Supplement to Geochimica et Cosmochimica Acta. We also received a document from Dan Anderson, the new Curator, in which both the sample numbering system and the procedure for recording the genealogy of each sample were explained.

The Public Relations and Information Services (PRIS) had firmed up the plans for handling the arrival of the samples on October 7 and subsequent publicity. Jack Donoghue, PRIS Director, would oversee the plan with the assistance of Carl Mayhew. No ceremonies were planned for the airport arrival but were scheduled for Camsell Hall in the presence of the Minister, and with only press and other media representatives invited, time uncertain but no later than 1:30 PM. This was later changed to 3:00 PM.

On September 15 we were informed by a telegram from Dick Barnes, NASA, Washington, of the nature of the samples allotted to us:

- Collett - 17 grams (5 grams of fines, pieces from 2 rocks);
- Douglas - 5 grams of fines, plus access to 22 thin and polished sections from 11 rocks (a chip of from 5-20 grams would accompany 9 of the rocks);
- Larochelle - 21 grams (5 grams of fines, and one piece weighing 16 grams);
- Maxwell - 26 grams (7 grams of fines, and 2 pieces of rock) from splits to be prepared by L.C. Peck, USGS;
- Wanless - 24 grams (10 grams of fines, and chips (from 2-5 grams) from each of 4 rocks).

This added up to about four times the quantity which had been envisaged. John Douglas informed Dan Anderson that we would collect the samples some time after September 25, and sent a telegram to me in England⁹ to advise me to get back to Ottawa. I was back on September 23, only to receive a telegram from Dan Anderson saying that the processing of the samples was delayed for another week. This was followed by a telephone call from Dan to say that, unfortunately, no one had thought to tell Lee Peck about the arrangements for splitting the samples. Birger Wiik was at the LRL, however, and so it was Dr. Wiik who did the honours. The fines (about 22 grams) were split in air (5 minutes) using a laminar flow bench, packaged under dry nitrogen and stored in a desiccator until required. Three rocks of about 20 grams each and sufficiently fine-grained to be considered homogeneous were split into two aliquots of about 10 grams each, and Peck, Wiik and myself received

⁹ By a nice coincidence I was staying at a hotel on Half Moon Street, London.

one split from each of two rocks. By this means we each duplicated the analysis of two of the rocks and all three analyzed the fines. The rocks were split in air and packaged in air.

A telegram from Dr. George Wetherill, UCLA, to Dr. Wanless reported the readiness for collection of two standard rubidium and strontium solutions prepared for those carrying out age and isotopic studies. Dr. Wanless was not able to go to Houston (French Language Course) and R.D. Stevens asked me to collect these for him. Len Collett also could not make the trip and requested that a blank nitrogen-filled container also be picked up with his samples. Dan Anderson was notified that Douglas, Larochelle and Maxwell would arrive at the MSC on October 6 about noontime to get the samples, stay overnight at the Nassau Bay Hotel and return to Ottawa next morning. I put a sign on my office door on Friday evening, October 2nd, "Gone to Get the Moon Samples - Back Tuesday".

The Falcon jet was from 412 Squadron and crewed by Major D.B. O'Connor (Captain), Major McIlraith and Corporal Saunders. The three of us boarded at the military section of Uplands Airport at 6:30 AM local time, with estimated arrival at Houston 10:30 AM local time after a stop at St. Louis. We landed at Hobby Field after a very pleasant flight and immediately went to the MSC. Security was very tight, both to enter the MSC and the LRL, but eventually we were shown into a waiting room to await a call from Dan Anderson. We expected that the handing over of the samples would be done in a formal way and under heavy security but the reality was very different. I was called first and directed to the Curator's office but found the corridor filled with men moving desks, filing cabinets, chairs, etc. It turned out that the Curator's office was being moved from the neighborhood of

the sample processing wing to the front of the LRL in order to keep eager PIs from getting underfoot in the critical area. I met Dan Anderson in the corridor and, after a brief greeting, he took a white vial out of his coat pocket and said, "Oh, by the way, here's one of your samples"! It was lacking in the expected drama but it was still a beautiful moment when I realized that I had a piece of the moon in my hand. Drs. Douglas and Larochelle had similar experiences and by about 4 p.m. we had collected sixteen assorted containers containing the GSC allotments of lunar material. We also signed Lunar Sample Custody Transfer forms which listed the allotted samples and repeated the stipulations regarding use of the sample, its return and publication of results. My form began as follows:

"The undersigned acknowledges receipt of the following three(3) samples identified by sample numbers and net sample weights:
10017,29 (16.24 gr.); 10084,132 (7.30 gr.) and 10020,30 (9.82 gr.).

We checked in at the Nassau Bay Hotel (the flight crew stayed at the Airport Inn), very conscious of what we had in our brief cases. We took them to dinner with us and, it being a buffet, one of us guarded the brief cases while the others picked up the food. After dinner we repaired to my room to look at those samples which could be opened without injury to the contents. It was a memorable moment for the three of us when we could look at a piece of lunar rock. I could not loosen the screwtop of the large plastic container which held the vial containing one of my rocks and finally resorted to high technology by using the door jamb as a vise to aid in unscrewing the top! We did not take the briefcases to bed with us but we did keep them handy in case of an emergency.

We left Houston at 6:30 a.m. local time with an estimated time of

arrival at Ottawa of 12 noon local time. Again we had an uneventful flight, during which we showed the samples to the flight crew, and arrived at Uplands Airport to find the Customs Inspectors waiting for us. They boarded, looked at the sixteen containers and signed the clearance form. Dr. Wanless was waiting ^{with} a Survey station wagon, as was my wife, Helen, with a camera! We said goodbye to the flight crew (it is the only time that I have been saluted, which Corporal Saunders did as I left the plane) and joined Dr. Wanless for pictures taken by Carl Mayhew and his people from PRIS. We left in the Survey vehicle with an escort of two Ottawa police motorcycles and drove to the Survey building, resisting the temptation to wave to passers-by! We were told that an RCMP escort would conduct us to 588 Booth Street at 2:30 p.m. for the press conference in Camsell Hall at 3:00 p.m. Helen had brought a lunch for me and guarded the samples when I was out of the office.

The Press Conference

At 2:30 pm two very large RCMP officers in plain clothes escorted Drs. Douglas, Larochelle, Wanless and myself to Camsell Hall. Mr. H.R. Steacy, GSC, had arranged for a large glass case to be put on the Camsell Hall stage into which we placed the containers, drew the stage curtains and left the RCMP officers to stand guard. Camsell Hall was nearly filled with media representatives and, as a special benefit, our wives could also attend.

A row of tables were set up at the front of the stage and the four Principal Investigators sat down to await Mr. Greene's arrival. He entered at 2:55 p.m., accompanied by Dr. Isbister, Dr. Fortier and Mr. Wilkerson, took his seat and immediately launched into his opening statement on the importance of the project, his gratification that his Department had been chosen to participate and how it was a tribute to the reputation of the GSC. He then asked me to give some

background details about the collection of the samples, after which he invited questions from the press and called upon the appropriate PI to answer. Mr. Greene then invited the writers to come to the platform to look at the samples, the curtains were drawn back, and the rush was on. All of us were interviewed more than once; I stayed with the Minister as much as possible in order to field any scientific questions. Two of the containers were taken from the case so that Mr. Greene could be photographed looking at them when the TV and still photographers had their turn. Mike Kelly, a PRIS photographer, produced a large Sherlock Holmes-type magnifying glass from his pocket for the Minister to use; it was covered with Mike's fingerprints. One well-publicized photograph shows Mr. Greene looking intently through the magnifier at the lunar rock visible through the container wall. I was standing beside him and he muttered to me, "Hell! I can see it better without this damn thing!".

The press conference ended about 4:30 p.m. and we collected our samples and transported them back to 601 Booth Street, again under the watchful eyes of the RCMP. We put the samples into the safe in the basement vault, and relaxed.

Public Display of the Samples

Dr. Isbister, our DM, was very much in favour of a public display at the GSC, with emphasis solidly on the lunar material and on the implication that the recognized competence of GSC scientists to participate in the lunar work was also an indication of the competence of the GSC to carry out its historical mission. A meeting was held on September 30 with H.R. Steacy and me representing the GSC, Jack Donoghue, A. Goodson and Carl Mayhew from PRIS, and Charles Caron and George Rhyne from the Canadian Government Exhibition Commission,

to work out the details. It was decided that it would be held on Saturday and Sunday, October 18-19, and again on October 25 and 26 if necessitated by public interest. A private showing for Departmental personnel would be held on Friday, October 17, 7-10 pm. The DM requested that the Commissioner of the RCMP would be responsible for security, parking and traffic control. The cost of the display would be borne by PRIS.

The display would consist of a preamble showing NASA Posters and photographs, the scientists involved and brief descriptions of the five investigations, and an explanation as to why the GSC was selected to participate in the Apollo mission studies. The preamble was to be in the foyer of the building and would direct the traffic flow into Logan Hall where the lunar rock and fines would be displayed. A large set of NASA slides of various previous missions were automatically projected on a screen at the entrance. Three clear plastic globes, 16 inches in diameter, were mounted on black metal stands and spot-lighted from above to display two rocks and a vial of fines. These samples were in turn supported by a three-pronged rod at the centre of the globe. The stands would be in a black-drape-enclosed area large enough to permit the viewers to pass in front but prevented from touching the globes by a metal railing enclosing them. The three samples would remain in the globes for the duration of the display; the globes would be removed by me and stored in the basement vault at night, and remounted by me as required. A security officer would be on duty in the viewing room at all times.

A letter was received, via Dr. Rettie, NRC, from Mr. Tom Paine, the NASA Administrator, in which he emphasized the need for strict safeguarding of the lunar material, and pointed out that its existence in our institution would doubtless be publicized, thus "making it

attractive to the curious and to those otherwise motivated". Principal Investigators were asked to provide information on their plans for protection of the samples and to consult first with the NASA Assistant Administrator for Public Affairs for appropriate coordination.

A new wrinkle was introduced into the display plans when Dr. Isbister wrote to Mr. Cadieux, Minister, DND, to ask if it was possible for HRH Prince Philip to visit the display while in Canada in October to present the Duke of Edinburgh Awards to Ottawa boys. It thus became urgent to ensure NASA's approval of our display plans and I first telephoned, and later wrote to Mr. J. P. Riley, NASA Office of International Affairs in Washington about this. I was assured that, for an institution like ours which is studying the material, approval would be granted when a formal request was made. Dick Barnes (NASA) sent a letter of concurrence on October 20.

Dr. Isbister was first informed on October 2 by the office of the Undersecretary of State for External Affairs that, although the Duke of Edinburgh had indicated that he did not wish any additions to his planned program, they would ask him about it. On October 3 Mr. Donoghue was told that Prince Philip would be delighted to visit the exhibit at 10 am Saturday, October 18:

Notices appeared in the Ottawa papers announcing that EMR would "hold an exhibit and public display of "MOON MATERIAL" in the GSC building on Saturday, October 18, from 11 am to 6 pm, and on Sunday, October 19, from 1 pm until 6 pm, and that this would be "the only public showing in Ottawa of the moon samples brought back by the Apollo XI astronauts". Prince Philip's expected visit was also reported. We had received a fair amount of publicity since we were selected by NASA to take part, and I summarized it for Dr. Fortier's benefit on August 13, 1969. From March 18, 1967 to July 30, 1969 there

were twelve articles in the Ottawa Citizen and Journal, the Globe and Mail, Le Droit and Northern Miner. From June 17 to July 25, 1969, John Douglas and I had five radio interviews including a Saturday morning Open Line Show on CKPM¹⁰, three TV interviews (which also included Drs. Wanless and Plant), and three telephone interviews. There were, of course, many small newspaper items and several good cartoons, among which must be mentioned the fifteen very pertinent ones that flowed from Hal Steacy's pen!

Notices were posted throughout EMR advising of the private showing of the samples for staff members and immediate families on Friday, October 17, 7:30 - 10 pm. Staff members were required to show Departmental identification cards or temporary building passes at the door. Dr. Fortier was originally not in favour of a display but became quite enthusiastic about it once it was known that PRIS would pay the cost. He decided to send out invitations to Deputy Ministers in other departments with which the GSC had contacts.

The Friday evening was a spectacular affair. The line-up of EMR people stretched from the entrance to 601 Booth all the way past the Surveys and Mapping Building! There were several special guests, including Mr. Schmidt, the US Ambassador, and his wife; Dr. Bill Schneider, President of NRC; and Simon Reisman, and a reception was held in the then Boardroom for them and senior GSC staff; Miss Gert Derry, the Chief Geologist's secretary, circulated among the guests with the Survey's new Visitors Book, with instruction to not sign on the first page. When it was known that the Duke of Edinburgh would visit the

¹⁰ Dr. Douglas and I were poised to provide all sorts of information about the Apollo mission when the line was opened to callers. The first question was for an explanation of how the moon caused tidal effects on earth!

Survey it was thought desirable that he should sign the Visitors Book, but this turned out to be a black notebook acquired from our Office Supplies and Mrs. Peg Arscott, the Director's secretary, thought that something better was needed. Dr. Fortier authorized Mrs. Arscott to purchase one, and was shocked to learn that it cost about forty-five dollars.

Visit of the Duke of Edinburgh

On Saturday, October 18, at 10 am the Duke of Edinburgh came to 601 Booth Street. It was planned that about 300 science students and their teachers from Ottawa-Hull High Schools would assemble on the patio at the entrance, together with PI wives and Co-Investigators, and there was an initial plan to have Prince Philip speak to the students and present Rock and Mineral Sets to the six top students, but this was axed and Mr. Greene performed the honours. RCMP officers would arrive at 9 am and no one would then be allowed into the building unless connected with the visit, and no one would be able to enter the Survey lobby while the Prince was there, nor could anyone leave the building before the Prince left at 10:30 am. Everyone in the Official Party was given an identification card.

The chronology of the visit was as follows:

- 9:45 Students arrived
- 9:50 Departmental Officials assembled at entrance-Mr. Greene; Mr. 'Bud' Orange, Parliamentary Assistant; Dr. Isbister; Dr. Harrison; Dr. Fortier; the five Principal Investigators.'
- 9:55 Mr. Greene went to sidewalk in front of building;
- 10:00 Duke arrived, was welcomed by Mr. Greene and they walked up to entrance; Mr. Greene introduced Duke to Messrs. Orange, Isbister, Harrison, Fortier and Maxwell; I introduced my fellow PIs.

The Minister accompanied the Duke, followed by me , through the exhibit to the lunar samples; the rest of the party followed, together with three or four photographers.

When the Duke finished touring the exhibit and asking questions, he and Mr. Greene returned to the lobby; the Duke chatted with the PIs and, at the Minister's invitation, signed the Visitors Book.

10:25 The Duke said goodbye and was accompanied to his car by Mr. Greene.

10:30 Mr. Greene returned to the entrance, spoke to the students and presented the six rock and mineral sets and then declared the exhibit open to the public.

Students were admitted to the exhibit, which was then opened to the public at 11 am.

A few points need further elaboration. When Dr. Fortier was introduced to the Duke as the Director of the GSC, the Duke laughed and said, "Oh, this is your shop, is it?" Then, when the Duke, Mr. Greene and I started to enter the exhibit, Mr. Greene pushed me forward and said, "You go with the Duke". Prince Philip certainly gave the impression of being genuinely interested in the lunar material and spent about ten minutes in the exhibit, before going to the lobby and asking more questions of the PIs. He shook hands with Dr. Fortier as he was leaving, and then suddenly returned to shake hands with me, an unnecessary but most appreciated gesture on his part ¹¹.

¹¹ Jack Donoghue, PRIS, was involved in a previous tour by the Duke to northern communities to present awards and told me a story that he swore was true. The Duke visited a small town and was entertained to dinner by the ladies of one of the churches. As they were clearing away the dishes from the main course, one of the ladies leaned over and said, "Hold on to your fork, Duke, there's pie for dessert!"

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The Visit of the Governor General

The interest shown by the public was most gratifying and the Saturday and Sunday line-ups stretched again down Booth Street past the Surveys and Mapping building; it was decided to extend the showing to the following weekend also, October 25 and 26. John Douglas and I were sharing the supervision of the exhibit, and I received a telephone call from him just after noon, ^{on October 25,} telling me to get down there because the Governor General's office had telephoned the PRIS office to say that Mr. and Mrs. Michener would like to see the exhibit at 1:30 pm. I picked up a suit from his home for him and joined him and Carl Mayhew. Efforts to locate Drs. Fortier or Harrison were unsuccessful but Dr. and Mrs. Isbister were able to come. At 1:30 pm the Vice-regal car arrived and, because Dr. Isbister could not easily manage our many steps, I greeted them at the sidewalk. They were accompanied by Mrs. Michener's young niece, and an ADC, and we all proceeded up the steps to be greeted by the Isbisters and John Douglas. The Micheners went through the exhibit in a leisurely fashion, signed the Visitors Book, chatted with the Isbisters and Dr. Douglas, and then asked what else they could see - their car would not be back for another half-hour! Fortunately we remembered Mr. Michener's interest in minerals, and Mrs. Michener's hobby of gem polishing, and took them up to the seventh floor where they were able to spend the half-hour looking at the display of the National Mineral Collection.

It was estimated that between fourteen and sixteen thousand people came to see the exhibit. I wrote to Dick Barnes, NASA, to tell him about it, and sent him photocopies of the newspaper coverage and, later on, a set of coloured photographs of the exhibit taken by PRIS. I think it is appropriate to include here a short poem written by Dr. E. R. Rose to commemorate the display. Dr. Rose died while this paper was being written.

MOON ROCK

*To have the Moon within one's grasp,
Is more than many mortals ask,
But here it is within your sight,
These première pieces of dark lunité.*

*Perhaps these specimens from the Moon,
May have come somewhat too soon,
For our earthbound minds to measure,
All the secrets in their treasure.*

*But when man looks back some day,
From a planet far away,
He'll feel full reverence for this sight,
A tribute to Apollo's flight.*

*Written on the
occasion of the
moon rock display
in Logan Hall,
October 17, 1969.*

E. R. Rose
E. R. Rose,
Poet Laureate,
G.S.C.

The Apollo XI Lunar Science Conference
January 5-8, 1970

The scientific work was finally able to get started in earnest by the end of October, and it became something of a race to complete the assigned investigation and to get a paper ready for presentation at the Apollo XI Lunar Science Conference scheduled for January 5-8, 1970, at the Albert Thomas Convention and Exhibit Centre, Houston (the MSC would still be involved in the quarantine period for the Apollo XII material and could not handle a group of this size (about 800)). Christmas passed in something of a blur for the PIs¹², as was noted in an article by Jeff Carruthers in the Ottawa Journal, December 31, 1969. In any event, the abstracts were submitted by December 15 as required, and the five PIs turned up in Houston on January 4 clutching their approximately 1800-word papers and consumed with curiosity about the results obtained by other PIs doing similar work. The ticket of admission to the Conference was the aforementioned manuscript.

The program was as follows:

Monday, January 5	9:00 am	Welcome and Introductions
	9:20	General Session I
	12:30 pm	Lunch
	2:00	General Session II
	5:15	Adjourn

¹² I had a further interruption by the request that I pose for the cover of the December, 1969 issue of The Canadian Geographical Journal, with a lunar sample. This issue featured an article on lunar work by Carl Maynew. The photographs for the cover and the inside pictures were the work of the distinguished Ottawa photographer, Malak.

Tuesday, January 6 9:00 am A.Lunar Chemistry I
B.Solar Wind and Cosmic Ray Spallation
Results

12:30pm Lunch

2:00 A.Mineralogy I
B.Physical Properties

5:30 Adjourn

Wednesday, January 7 9:00 am A.Lunar Chemistry II
B.Mineralogy II

12:30pm Lunch

2:00 A.Mineralogy and Petrology
B.Magnetic and Electrical Properties

5:30 Adjourn

Thursday, January 8 9:00 am A.Radiogenic Isotopes
B.Organic Chemistry

12:30pm Lunch

2:00 A.Impact Metamorphism
B.Micropaleontology
C.Soil Mechanics, Surface Properties
and Miscellaneous

5:00 Adjourn

and it was indeed a unique and fascinating conference! The subject of everyone's work was the same, these miscellaneous pieces of rock and bags of lunar regolith brought back by the Apollo XI astronauts. Small groups huddled together in corners to compare data and argue over interpretation. In the sessions there was a staggering amount of data to be revealed and absorbed and the general atmosphere was one of genuine interest and exhilaration. Unfortunately this euphoria would not last and this special spirit was not present at succeeding conferences.

The one group that did not seem happy was that of the organic chemists, the ones who had posed so many questions concerning the precautions to prevent terrestrial contamination of the samples. Since they did not find any organic substances in the lunar material they were reduced to explaining how they would have found them if they were present. As someone paraphrased Sir Winston Churchill, 'never have so many made so much fuss for so few results'!

A Conference Dinner was held in the Grand Ballroom of the Rice Hotel on January 6, hosted by the National Space Hall of Fame and the City of Houston. It was masterfully chaired by Clifford Frondel, and among the special guests were the astronauts Aldrin, Conrad and McDivitt. The principal speaker was Dr. Fred Hoyle, University of Cambridge; he said that the space program had succeeded in making everyone conscious of, and concerned about the need to protect the environment of our planet, a unique and precious place. There were several interesting newspaper articles about the conference, with mention of the work of the GSC in some, including in the Basler Nachrichten of January 8, 1970.

The proposal by NASA that all of the short papers (approximately 1800 words) presented at this conference would be published as soon as possible in a leading scientific journal was met by arrangements with SCIENCE, the journal of the American Association for the Advancement of Science. A team of editors and reviewers were sent to Houston to deal with the submitted papers on the spot and, incredible as it seems, all were published in the 30 January 1970 issue of 784 pages, four times the volume of a single issue. In July 1970, Pergamon Press, Inc. published the entire collection of papers, both short and long, in three massive volumes of about 1000 pages each as Supplement I

to Geochimica et Cosmochimica Acta under the title "Proceedings of the Apollo XI Lunar Science Conference". A unique feature of this publication was its dedication to Aldrin, Armstrong and Collins with a short note of thanks signed by all the Principal Investigators. We were asked on March 26 to provide our signatures by March 30 for inclusion.

Life After Apollo XI

The successful landing and return of the Apollo XII mission removed the need to pick up allotted samples at the LRL and they now arrived prosaically by registered mail. The number of PIs had risen to 193, with 55 spread over 16 foreign countries, including Czechoslovakia, Korea and Spain. The six Canadian PIs were joined by Drs. Thode (McMaster University), Masson (NRC Halifax) and Bancroft (University of Western Ontario).

On February 11, 1970, Dr. Gene Simmons, the six-foot-six Chief Scientist of NASA was the speaker at a Logan Club meeting; he talked about the state of lunar science before Apollo XI, the early results from Apollo XII, and about future missions, illustrated by a film from the Apollo XII mission.

On February 6 Dr. R.B. Ferguson, Department of Earth Sciences, University of Manitoba, telephoned Dr. A.G. Plant to ask if the PIs could take part in a special session on Lunar Materials, part of the joint Annual Meeting of the Geological and Mineralogical Associations of Canada to be held in Winnipeg, August 31-September 2, 1970. He also wanted to have a display of lunar material if possible. Dr. Fortier was in favour of the request but asked Dr. Ferguson to obtain the permission of the Minister. Mr. Greene gave his enthusiastic support and I obtained NASA's approval for the lunar exhibition. Papers were given by Messrs. Collett, Dence, Plant, Schwarz, Wanless and myself and

I showed the colour film that had been made by the CBC to illustrate the various aspects of the GSC lunar studies. Two samples were displayed, Dr.Larochelle's 18-gram piece of Apollo XI rock and Dr.Douglas' vial of lunar fines, and we shipped two of the globes and pedestals, as well as posters, slides and photographs to Winnipeg for this purpose. Curiously enough, the man in charge of the arrangements for the display was Mr.Moon! The public displayed much interest and there was a steady stream of viewers.

On May 15,1970, I asked Dr.Fortier to be released from my role of Coordinator,Lunar Crust Project,because there was now little requirement for coordination; Dr.Fortier asked me to continue as his advisor on lunar matters.

The LRL now turned its attention to the storage of returned Apollo XI material and we were asked by Dan Anderson in July,1970, to provide a complete inventory of the lunar material in our custody. All Apollo XI material had to be returned by August 31; Canadians could use registered mail, but other foreign PIs had to return their material via the American Embassies. Dr.Anderson also announced that Dr.Michael Duke,USGS,would be the new Curator as of July 27.

In January,1971, Dr.Fortier asked me to prepare a summary of the estimated cost in man-months and dollars of the lunar projects to that time, and anticipated, and it came out as follows:

1967/1969	\$2300	1.5 man-months
1969/1970	\$39000	30.5 " "
1970/1971	\$10000	8.0 " "
1971/1972 (Est.)	\$16350	4.75 " "

for a total of approximately \$68000 and 45 man-months.

The selection of PIs for the Apollo 14-17 Missions was announced in March, 1971. The PIs totalled 186, with 56 foreign PIs in 15 countries, including Holland and Brazil. Of the Canadians, only Dr. R.J. Traill (PI in place of J.A.V. Douglas, now at University of Ottawa) and myself from the GSC and Dr. Thode (McMaster) remained, joined by Dr. D. York, University of Toronto. At this time it was agreed by the PIs that the combination to the Vault Room (B 57) be given to the Editorial Division, but that the combination of the safe remain with the PIs.

The Second Lunar Science Conference was held on January 11-14, 1971, at the Albert Thomas Convention and Exhibit Centre in Houston, and featured reports on the Apollo XII samples. The format was much the same as that for the 1970 Conference and there was a good attendance. Len Collett, John Douglas and I presented papers, mine being a joint work with Birger Wiik, Finland. The proceedings were published by Pergamon Press in 1971, as Supplement II to Geochimica et Cosmochimica Acta. The Third Lunar Science Conference was held at the Lunar Science Institute in the MSC, January 10-13, 1972, and was attended by Dr. Traill and myself. The Proceedings, which covered studies of Apollo XI, - XV samples, were again published by Pergamon Press as Supplement III.

The lunar work was winding down at the GSC by this time. The Apollo XI and XII samples had been returned, those from Apollo XIV were, for the most part, finished by 1972 and work was done on those from Apollo XV-XVII in 1972 and 1973. On April 26, 1973, Dr. Harrison (Jack) Schmitt, billed as the only geologist to have walked on the lunar surface, spoke to the Logan Club on lunar geology.

In October, 1973, NASA created the Lunar Data Analysis and Synthesis Program (LDASP) for general studies of the accumulated lunar data and samples, and invited world-wide participation in the program. The emphasis would be on crater formation, degradation and transport of lunar material, and the GSC had no interest in participating but offered to give laboratory support to the Earth Physics Branch should they become involved in the future. I completed my lunar work in 1974 and, with Mr. Collett and Dr. Traill, retained the option of asking NASA for further samples if this became desirable.

As Coordinator of the Project I was asked to speak to some fifteen different groups between 1969 and 1972. Of particular interest was an appearance on the CBC-TV network coverage of the Apollo XII lunar landing, Tuesday evening to Wednesday morning, November 18-19, 1969; unfortunately I was already scheduled to speak to a dinner meeting of the Canadian Aeronautics and Space Institute in Ottawa on Wednesday evening, and I admit to being somewhat groggy when it came time to speak! I was asked by the Chemical Institute of Canada to make a speaking tour to local Sections in the Maritime Provinces; I carried the message to groups in Fredericton, Halifax, Antigonish and St. John's, October 19-23, 1970, and it seemed to generate much interest in the work of the GSC in general. I had previously published a paper in CHEMISTRY IN CANADA, March, 1970, "Geological Survey of Canada participates in Apollo Lunar Program" which summarized the scientific work of the Principal Investigators.

Mr. Collett notified me on December 11, 1975, that the last two lunar samples, which were in his custody, were removed from

the safe in the Vault Room and returned to NASA. I advised Dr. Harker that we no longer required access to the vault and thus the study of lunar material at 601 Booth Street came to an end.

SIC TRANSIT GLORIA LUNAE