NATIONAL ATOMIC ENERGY COMMISSION
ARGENTINE REPUBLIC

SESQUICENTENNIAL OF THE MAY REVOLUTION

Scientific Sessions on URANIUM RESOURCES and POSSIBILITIES

BUENOS AIRES
1960

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NATIONAL ATOMIC
ENERGY COMMISSION
..... Headquarters

I

GENERAL

INTRODUCTION

At the beginning of 1960 the Raw Materials Direction of the National Atomic Energy Commission considered the advisability of convening an international Symposium for the purpose of discussing the world's uranium resources and possibilities, in order to: *a)* complete partial data published or submitted (on uranium production, reserves and demand) by different producer or consumer countries; *b)* check the amounts stated in some official and/or unofficial reports, which sometimes did not agree; *c)* compare the methods adopted for evaluating deposits and estimating reserves; *d)* correlate the systems and standards used to express them.

In view of the international importance and the high level of the above mentioned meeting, it was considered that it could be included among the several scientific sessions to be held in Argentina commemorating the Sesquicentenary of the May Revolution. The National Executive Committee of the May Revolution Sesquicentennial, on being asked to support this motion, readily agreed, thus making is economically feasible.

Personal visits and letters sent to the pertinent organization of the main uranium concentrates producers or potential producers and/or consumer countries were favorably received and approved, thus insuring the attendance of outstanding representatives from every country.

The Scientific Sessions were held at the Headquarters of the National Atomic Energy Commission, at Buenos Aires, on November 28, 29, and 30, 1960. Subsequently, from December 2 to 11, the Delegates made a trip to the interior of the country, which included visits to study centers, uranium deposits and uranium mills. After completion of the trip, further visits were made to the CNEA facilities (metallic uranium mill. laboratories, reactor, etc.).

At the opening plenary session, held on the morning of November 28, the officers of the Scientific Sessions were elected, two Sub-committees were established, and their respective Chairmen were appointed.

The same afternoon each Sub-committee began its discussions, which continued on November 29, and both produced their respective reports.

At the closing Plenary Session the reports were submitted. read and put to consideration of the Delegates by the General Rapporteur, Mr. Pedro Stipanicic. The Chairman of the Session, Mr. Jesse Johnson, then read his closing speech.

The conclusions arrived at by the two Sub-committees jointly constituted the general report of the Conference.

A preliminary issue of the report was delivered to each Delegate during the trip to the interior of the country; some of them made additions or corrections and some Delegates considered it convenient to check, in their

respective countries, their own figures or opinions, previous to the official publication of the report.

Once the complete data, additions, corrections, etc., were received in Buenos Aires, the present final report, which is to be publicly distributed (in both Spanish and English), was drafted.

In view of the length of the tape-recorded version of the detailed discussions, it will be published *a posteriori* but not publicly distributed. Distribution will be restricted to the Delegates and the countries or organizations which they represent.

In view of the fact that five different languages (Spanish, Portuguese, English, French, and Italian) were used at the meetings, and because of technical difficulties, there may be some inaccuracies or omissions in the detailed version.

The undersigned wishes to extend, on his own behalf and that of the National Atomic Energy Commission, his sincere gratitude to every one of the foreign institutions which have contributed to the success of the Sessions by sending as their representatives such outstanding and worldwide known scientists. He also wishes to express his thanks to all his overseas colleagues, whose presence and valuable cooperation insured the success of this Conference.

PEDRO N. STIPANICIC
Manager, Raw Materials Direction

OFFICIALS

NATIONAL ATOMIC ENERGY COMMISSION

Directorate

President:

Rear Admiral (retired) Engineer Oscar A. Quihillalt

Directors:

Doctor Eilir Evans Morgan
Brigadier General (retired) Julio Cesar Merediz
Engineer Mario E. G. Bancora
Engineer Rodolfo Bayol

Managements

Managers:

Raw Materials: Doctor Pedro N. Stipanicic
Technology: Profesor Jorge Sabato
Energy: Engineer Celso Papadopulos
Administration: Captain (retired) Accountant Joaquin Urretabizkaya

Delegate of the Investigation Center:

Engineer Enrique Silberman

Chief of Complementary Services:

Commander (retired) Salvador Di Marzio

HONORARY COMMITTEE OF THE SESSIONS

Doctor Arturo Frondizi
His Excellency the President of the Argentine Republic

Doctor Alfredo R. Vitolo
Minister of the Interior, President of the National Executive Commission of the Sesquicentenary of the May Revolution

Doctor Justo P. Villar
Minister of National Defense

Doctor Carlos A. Juni
Secretary of State for Commerce, and Acting Secretary of Industry and Mining

Brigadier General Rosendo M. Fraga
Secretary of State for War

Brigadier General (retired) Ramon A. Abrahin
Secretary of State for Aeronautics

Rear Admiral (retired) Gaston C. Clement
Secretary of State for Navy

Doctor Bernardo A. Houssay
President of the National Council of Scientific and Technical Investigations

ORGANIZING COMMITTEE OF THE SESSIONS

President:

Dr. EILIR EVANS MORGAN, Member of the Directorate of the CNEA

Vice-President:

Eng. VICTORIO ANGELELLI, Advisor to the Presidency of the CNEA

Secretary:

Dr. PEDRO N. STIPANICIC, Manager of Raw Materials of the CNEA

Treasurer:

Captain JORGE DILLON, Sub-Chief, Administration Department of the CNEA

Members:

Mr. JOSE LUIS ALEGRIA, Chief of the Technical Division of Raw Materials Direction of the CNEA

Dr. ENRIQUE ZALDIVAR, Legal Advisor of the CNEA

Eng. CALICRATES J. OJEDA, Chief of the Information Department of CNEA

EXECUTIVE GROUP OF THE SESSIONS

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Dr. PEDRO N. STIPANICIC

Secretary:

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Assistants:

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Mrs. ELENA GRAVES
Miss SHEILA MULLIGAM
Mrs. CYNTHIA F. DE GIMENEZ
Miss ADRIANA IZURIETA
Miss SUSANA MARTORANI

ELECTED OFFICERS OF THE SESSIONS

President:

Eng. JESSE JOHNSON (USA)

Vice-President:

Eng. ROGERIO A. CAVACA (Portugal)

General Rapporteur

Dr. PEDRO N. STIPANICIC (Argentina)

Secretary:

Mr. JOSE LUIS ALEGRIA (Argentina)

SUB-COMMITTEES

Sub-Committee I

President:

Eng. ANTOINE GANGLOFF (France)

Rapporteur:

Eng. VICTORIO ANGELELLI (Argentina)

Members:

Eng. VICTORIO ANGELELLI (Argentina)
Eng. M. G. ATMORE (Union of South Africa)
Eng. RICHARD E. BARRETT (Canada)
Dr. C. B. CAMPBELL (Great Britain)
Eng. JUAN M. DELGADO TAMAYO (Spain)
Eng. FRANCISCO A. ECHAGARAY (Mexico)
Prof. RESK FRAHYA (Brazil)
Eng. ANTOINE GANGLOFF (France)
Eng. THOMAS J. MCCARVILL (USA)
Eng. FABIO PANTANETTI (Italy)
Dr. HANNFRIT PUTZER (Federal German Republic)
Dr. KOSABURO TAKAHASHI (Japan)
Eng. JOHN WEBB (IAEA and Australia)

Sub-Committee II

President:

Mr. ROLAND TURK (Euratom)

Rapporteur:

Dr. EILIR EVANS MORGAN (Argentina)

Members:

Eng. M. G. ATMORE (Union of South Africa)
Eng. RICHARD E. BARRETT (Canada)
Eng. ROGERIO A. CAVACA (Portugal)
Dr. EILIR EVANS MORGAN (Argentina)
Dr. ELIAHU FOA (Israel)
Eng. JESSE JOHNSON (USA)
Eng. JACQUES SORNEIN (France)
Dr. PEDRO N. STIPANICIC (Argentina)
Dr. KOSABURO TAKAHASHI (Japan)
Mr. ROLAND TURK (Euratom)
Eng. JOHN WEBB (IAEA and Australia)

AGENDA

Sub-Committee I

NUCLEAR ORE RESOURCES IN PRODUCING COUNTRIES

A) *Present Reserves*
   1) With present commercial economic value
   2) With eventual possible interest
   3) With present non-economic exploitation

B) *With possible future potential*

C) *Methods adopted for estimating and evaluating resources*

D) *Correlation of systems and standards used to express resources*

Sub-Committee II

PRESENT AND FUTURE REQUIREMENTS
RAW MATERIALS POLICY

A) *Present requirements of the consuming countries*

B) *Estimate of future requirements in the same and in other countries with nuclear programs*

C) *Estimate of ore and concentrates deficit and/or superavit during 1960-1975*

D) *Economic outlook for production and marketing of nuclear ores and their concentrates*
   1) Present concentrate *(yellow cake)* price in different countries
   2) Government and private economy in the production of nuclear ores and concentrates

LIST AND ADDRESSES OF THE OFFICIAL DELEGATES

Argentina

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   Comisión Nacional de Energía Atómica
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   Avda. Lib. Gral. San Martín 8250, Buenos Aires
3. Ing. Victorio Angelelli
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Division of Raw Materials
United States Atomic Energy Commission
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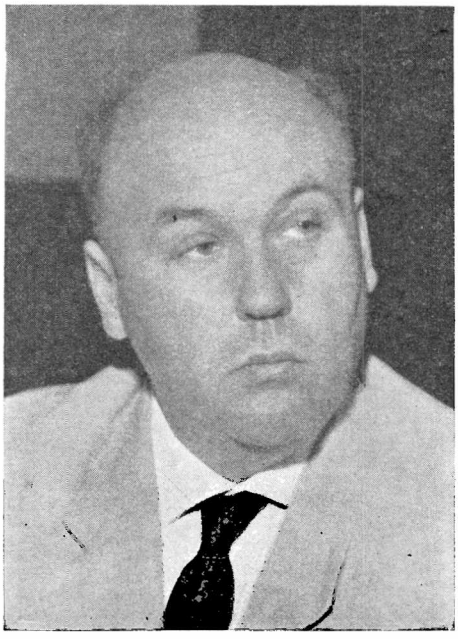

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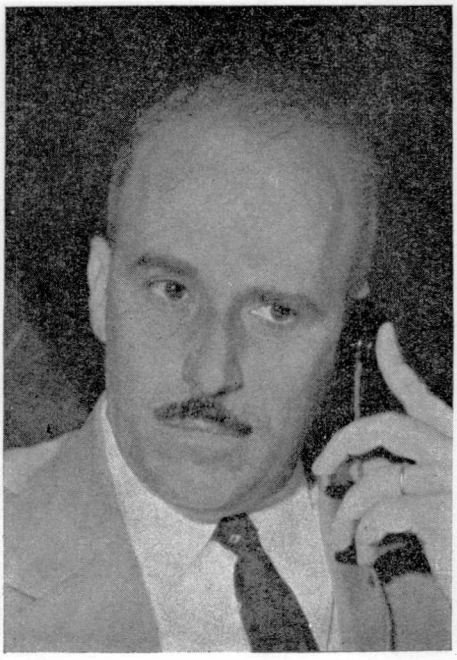
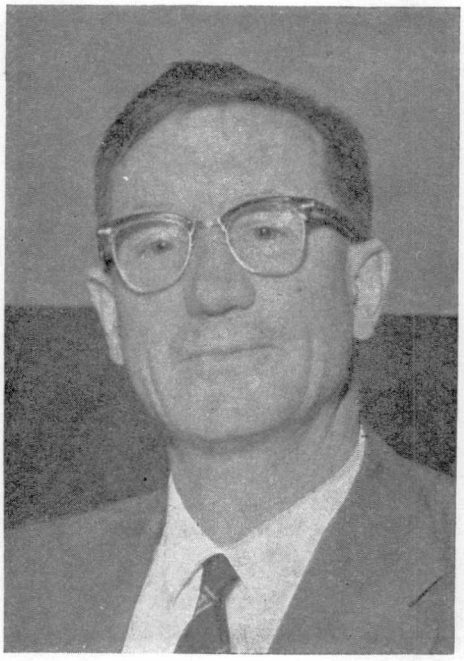
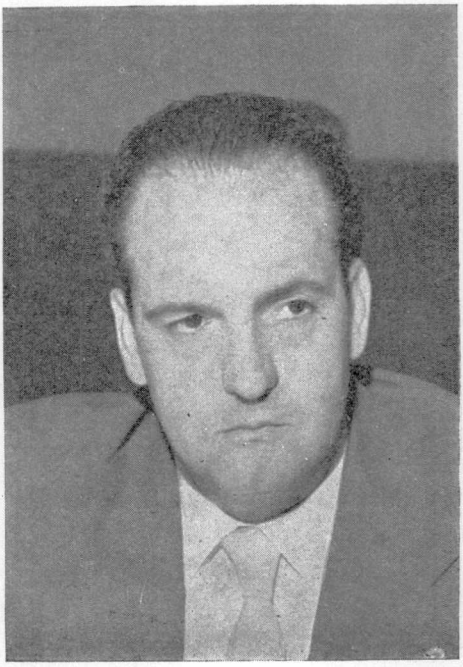
Australia and OIEA



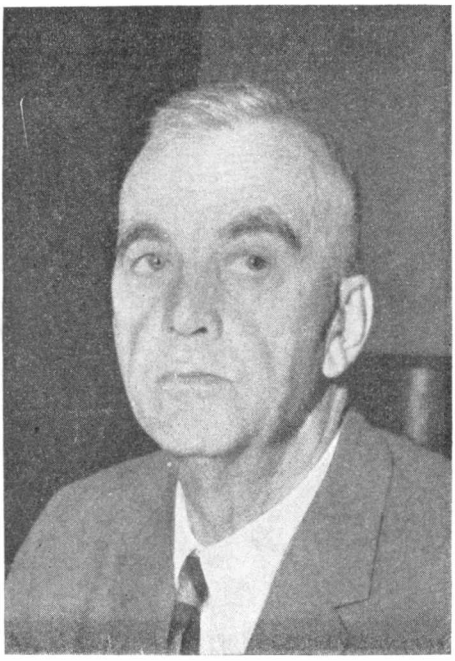
Prof. RESK FRAHYA
Brazil



Eng. RICHARD BARRETT
Canada



Eng. JUAN MARTIN DELGADO TAMAYO
Spain



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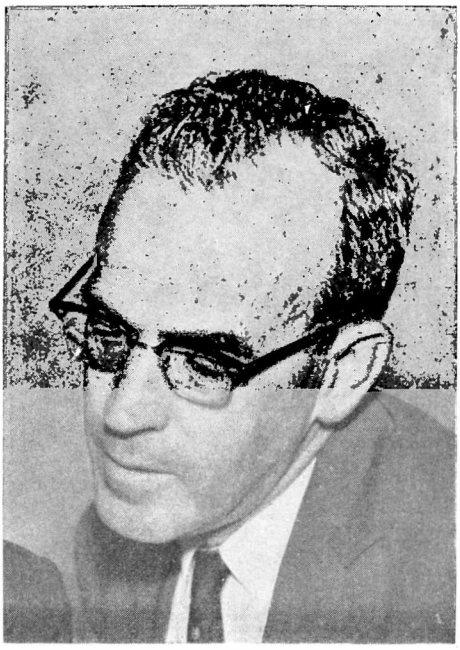

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Mr. Roland Turk
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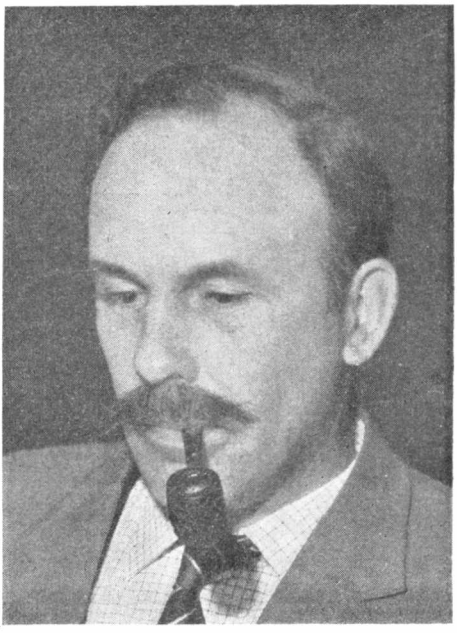

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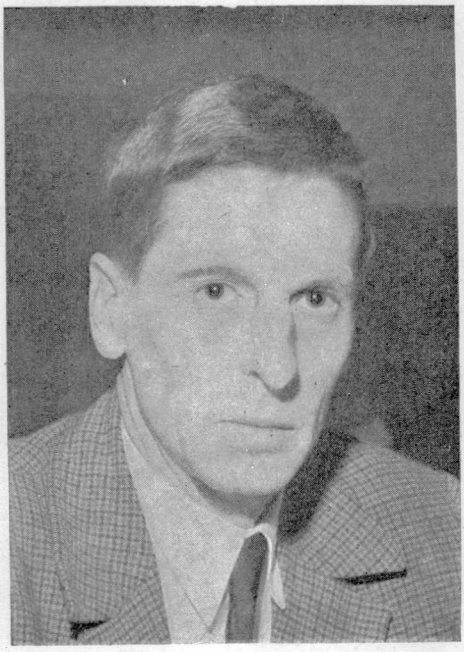

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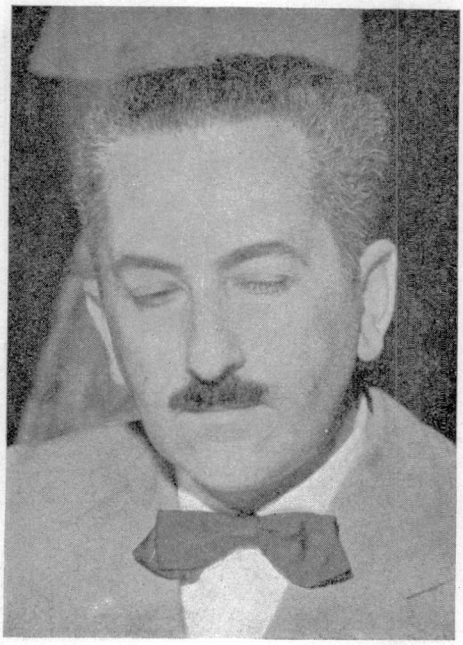

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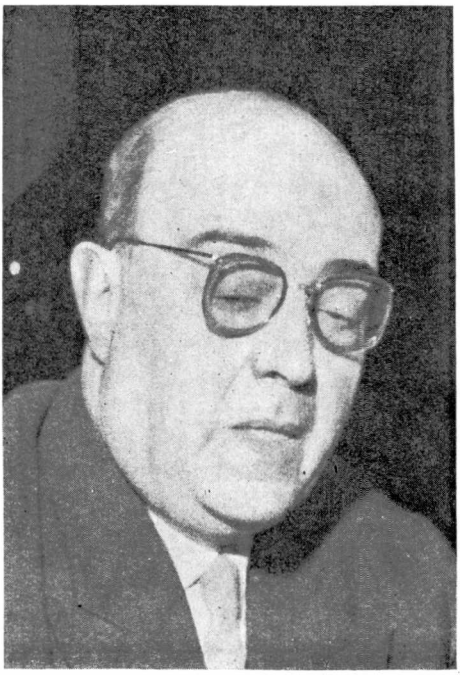


Eng. ROGERIO A. CAVACA
Portugal

Dr. M. G. ATMORE
Union of South Africa

SCHEDULE COMPLETED

November 28 (Monday)

9.30 a.m. to 10.30 a.m.:	Opening session, Conference Hall of the CNEA. a) Speech of welcome to the Delegates by Chairman of the Organizing Committee, Mr. EILIR EVANS MORGAN. b) Opening speech by the President of the National Atomic Energy Commission, Rear Admiral Engineer OSCAR A. QUIHILLALT.
11.00 a.m. to 12.00 a.m.:	Plenary Session. a) Election of the Officers for the Scientific Sessions (President, Vice President), General Rapporteur and Secretary). b) Election of the two Sub-Committee and election of their respective Officers (Chairmen and Rapporteurs). c) Speech by the elected President, Mr. JESSE JOHNSON.
12.15 p.m. to 1.15 p.m.:	Cocktail party in honor of the Delegates by CNEA.
3.45 p.m. to 6.30 p.m.:	Meeting of the Sub-Committees. Sub-Committee I: Conference Hall of the CNEA. Sub-Committee II: Library of the CNEA.
9.00 p.m.:	Dinner offered by the President of the CNEA to the foreign Delegates, and diplomatic representatives of their countries, at the Club House of the Palermo Golf Course.

November 29 (Tuesday)

9.30 a.m. to 12.00 a.m.:	Meetings of the Sub-Committees. Sub-Committee I: Conference Hall of the CNEA. Sub-Committee II: Library of the CNEA.
3.30 p.m. to 6.30 p.m.:	Joint assembly: resolutions on subject submitted by the Sub-Committees.

November 30 (Wednesday)

8.00 a.m. to 11.00 a.m.:	Drafting of the Final Report of the Conference.
11.00 a.m. to 11.45 a.m.:	a) Reading of the Final Report of the Sessions, by the General Rapporteur Mr. PEDRO N. STIPANICIC. b) Discussion and approval of the Final Report.
11.45 a.m. to 12.15 p.m.:	Closing speech by the President of the Sessions, Mr. JESSE JOHNSON.
12.30 p.m. to 1.30 p.m.:	Trip from CNEA Headquarters to Ezeiza.
1.30 p.m. to 3.30 p.m.:	Criollo lunch at CNEA's plant at Ezeiza.
3.30 p.m. to 4.30 p.m.:	Visit to CNEA's plant for preparation of metallic uranium at Ezeiza.
4.30 p.m. to 5.15 p.m.:	Trip from Ezeiza plant to Constituyentes.
5.15 p.m. to 6.15 p.m.:	Visit to CNEA's facilities at Constituyentes (Reactor, Metallurgy & Hydrometallurgy Laboratories).

December 1 (Thursday)

9.30 a.m. to 10.00 a.m.:	Meeting with CNEA's authorities.
10.00 a.m. to 12.00 a.m.:	Visit to facilities at CNEA headquarters (Raw materials, physics and chemistry laboratories, cyclotron, etc.).
Afternoon:	Free.

December 2 (Friday)

3.30 p.m. to 5.30 p.m.:	Flight from International Airport at Ezeiza to Bariloche (Rio Negro) by Comet IV of Aerolineas Argentinas. Lodging at Tunquelen Hotel.
9.00 p.m.:	Dinner attended by the Delegates, guests and authorities of the Bariloche Atomic Center.

December 3 (Saturday)

9.00 a.m. to 12.00 a.m.:	Visit to Bariloche Atomic Center.
12.30 p.m. to 3.00 p.m.:	Lunch at the B.A.C.
Afternoon:	Free (Sightseeing at Bariloche's environs "Small circuit").

December 4 (Sunday)

Free:	Boat excursion at Nahuel Huapi Lake. Lunch at Isla Victoria.

December 5 (Monday)

8.00 a.m. to 12.00 a.m.:	Visit to Cerro Otto.
12.00 a.m. to 2.00 p.m.:	Lunch at Bariloche.
3.00 p.m. to 7.00 p.m.:	Flight from Bariloche (Rio Negro) to Malargüe (Mendoza), Argentine Air Force DC-3 plane.
7.30 p.m. to 8.30 p.m.:	Visit to Malargüe Pilot Plant for processing of uranium ore.
9.00 p.m.:	Lodging at Turismo Hotel, Malargüe.
9.30 p.m.:	Dinner with authorities and technical experts of Cuyo Branch and Malargüe Plant.

December 6 (Tuesday)

7.30 a.m. to 8.30 a.m.:	Trip from Malargüe to the Huemul and Agua Botada mines.
8.30 a.m. to 11.00 a.m.:	Visit to Huemul and Agua Botada Mines.
11.00 a.m. to 12.00 a.m.:	Trip from the mines to Malargüe.
12.30 p.m. to 2.30 p.m.:	Lunch at Hotel de Turismo, Malargüe.
3.00 p.m. to 4.30 p.m.:	Flight Malargüe-Mendoza, by Argentine Air Force DC-3 plane.
4.30 p.m. to 5.00 p.m.:	Loading fuel for plane at Mendoza.
5.00 p.m. to 7.00 p.m.:	Flight from Mendoza to Cordoba, Argentine Air Force DC-3 plane.

7.00 p.m. to	8.15 p.m.:	Trip from Pajas Blancas Airport (Cordoba) to Carlos Paz.
	8.15 p.m.:	Lodging at Hotel Castell (Carlos Paz).
	9.00 p.m.:	Dinner with authorities and technical experts of Seccional Centro and ore treatment plant (Fabrica Cordoba).

December 7 (Wednesday)

8.30 a.m. to	9.00 a.m.:	Trip from Carlos Paz to the "Cerro Blanco" deposit.
9.00 a.m. to	9.45 a.m.:	Visit to the "El Criollo" pegmatite deposit.
9.45 a.m. to	10.15 a.m.:	Trip from Cerro Blanco to Cosquín.
10.45 a.m. to	12.00 a.m.:	Visit to the "Rodolfo" uraniferous deposit.
12.30 p.m. to	3.00 p.m.:	Lunch at the Costanera Hotel (Cosquin).
3.00 p.m. to	4.30 p.m.:	Trip from Cosquin to Cordoba.
4.30 p.m. to	7.00 p.m.:	Visit to CNEA's Cordoba plant (uranium ore treatment).
	8.00 p.m.:	Lodging at the Crillon Hotel (Cordoba).
	9.30 p.m.:	Dinner at "La Revoltosa" restaurant.

December 8 (Thursday)

9.15 a.m. to	12.55 p.m.:	Part of the Delegates made the trip from Cordoba to Salta, on board a Transcontinental Super Commuter plane.
10.30 a.m. to	1.30 p.m.:	The remaining Delegates made the trip in an Aerolineas Argentinas DC-4 plane.
	1.30 p.m.:	Lodging at the Hotel de Turismo (Salta).
	1.30 p.m.:	Lunch at the Hotel de Turismo.
	Afternoon:	Free.

December 9 (Friday)

6.30 a.m. to	11.00 a.m.:	Car drive to the Valle del Tonco, through Quebrada de Escoipe and Cuesta del Obispo.
11.00 a.m. to	1.00 p.m.:	Visit to "Don Otto" deposit.
1.00 p.m. to	2.00 p.m.:	Return to the camp.
	2.00 p.m.:	Lunch at the camp.
	Afternoon:	It rained so hard that the scheduled visit to the "Martin M. de Güemes" deposit was canceled.
4.00 p.m. to	9.30 p.m.:	Return trip to Salta.

December 10 (Saturday)

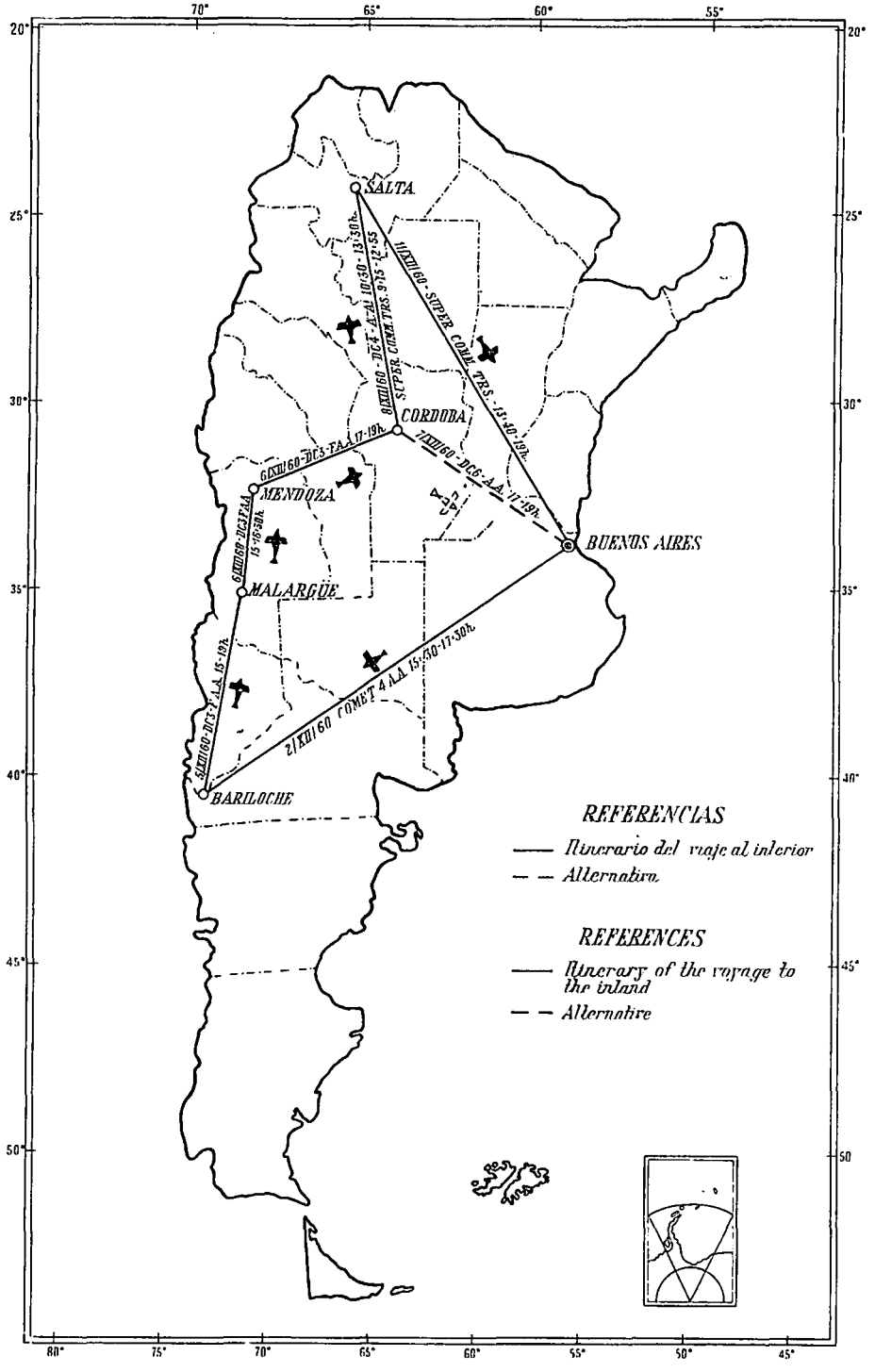
Morning:	Free.
Afternoon:	Visit to the offices of Seccional Norte.
Evening:	Folklore entertainment at the "Gauchos de Güemes" Club.

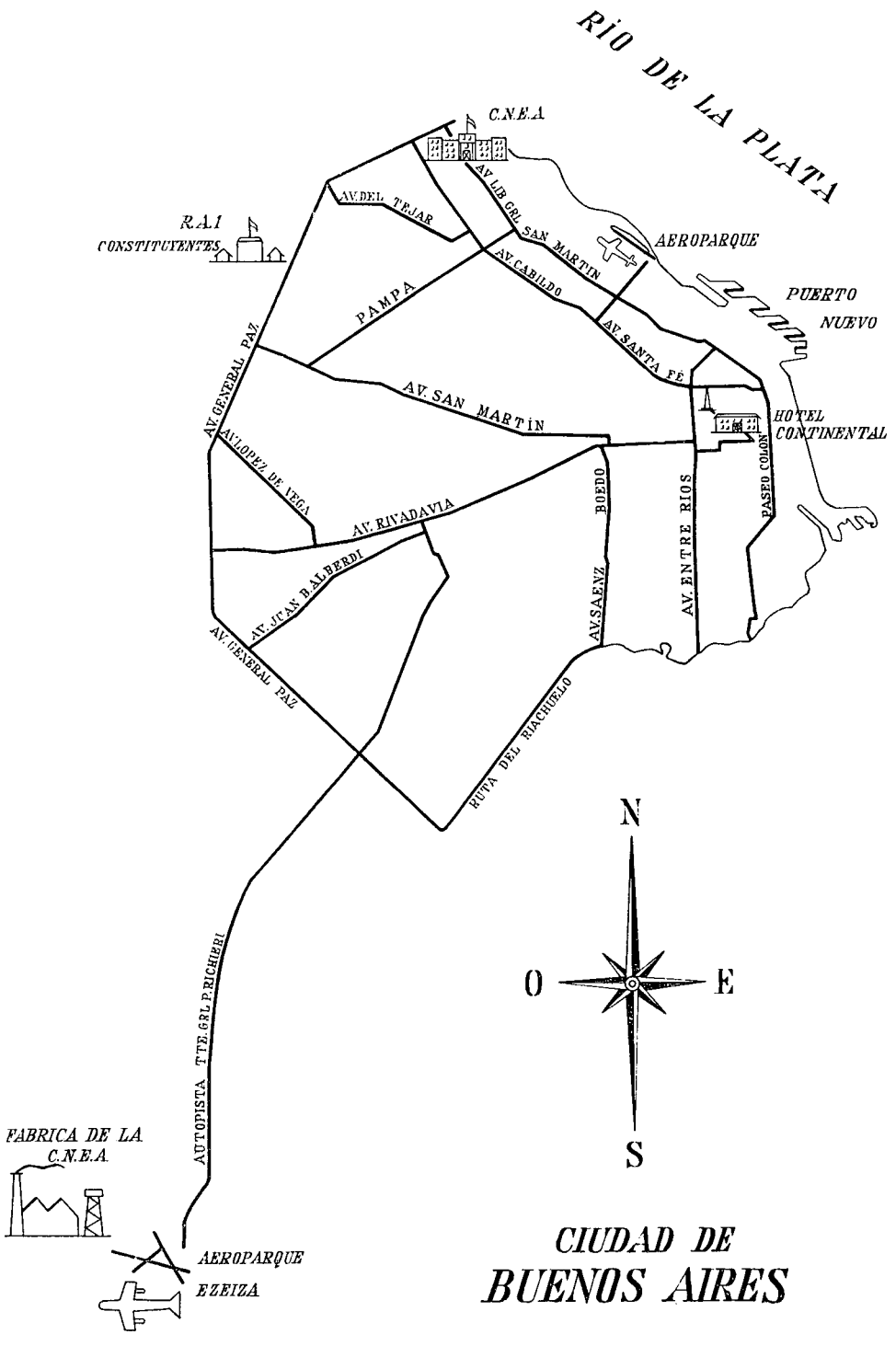
December 11 (Sunday)

1.40 p.m. to	7.00 p.m.:	Flight Salta - Buenos Aires, by Transcontinental Super Commuter plane.

December 12 (Monday)

Morning:	Individual visits to CNEA's President.


SALTA
CORDOBA
MENDOZA
MALARGÜE
BARILOCHE
BUENOS AIRES
REFERENCIAS
Itinerario del viaje al interior
Alternativa
REFERENCES
Itinerary of the voyage to the inland
Alternative


RÍO DE LA PLATA
C.N.E.A.
AV. DEL TEJAR
AV. LIB. GRL. SAN MARTIN
AEROPARQUE
R.A.I.
CONSTITUYENTES
AV. CABILDO
PUERTO
NUEVO
PAMPA
AV. SANTA FÉ
AV. GENERAL PAZ
AV. SAN MARTIN
HOTEL
CONTINENTAL
AV. LOPEZ DE VEGA
AV. RIVADAVIA
BOEDO
PASEO COLON
AV. JUAN B. ALBERDI
AV. SAENZ
AV. ENTRE RIOS
AV. GENERAL PAZ
RUTA DEL RIACHUELO
AUTOPISTA TTE. GRL. P. RICHIERI
N
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E
S
FABRICA DE LA
C.N.E.A.
AEROPARQUE
EZEIZA
CIUDAD DE
BUENOS AIRES

WELCOMING SPEECH TO THE FOREIGN DELEGATES BY DR. EILIR EVANS MORGAN

Representative of His Excellency the Secretary of Navy;
Representative of His Excellency the Secretary of War;
National Director of Geology and Mining;
Diplomatic Representatives and Foreign Delegates:

The Argentine Republic celebrates the 150th anniversary of the May Revolution. It is my understanding that with the series of cultural, artistic, scientific, and technological meetings held in our country, we not only wish to express our patriotic rejoicing but also to present before our own and foreign eyes a balance of our accomplishments, and thus be able to judge to what extent we have fulfilled the historic mandate of the founders of our national destiny.

As Chairman of the Organizing Committee of the Scientific Sessions on "Uranium Resources and Possibilities", it is my pleasure to acknowledge the decided and generous aid given by the Executive Committee of the Sesquicentenial of the May Revolution and, in particular, of the Sub-Committee on Scientific and Technological Matters, which has enabled the National Atomic Energy Commission to materialize a longstanding desire. We are sure that due to this being the first international meeting on nuclear raw materials, the transcendency of the subjects to be discussed, and the prestige of the participating Delegates, success will accompany us and that these Sessions will always be remembered in conjunction with the Sesquicentennial we now celebrate.

We extend our most heartfelt welcome to the Delegates. They come from countries which profess to the same cult of liberty and fraternity as our people so we know that, notwithstanding their short stay, they will not feel as strangers among us.

I now invite the President of the National Atomic Energy Commission, Rear-Admiral Oscar A. Quihillalt, to inaugurate the Sessions on "Uranium Resources and Possibilities".

INAUGURATION SPEECH OF THE SCIENTIFIC SESSIONS, BY THE PRESIDENT OF THE NATIONAL ATOMIC ENERGY COMMISSION REAR-ADMIRAL (RETIRED) ENGINEER OSCAR A. QUIHILLALT

Diplomatic Representatives of foreign countries;

Foreign and National Delegates;

Ladies and Gentlemen:

As President of the Board of Directors of the National Atomic Energy Commission, an institution which has originated and organized —with the moral and economic support of the Executive Committee of the Sesquicentennial of the May Revolution— these Sessions on "Uranium Resources and Possibilities", I wish to express my gratitude for your presence, in this case a presence which adds prestige and dignity to this simple inaugural ceremony. I am sure that your gesture will sensibly influence the spirit of all the Delegates, as it expresses the Argentine feeling concerning the importance and transcendence we assign to the coming discussions.

We have with us the representatives of two international organizations, and 15 countries which are the world leaders in the investigation and application of nuclear energy for peaceful purposes. They are:

For the International Atomic Energy Agency: Engineer JOHN WEBB.

For Euratom: Doctor ROLAND TURK.

For the German Federal Republic: Doctor HANNFRIT PUTZER.

For Australia: Engineer JOHN WEBB.

For Brazil: Profesor RESK FRAHYA.

For Canada: Engineer RICHARD E. BARRETT.

For Spain: Engineer JUAN M. DELGADO TAMAYO.

For the United States of America: Engineers JESSE JOHNSON and THOMAS MCCARVILL.

For France: Engineers JACQUES SORNEIN and ANTOINE GANGLOFF.

For Italy: Engineer FABIO PANTANETTI.

For Great Britain: Doctor C. B. CAMPBELL.

For Japan: Doctor KOSABURO TAKAHASHI.

For Mexico: Engineer FRANCISCO A. ECHAGARAY.

For Portugal: Engineer ROGERIO A. CAVACA.

For South Africa: Doctor M. G. ATMORE.

And finally, our country will be represented by Doctor EILIR EVANS MORGAN, Doctor PEDRO N. STIPANICIC and Engineer VICTORIO ANGELELLI.

The Delegates of the said countries and organizations, which in total only reach the relatively small number of 20 persons, constitute a most select group of specialists —most of them of international renown— in the procurement and supply of nuclear raw materials. We are highly honored that they have assembled for the first time in our premises.

We are convinced that these Sessions will be crowned with success not only on account of the importance of the subjects to be discussed and the interest in the results to be obtained, but also on account of the unusual background of the participants. They belong to that great international brotherhood composed of prospectors, geologists, mining engineers, and some public officials who, without possessing the necessary titles, have been able to pass an intangible test that permits them to become part of a family from which they cannot be separated.

These men, accustomed to continuous contact with Nature in its friendly and hostile expressions, men who have confronted similar hardships and risks in geological exploration and mining work, who have had the same disillusionments and failures and also, although on a lesser scale, the same happiness and success, have had their spirit molded and their character tempered by common experiences, resulting in a strange mixture of poetic lyricism and cold practical materialism.

This is why we are sure that the Delegates will reach a rapid understanding and obtain concrete results, without the differences in nationality, race, religion, or language being major obstacles.

The investigations in search of uranium were started during the Second World War, as an absolute necessity for the so-called Manhattan Plan.

A relatively small group of specialists that, for obvious reasons, hid their identity and purpose, began the study and exploitation of the few uraniferous occurrences mentioned in the bibliography.

With peace obtained, it was evident that the liberation of nuclear energy offered humanity a field of far-reaching possibilities for peaceful uses, and whose future potential is difficult to surmise even today. Nearly all of the countries of the world, and among the first is ours, with full knowledge of the influence the intensive employment of nuclear energy would have on the social, economic, and politic spheres of the countries involved, created state organizations that, among other functions, should be actively engaged in the search for, and exploration and exploitation of, nuclear raw materials, particularly uranium.

This policy of the Governments, jointly with the valuable assistance of private persons, has resulted in the most surprising results ever registered in the history of extractive industries.

In effect, the known uranium reserves at the end of the last World War were extremely modest, but their value has increased to such a surprising amount that today it can be said it took only 15 years to reach the point that other metals required centuries to attain.

With the increase in rhythm impressed on the activities of prospecting, exploration, and exploitation for uranium in the world, there has been a parallel isolation of those responsible for these tasks in different countries.

It is the intention of these Sessions, in the first place, to obtain full knowledge of the existing reserves of uranium and the possible future potential, as well as to standardize methods and systems for estimating and evaluating the same. In spite of the magnitude of the uranium reserves in the world, there are but few countries which have the capacity for economic production.

These Sessions will also attempt to determine the present demand for uranium and that anticipated in the near future, as well as the situation that will be faced by the countries with excess production, and those which do not have their own reserves.

The National Commission of Atomic Energy has considered it of fundamental importance to promote a discussion on these questions since, given the particular situation of the country as a potential producer of uranium on an appreciable scale, it has the responsibility to correctly advise the Executive Power on measures tending to better express our policy in this matter, and thus to affirm and develop the actual situation which we consider to be a privileged one.

These Sessions are included in functions that the National Government, interpreting the feeling of all Argentines, has wished to celebrate in connection with the Sesquicentennial of the May Revolution. One hundred and fifty years ago the peoples of America pinned their hopes on the success of marvelous warlike exploits that would permit the enjoyment of precious liberty. When attained, the resources of the country were channeled toward the full enjoyment of such liberty by means of a progressive increase in the spiritual and material level of life for its inhabitants. This has been and continues to be a difficult task.

The National Commission of Atomic Energy, by means of constant labor of its scientists and technicians in the development of multiple peaceful applications of nuclear energy, is certain to contribute effectively to the quick attainment of the grand final objetive.

Distinguished foreign guests:

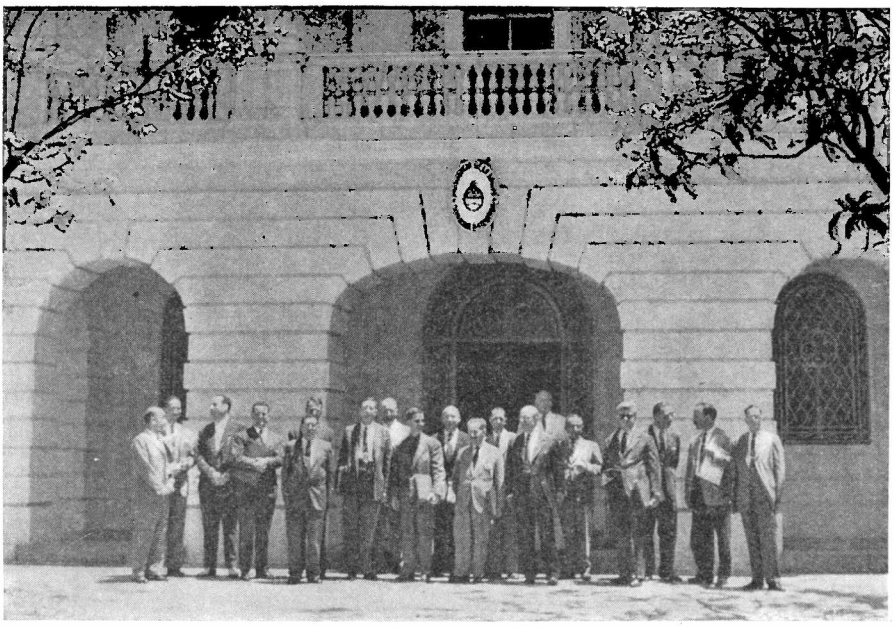
You will work and collaborate with us, contributing with your effort and knowledge to this marvelous task of progress which science and technique have already begun. It foresees a magnificent reward to your noble labor: to build a much better, more beautiful, and happier world.

It remains for me only to give you once more a hearty welcome and to wish you success on the task you are about to fulfill.

Ladies, Gentlemen:

I have the high honor to declare officially inaugurated the Scientific Sessions on "Uraniferous Resources and Possibilities".

Many thanks.



Foreign guests joined in front of National Atomic Energy Commission's Headquarters.

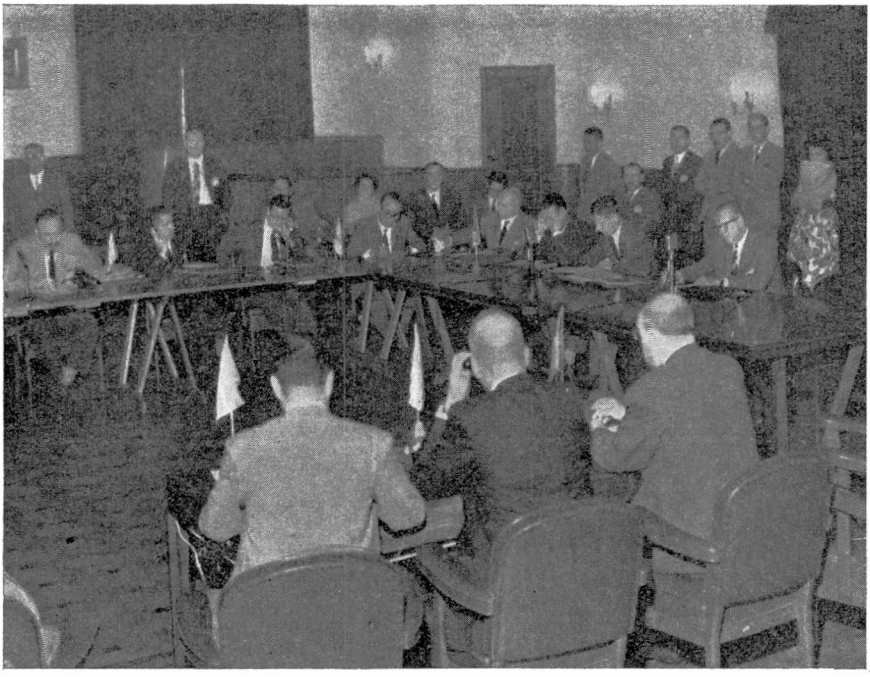
Admiral Engineer Oscar A. Quihillalt, President of National Atomic Energy Commission pronounces the inaugural speech for the Scientific Sessions.

Dr. EILIR EVANS MORGAN, as President of the Organizing Commission of the Scientific Sessions delivers the welcome speech to the foreign guests.

The appointed authorities of the Sessions: (left to right): Eng. ROGERIO A. CAVACA, of Portugal (Vice-president); Eng. JESSE JOHNSON, of USA (President); Dr. PEDRO N. STIPANICIC, of Argentina (General Rapporteur) and Mr. JOSE LUIS ALEGRIA, of Argentina (Secretary).
Eng. JESSE JOHNSON leads the plenary Meeting.

The General Rapporteur, Dr. Pedro N. Stipanicic reads the Sessions' Final Report.

Eng. Jesse Johnson, President of the Sessions, pronounces the Conference's concluding speech.



Eng. ANTOINE GANGLOFF submits the Report of Sub-committee I to the consideration of the delegates.

Engineers ANTOINE GANGLOFF (France), VICTORIO ANGELELLI (Argentina), THOMAS MCCARVILL (USA) and JUAN MARTIN DELGADO TAMAYO (Spain) adjust the text of Sub-committee I's Report.

II

GENERAL REPORT OF THE SESSIONS

II. 1.

Final Reports of the Sub - Committees

By the General Rapporteur

Mr. PEDRO STIPANICIC

(Argentina)

This International Conference was convened for the purpose of disscussing *"Uranium Resources and Possibilities"*.

Since two distinct subjects were involved, the Conference was divided into two working groups. Sub-Committee I considered *"Uranium Resources"* and Sub-Committee II dealt with *"Present and future uranium production and requirements"*.

The reports of the two Sub-Committee and the closing speech of the President, together, constitute the General Report of the Conference.

REPORT OF SUB-COMMITTEE I

Sub-Committee I decided that its purpose would be better served by drawing up a composite tabulation, as complete as possible. of the uranium reserves of the countries represented at this Conference.

The need of standardizing, as far as possible, the criteria destined to define the various categories of reserves in each of the countries was at once apparent.

From the *technical* point of view, the classification of the various categories of reserves depends upon:

a) *The degree of refinement involved in the methods of assessing the deposits.*

b) *The standards adopted in applying the quantitative data obtained in assessment work.*

Depending on the reliability of the methods and the validity of the interpretations made, it is possible to classify the reserves into several classes, each characterized by the degree of precision and its probability of existence. In this respect different terminologies may be used; the meanings of those which have been mentioned during this session are more or less technically comparable.

However, it has been proposed that definitions used by the United States Atomic Energy Commission should be adopted for each of the categories, in order to arrive at a better standardization. These definitions have already been published and were brought to our attention during the Conference. They apply equally well to the different classes of deposits, namely: "Measured Ore", "Indicated Ore" and "Inferred Ore", which categories are included in the term *"Reserves"*. In regard to the *"Potential"* category, evaluations have sometimes been based on analogy of geological characteristics between countries which are widely separated. The inherent weakness of such extrapolations should be borne in mind.

These standards have been adopted, and it is strongly recommended that they be uniformly applied, now and in the future, in order to have a common language for discussion of reserves.

The methods by which the data from prospecting operations are obtained, will serve to define the measured ore and consist either in the application of traditional simple methods commonly used in the mining industry and eventually corrected by experience in a given district, or by using the methods of statistical calculations. The latter have the advantage of giving indications of the probable existence of a certain tonnage, and of allowing for the exact evaluation in advance of the tonnages in ore and metal yielded by a block of ground *(Cut-off)*.

However, these technical aspects, insofar as they appear to be generalized. cannot be divorced from *economic considerations*. The latter must also be standardized. The most reliable and the quickest way to achieve this is to refer all the reserves to a standard price for the recoverable concentrate. The standard price which has been adopted as a yardstick is that of one pound of uranium oxide (U_3O_8), which is set at present at U$S 8 to 10.

We should distinguish clearly one category which includes ore whose cost is less than U$S 8 to 10 —*"reserves"*— and another which includes ore of a higher cost. The latter can only be considered in the *"potential"* category; they would only be classed as *"reserves"* in the event of an increase in the price of uranium or through technological improvements.

Furthermore, the above considerations imply that the material classed as "reserves" should be exploitable, or treatable on an industrial scale, with recoveries which conform to normally acceptable standards.

In the light of the foregoing remarks, we tried to establish a table as representative and homogeneous as possible, with the help of data supplied by each delegate in respect to his own country.

A few points should be explained regarding this table:

1. We limited its scope to the countries represented at this Conference; the table does not, therefore, present a global picture of world resources, particularly in regard to the omission of countries like Sweden and those states comprising the Soviet Bloc. We did not overlook these additional resources, but in the absence of authentic data, and in order to avoid the inclusion in the table of indeterminate figures, perhaps too high, we decided to omit them altogether.

2. Notwithstanding the effort of all the delegates, there may well be some heterogeneous features in the table.

It seems necessary to recommend that the countries represented should continue to apply in the future the standards which have been adopted in this Conference, which are of an economic as well as a technical nature. Such standardization would facilitate all future exchanges of information concerning ore reserves.

RESOURCES

Division of categories

A) "RESERVES". Included in this category are minerals from which uranium can be extracted and concentrated at a price not exceeding U$S 8 to 10 per pound of U_3O_8.

This price *includes mine operating costs, transport and treatment costs, as well as amortization of equipment, machinery, etc.*

The tonnage and grades must conform to the classes of reserves defined in the classification adopted.

B) "POTENTIAL". In this category, there are two sub-divisions:

1) Material considered to contain uranium that could be extracted and concentrated for an inclusive price not exceeding U$S 8 to 10 per pound of U_3O_8.

1) That for which the total cost would exceed U$S 10 per pound of U_3O_8.

The quantities included in the "POTENTIAL" category should be added to "RESERVES".

TABLE I

Country	A) *"Reserves"* Costs < U$S 8-10/lb. U_3O_8		B) *"Potential"*			
			Costs < U$S 8-10/lb. U_3O_8		Costs > U$S 10/lb. U_3O_8	
	Metric ton U	Short ton U_3O_8	Metric ton U	Short ton U_3O_8	Metric ton U	Short ton U_3O_8
1. *Argentina*	550	720	no data (1)	no data (1)	2.100 (2)	2.700 (2)
2. *Australia*	7.700	10.000	no data (3)	no data (3)	1.500	2.000
3. *Brazil*	440	580	no data	no data	4.250	5.500
4. *Canada*	300.000	385.000	no data (4)	no data (4)	no data (4)	no data (4)
5. *France*	50.000	65.000	no data (5)	no data (5)	20.000	25.000
6. *Germany*	170	220	no data	no data	no data	no data
7. *Italy*	3.850	5.000	4.000	5.200	no data	no data
8. *Japan*	1.000	1.300	no data	no data	no data	no data
9. *Mexico*	1.000	1.300	no data	no data	no data	no data
10. *Portugal*	4.200 (6)	5.500 (6)	no data (7)	no data (7)	min. 13.000 (8)	min. 16.500 (8)
11. *Rhodesia (Fed.)* ..	—	—	—	—	45	50
12. *Spain*	1.450	1.880	no data (9)	no data (9)	no data	no data
13. *South Africa*	285.000	370.000	(10)	(10)	no data	no data
14. *USA*	184.000	240.000	308.000	400.000	4.620.000 (11)	6.000.000 (11)

(1) Excellent possibilities in wide sedimentary areas with known uranium occurrences. Up to the present, less than 10 % of the area with possibilities has been prospected.

(2) These figures include measured, indicated, and inferred ores, with 300-500 g/t U_3O_8. The "geological potential" is not considered.

(3) Infinite possibilities which will depend upon present and future prospecting.

(4) Its possibilities will depend upon prospecting of new areas.

(5) At present.

(6) Portugal will only complete the prospecting program in its metropolitan area around the middle of 1962. Consequently, figure on reserves that would express the real potential of the country cannot be present and those furnished refer only to deposits surveyed up to the present, and have a provisory character.

(7) There are very good possibilities, that will rely on the conclusions of the studies of current detail and on the prospection that is being carried into effect beyond the sea in favorable geological areas.

(8) Contained in phosphatic rocks.

(9) There exist potential reserves in deposits already discovered, on which no figures are given because these are being investigated and evaluated. There also exist the possibility of new discoveries in areas of geological interest.

(10) Can be slightly increased with the discovery of new gold mines.

(11) Of which amount, 5.400.000 s.t. are contained in black shales and phosphatic rocks.

REPORT OF SUB-COMMITTEE II

Demand and Availability

The points stated on the agenda of Sub-Committee II apply generally to the period 1960-1975. In the course of this work, the Sub-Committee agreed unanimously that a comparison between demand and availability could not be made for such a long period ahead.

It is the Sub-Committee's considered opinion that the various points of the agenda can be projected usefully only for the period 1960-1966, as the further evolution of the market and the importance of nuclear energy developments is largely depending on technical improvements, industrial and financial possibilities, and on cost compared with energy by conventional production methods.

The comparison of availability and demand in accordance with points A, B, and C is shown on Tables II and III.

Present Prices

The recent trend tends towards a price of about U$S 8 a pound of U_3O_8. Several other prices were mentioned up to U$S 10 and more, and also much lower prices on small sales have been reported, going down to about U$S 5 a pound.

The general feeling is that a price of about U$S 8 and an assured market would be required to justify opening new mines of the type generally being worked today.

After the fulfilment of current contracts the Sub-Committee agrees that supply will exceed demand until about 1970 or possibly as late as 1975, at which time it is expected that the demand for nuclear power developments will be appreciable. Until then some producers may be forced to suspend operations and in this period excessive competition will force prive below the level at which many present producers can economically operate. These mines would probably not be reopened until prices advance to about U$S 8 per pound of U_3O_8.

It is the general feeling that, as prospecting has only brought few major new discoveries in the last few years, *the cost of exploration in the future is likely to be higher.*

STATE AND PRIVATE POLICIES IN THE PRODUCTION OF NUCLEAR ORE

In reference to this subject, the practices vary from one country to another according to the particular situation, but it seems that a general trend exists to permit private industry to participate to a growing extent in the various Government programs.

TABLE II

ESTIMATED U_3O_8 PRODUCTION

in the period 1960-1966

Country	*Year*	*Production* U_3O_8 (short tons)	*Capacity* (yearly) (short tons)	*Observations*
Argentina	1960 1961 1962 1963 1964 1965 1966	10 5 15 50 (1) 50 50 50		(1) Production related to the operation of the new Malargüe Mill.
Australia	1960 1961 1962 1963 1964 1965 1966	(2) 1,000 1,000 800 600 600 500 500		(2) These figures are based on firm contracts, some of which expire during the period under review. Production may be greater, depending upon new contracts or sales, up to a total capacity of 1,000 s.t. per anum.
Canada	1960 1962 1964 1966	(3) 12,000 8,370 3,500 1,100	(contracts) 16,000	(3) The figures given indicate the production necessary to satisfy existing commitments and do not include any other sales which may be made.
Israel		Small (4)		(4) As subproduct, from phosphates.
Japan		None		
OECE (Western Europa)	1960 to 1966	17,000 (5) (total)	France: 2,300 Others: 250/300	(5) France: 14,500 s.t. Others: 2,500 s.t.
Portugal	1960 1961 1962	(6) 120 120 60		(6) Contracts.
South Africa	1960 1961 1962 1963 1964 1965 1966	(7) 6,200 6,200 6,200 6,200 about 5,000 about 4,000 about 3,000	7,200 6,000/7,000	(7) The figures given indicate the production necessary to satisfy existing commitments and do not include any other sales which may be made.
Spain	1960 1961 1962 1963 1964 1965 1966	(8) 66 72 72 72 72 72 72		(8) Production related to the expected operation of Andujar Mill for the period 1960-1966.
USA	(9)	17,000 (9)	22,000	(9) Average annual production in the period 1960-1966.

TABLE III

ESTIMATED U_3O_8 CONSUMPTION

in the period 1960-1965

Country	*Year*	*Consumption* (short tons)	*Observations*
Argentina	1960 1963	10	
Canada	1960 1965 1970	100 200 max. 500	
Japan	1960 to 1975	total 1,000	
OECE	1960 1966 1967/68	total 23,000 (1) yearly 5,000 (2)	(1) Of which, 3,000 s.t. as enriched form. (2) Probable.
South Africa	After 1964/65	10-50	
Spain	1960 1961 1962 1963 1964 1965 1966	11.0 (3) 5.5 2.2 13.2 4.4 4.4 4.4	(3) There is a firm plan for the installation of a semi-industrial reactor before 1966 but no consumption figures are given because, as yet, the type of the reactor to be installed has not been decided upon.
USA	1960	34,000 (4)	(4) Purchased 1960.

II. 2.

Closing Speech

By the President

Mr. Jesse Johnson

(USA)

The Conference report deals only with near-term uranium production and market potentialities. For this period, from now to the end of 1966, we have reasonably firm data. Beyond that we enter the realm of forecasts. These are so much a matter of individual opinion that it would be difficult for this Conference, in the brief time available, to arrive at forecasts which would represent the view of all the Delegates.

However, all the Delegates are looking beyond this present period in which atomic power is in the developmental stage. Therefore, I should like to address my closing remarks more to the future than to the present, recognizing fully the danger in making predictions.

The problem facing uranium producers is the uncertainty as to when there will be an atomic power market commensurate with present uranium production capabilities. The military demand has leveled off, and the anticipated requirement for atomic power will not materialize as soon as was expected. The two present principal buyers of uranium, the Unites States and the United Kingdom, have been endeavoring to reduce near-term deliveries under existing contracts through stretch-out arrangements. Although uranium producers have received a number of inquiries from other countries, so far no important orders have been placed.

As a result of these stretch-out arrangements, and the expiration of certain contracts, uranium production of the non-Communist countries has started to decline. In 1959 and 1960 production reached a high of approximately 41,000 tons of U_3O_8 annually. By 1964 production probably will have declined to less than 30,000 tons. A number of uranium mills have already closed, others will close, and many of the remaining mills will produce at less than capacity.

For the next five years, and probably for the next ten years, there will be keen competition for the gradually developing commercial business. Mills operating at less than capacity under existing long-term contracts —some of which extend to the end of 1966— can be expected to cut prices in order to utilize excess capacity. This additional uranium need carry no charge for amortization of capital or for overhead, and should involve a relatively small increase in operating costs. Such incremental uranium production might be available at prices as low as U$S 5 a pound of U_3O_8. No new commercial mining and milling operation with the grade of ore now mined would be profitable on a U$S 5 market.

As pointed out in the report of the Sub-Committee II, *it would be a mistake to estimate nuclear fuel costs on the basis of prices for which small quantities of uranium may be sold during the next five years. A price of U$S 8 a pound of U_3O_8 appears to be about the minimum needed to support a uranium industry exploring for and developing new ore reserves, opening new mines and building new mills.* This is the kind of a uranium which will be required if atomic power is to play a major role in meeting the growing energy requirements of the world's expanding population.

Let us look at the present and prospective energy requirements of the world, and make some assumptions as to what portion might be supplied by nuclear energy. We then can calculate roughly the uranium market on the basis of these assumptions.

Based upon present reactor technology and an 80 % load factor, each megawatt of installed capacity will require the equivalent of about one ton of U_3O_8 for inventory and 0.16 ton for annual replacement, or burn-up. Fuel requirements vary with different types of reactors but these figures are considered to be typical. Eventually breeder reactors may be developed for more efficient use of nuclear fuel. Thorium then may also be used as a nuclear fuel and, to the extent used, would share the market with uranium.

In 1959 the total electrical energy output of the non-Communist world was approximately 1,700 billion kilowatt hours. For the past thirty years electrical energy has been doubling about every ten years. This rate of growth is expected to continue. In that case, the electrical energy output of the non-Communist countries should be about 3,500 billion kilowatt hours in 1970 and by 1980 will have increased to 7,000 billion.

Based upon such a growth of power consumption and assuming, for purposes of illustration, that 10 % of the 1960-1970 growth, and 25 % of the 1970-1980 growth, will be supplied by atomic power, there would be nuclear generating capacity of about 25,000 megawatts by 1970 and 150,000 by 1980. Approximately 50,000 tons of U_3O_8 would be required during the first decade and 300,000 tons for the 20-year period. The annual burn-up for 150,000 megawatts is equivalent to about 24,000 tons of U_3O_8. Including inventory for new power stations, total 1980 uranium requirements for power alone would then be approximately 40,000 tons of U_3O_8 comparable to 1960 production of non-Communist countries.

These figures should not be construed as predictions. They are given to indicate the growth of atomic power needed to provide a market by 1980 equivalent to the present level of production. Such a market by 1980 is considered by some to be a possibility and by others to be too optimistic. In any event, only the timing is considered uncertain.

Many experts look for atomic power eventually to supply about 50 % of the world's new generating capacity.

The picture of the next few years, however, is reasonably clear. Nearly all atomic power plants which will come into operation by the end of 1965 already have been announced. This is because, after the decision has been made, a minimum of from four to five years is required for engineering and construction.

The number of new power stations which will come into operation during the 1965-1970 period will depend upon decisions made between now and 1965 or 1966. Any major expansion will depend upon achieving power costs which will be competitive in reasonably large power consuming areas. It is unlikely that sufficient operating data and experience will be available to cause a rapid expansion in atomic power capacity before 1970 even though the 1960-1965 reactors are highly successful.

Thus the period between now and 1970 is essentially a developmental period. During this period a relatively large number of experimental, prototype and commercial power reactors will be constructed and operated, based on a variety of reactor concepts. The information gained from these reactors, particularly cost data, will largely determine the number of commercial power reactors which will be constructed in the 1970-1980 decade.

Power costing between seven and eight mills per kilowatt hour would be competitive in relatively high-cost power areas; power costing between six and seven mills would be competitive in many large industrial countries; power costing six mills or less should assure rapid expansion in the use of atomic power. These statements assume no change in the present cost of producing electricity from fossil fuels.

No reactor has yet produced electricity for less than ten mills per kilowatt hour. Eight mill power may be produced from reactors now being constructed, some of which will soon be in operation. Several responsible organizations are estimating seven mill power and less, on the basis of present technology. For example, Canada expects its 200-megawatt natural uranium, heavy water reactor to produce power for 6 to 7 mills. This reactor is scheduled to come into operation in 1964. If the capacity of this reactor is doubled, a power cost of 5 to 6 mills is considered possible.

It should be emphasized that atomic power is new and rapid advances can be expected from the huge research and developmental programs now underway and planned for the next ten years. The problem of making nuclear energy competitive for a large share of the world's power market is being attacked on a broad front, with probably the greatest concentration of effort ever brought to bear upon a single technological field.

Let me give you a few figures of the proposed expenditures. These also indicate in a broad way the tremendous amount of scientific talent being directed toward accomplishing the task. Present forecasts indicate that non-Communist countries will spend between U$S 8 and U$S 11 billion on atomic power development during the next ten years. Nearly half of this amount will be spent for research and development and prototype plants. The remainder will be spent for construction of large power stations, many of which may not be competitive in the areas they will serve, at least during the initial period of operation.

The United States —government and industry— has embarked upon a ten-year program for research and development and commercial power plant construction which may well cost between 2 and 3 billion dollars.

The British program, even though revised downward, still calls for construction of commercial power stations involving an expenditure of nearly 3 billion dollars during the same period. In support of this construction effort, the British are expected to spend about one billion dollars on the nuclear power research and development program during those years.

Other European countries, including member states of Euratom, according to current estimates, should spend from 2 to 3 billions for research and development and commercial plant construction by 1970. The atomic power projects of Canada, Brazil, India and Japan, together with the research and development programs of these and the many other countries working on atomic power, should add another 1 to 2 billion dollars to the expenditures during that period.

This tremendous expenditure of money and effort is based upon confidence in the ability to produce electricity at competitive costs. Also, there is confidence in adequate supplies of nuclear fuel, or there would be no justification for proceeding with this gigantic power development.

For those concerned with uranium programs, the important point is that the longer range outlook is for expanding uranium requirements. The 1970-1980 decade holds promise for a major expansion in the use of nuclear energy. By the end of that decade, possibly before, the uranium industry may be called upon to increase production to new high levels.

In order to prepare for this increased demand, we must know more about the world's uranium resources, where they are, and the cost of production. *It will be sound policy for nations to undertake during the present period of oversupply a systematic appraisal of their uranium resources and potentialities.* Also, some countries may wish to undertake or maintain uranium operations to supply their current requirements or to provide insurance against future requirements. *Crash programs to meet requirements after they develop can be costly and wasteful.*

In closing, I should like to thank the National Atomic Energy Commission for holding this Conference on "Uranium Resources and Possibilities". This meeting of the Delegates from many parts of the world, who are concerned with nuclear raw materials, has provided a welcome and useful opportunity for review, discussion, and consideration of our common problems and future programs. There should be more such international meetings on the subject of nuclear fuels.

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