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REPORT OF THE MISSION OF THE INTERNATIONAL
ATOMIC ENERGY AGENCY TO LATIN AMERICA

Note by the secretariat



NOTE BY THE SECRETARIAT

The Commission has been keenly interested in developments relating to nuclear energy for several years. In resolution 100 (VI), it resolved to suggest to the "Governments of the Latin American countries that they avail themselves, individually or in groups, of any facilities obtainable through the United Nations or other sources, chiefly with the aim of training a larger number of technical experts in the various aspects of the generation and use of nuclear energy and products obtained from it", and to request the secretariat to devote special attention to the development of nuclear energy and the possibilities of its application on the basis of various sources of nuclear fuels and their use and to study the relevant economic questions. In resolution 130 (VII), it recommended that the secretariat should keep in touch with the International Atomic Energy Agency (IAEA) and keep member Governments informed of those economic aspects of the problem of nuclear energy.

In January 1958, the Board of Governors of the IAEA agreed to a proposal by the Governor from Brazil, supported by the Governor from Argentina and Guatemala, that studies should be undertaken concerning the possibility of establishing in Latin America an atomic energy training centre or centres. As a result of this proposal, the IAEA sent a mission to Latin America, which was accompanied by an observer from the ECLA secretariat who subsequently returned with the mission to Vienna to assist in the drafting of the resultant report (IAEA, General Conference, document G C (II)/INF/19). Since the subject matter of this report is of interest to ECLA Governments, the IAEA has agreed that it should be reproduced and submitted to the Commission at its eighth session.

REPORT OF THE MISSION OF THE INTERNATIONAL ATOMIC ENERGY
AGENCY TO LATIN AMERICA IN REGARD TO THE TECHNICAL
ASPECTS OF THE ESTABLISHMENT OF A POSSIBLE
ATOMIC ENERGY TRAINING CENTRE OR CENTRES

Note by the Director General

1. On 19 September 1958 the Board of Governors requested the Director General to communicate the report of the mission of the International Atomic Energy Agency to Latin America in regard to the technical aspects of the establishment of a possible atomic energy training centre or centres to the General Conference for its information. The report is accordingly reproduced as an annex to the present document.
2. The Board further requested the Director General to inform the General Conference that it had not yet studied the report.

ANNEX

REPORT OF THE MISSION OF THE IAEA TO LATIN AMERICA IN REGARD TO THE
TECHNICAL ASPECTS OF THE ESTABLISHMENT OF A POSSIBLE
ATOMIC ENERGY TRAINING CENTRE OR CENTRES

Formation of IAEA Mission to Latin America

1. In January 1958 the member of the Board of Governors of the International Atomic Energy Agency for Brazil, supported by the members from Argentina and Guatemala proposed that studies should be undertaken on the possibility of establishing in Latin America a training centre or centres in the field of atomic energy activities. The Board recommended that the Director General of the Agency appoint a mission to survey the Latin American countries with respect to their needs for the establishment of such training centre or centres. In pursuance of this action, the Director General requested nominations of personnel properly qualified and experienced for service on such a mission from Member nations of the Agency, which had by then offered experts to the Agency. The mission was headed by Dr. Norman Hilberry, Director, Argonne National Laboratory, U.S.A. and composed of the following members:

Prof. Mario E. Bancora,
Director of Technical Supplies,
International Atomic Energy Agency,
Vienna.

Mr. Alfred Carcasses,
Deputy Director,
Nuclear Research Centre of Saclay,
France.

Mr. Harold Sheard,
Technical Adviser on Overseas Relations,
Atomic Energy Research Establishment,
Harwell,
England.

2. Assigned to the mission by the Organization of American States as observers but active in all discussions and in the preparation of the final report:

Prof. Luiz Cintra do Prado,
University of São Paulo,
Brazil.

Dr. John K. Rouleau,
Chief, Inter-American Branch,
Division of International Affairs,
USAEC.

Appointed to serve as technical experts to the mission:

Dr. James W. J. Carpender (medicine)
Prof. of Radiology,
University of Chicago and Argonne Cancer Hospital,
U.S.A.

Dr. French T. Hagemann (chemistry and physics),
Associate Director, Chemistry Division,
Argonne National Laboratory,
U.S.A.

Dr. Nathan H. Woodruff (isotope applications),
Scientific Representative to Latin America,
USAEC.

Assigned to the mission by the Economic Commission for Latin America,
United Nations, to advise on economic matters:

Mr. Francis Silvert,
Economic Commission for Latin America, United Nations,
Santiago,
Chile.

Assigned by the International Atomic Energy Agency to serve the mission
as its Administrative Officer:

Mrs. Ulrike Schiller,
International Atomic Energy Agency,
Vienna.

Assignment of Mission Objectives

3. In his letter of 16 May 1958 to the chairman of the mission, the Director General established the terms of reference for the mission's investigations. The Working Group of Experts was established "to undertake a preliminary study of the technical problems involved in the setting up of a regional centre or centres in Latin America". On the basis of this study, the Working Group will submit a report (to the Director General) and recommendations as to possible course of action.

"At the present stage of the problem, a field survey by the Working Group is required that will evaluate the following matters on a technical basis:

1. The need for establishing a regional training centre or centres, in Latin America, for the preparation of specialists in science, technology and practical applications of atomic energy for peaceful purposes, bearing in mind the particular requirements of the countries of that region;
2. The availability of existing facilities having a bearing on such training and the collection of technical data relating to such facilities;
3. Within these terms of reference, it is also expected that the group will give a general appraisal of the scientific, technological and industrial conditions of the countries visited insofar as these have a bearing upon the need and the possibility of establishing such a regional training centre or centres.

"Questions related to financing, location, organization, administration, effective establishment and/or operation of the centre(s) may be considered by the Agency at a later stage, on the request of the Member States concerned. The terms of reference of the group do not include, accordingly, the consideration of these questions, except for the collection of data, including costs, which may be useful in subsequent considerations.

"In carrying out this assignment, it is important to encourage the co-operation and support of the regional organizations of which the Latin American governments are members.

"It is desirable to have participation with the work of the group by representatives of the Organization of American States (OAS) and representatives which the Economic Commission for Latin America (ECLA) may be able to provide, and it is hoped that they will be able to accompany the group to Vienna to participate in the final discussions of the study".

Function of a "Training Centre"

4. The above terms of reference focus sharply upon the concept of a training centre or training centres. It is necessary, therefore, before proceeding further, to discuss briefly the function of a training centre and to arrive at a definition of such a centre.

5. Three members of this mission represent some of the world's greatest and most successful of such training centres. The Atomic Energy Research Establishment at Harwell, England, serves this training function for the United Kingdom; the Nuclear Research Centre of Saclay with its companion laboratories at Fontenay-aux-Roses and Grenoble provides this training service for France; Argonne National Laboratory together with its companion national laboratories at Brookhaven and Oak Ridge fulfils this training responsibility for the United States of America. Harwell, Saclay and Argonne have evolved during the past ten to fifteen years by diverse paths into very similar organizations. The principal characteristic of each is that it serves two distinct but indivisible functions. The first of these is the production of a continually growing body of trained, creative personnel experienced in the techniques, the technologies and the scientific insights characteristic of atomic energy activities. These laboratories have accomplished and are accomplishing this objective only because of their success in fulfilling their second function, which is to serve as principal centres of research and development in the major scientific and technical areas of interest in the peaceful utilization of atomic energy.

6. The creation of a body of specialists is a first and a most essential step in any atomic energy programme. The quality and the size of this group will largely determine the rate at which useful applications of atomic energy will become effective and new scientific discoveries will be made upon which future useful applications must be based. But the quality and size of this group in turn depends upon the quality, the vigour and the variety of the research and development activities upon which they are engaged while in training, for it is only through active participation in such research and development activities that they become "trained".

7. Two types of training appear to be involved. In the extremes they are distinct and different; at one end of the scale is the acquisition of manual skills and technical routines essential in using a new instrument, at the other the development of scientific insight into the pertinent atomic processes themselves. In between lies the complete spectrum of variations between the extremes.

8. To the "radiation" prospector, his Geiger counter or scintillator is simply a modern version of the "water wand". He can get his training from the sales clerk and instruction sheet. The thyroid diagnostician using radioiodine has a new and particularly potent new "photographic" process with a scintillation scanner as camera. His technician soon learns to run the scanner with a minimum of scientific training.
9. But the nuclear chemist using his scintillation spectrometer to analyse the composition of a freshly-irradiated sample of a heavy element is much more concerned with the changes occurring in the sample due to radioactive decay than he is in the counting rates he is observing. These rates in themselves are meaningless and it is only the indirect interpretation based on knowledge of the nuclear changes occurring in the sample that gives them significance.
10. Training courses in the pure routines and technical skills required for effective use of nuclear instruments and simple "tracer" techniques requires only modest equipment and a good instructor. However, these are instrument and technique courses primarily. As such courses go farther into, for example, the use of tracers in specific research areas the time required and the scientific material which must be presented both increase. In the ultimate extension of this process of getting deeper and deeper into research use, only the "on-the-job" research experience proves to be adequate.
11. Tracer technique training is not the only largely operational training required in atomic energy work. A reactor-operator can only be trained where there is a reactor to operate. A health physics monitor can only be trained effectively where facilities using high levels of radiation are in use. Reactors and high radiation level facilities are expensive to buy, to install and to operate. Here universities cannot, in general, provide training and where large numbers of such trained individuals are needed, a training centre (or centres) becomes very valuable if indeed it does not become essential as a training ground in view of the universal shortage of such facilities.
12. Training in research is only incidentally concerned with the acquisition of operational skills; these are taken for granted. Here the requirement is for actual training and experience in the new avenues of investigation opened up by the new techniques and the new facilities and materials made available

by atomic energy development. This training for able research personnel is best provided by "on-the-job" research and development experience in association with a productive research group. This is true in many instances even for the skilled scientist who plans to initiate work with tracer radioisotopes; such experience may not be essential but the individual will become fully effective in his new endeavours only if such a training period is available. Work with reactors, with high level irradiation facilities or with high levels of radioactive isotopes requires such a training period at an installation where such facilities are in operation. Since up until the present, at least, there has always been a strong reluctance on the part of a university and its staff to utilize the facilities of another university, a training centre (or centres) does provide a mechanism by which training of this second kind can be offered to all qualified scientists.

Definition of "Training Centre"

13. A "training centre" for atomic energy personnel may therefore be defined as an establishment equipped with the facilities and apparatus necessary for active research in the atomic energy field and staffed with experienced scientists capable of providing courses on atomic energy techniques to technicians or scientists interested in acquiring technical skills. It must be equally capable of providing "on-the-job" research and development experience for the qualified scientist or engineer desiring to embark on a programme of research or of application in the atomic energy field. Such an establishment may be an integrated centre or a specialized centre. If the region it serves is concerned with power reactor construction or development and with the associated problems in fuel element fabrication and chemical processing, much is to be gained by the integrated centre. Here both the engineering disciplines and the science disciplines have the fullest opportunity for interplay of their interests. This interplay between scientific disciplines themselves and between them and the various engineering disciplines is highly productive and where regional needs warrant, is to be highly recommended.

14. Where regional needs do not warrant significant effort on reactor engineering and allied engineering investigation, the facilities and equipment can be limited to those required for effective investigation in the scientific

disciplines which are of particular interest, thus creating a specialized centre. A training centre may therefore range from a fully integrated establishment involving eight or more major disciplines covering the life sciences, the physical sciences and the appropriate engineering fields down to a specialized centre involving only one or two disciplines and concerned only with life or physical sciences. A highly specialized centre established to meet needs in a limited field of interest can expand as regional requirements broaden, by the provision of additional facilities, equipment and staff qualified in the new fields being added.

Method of mission operation

15. The mission met at the United Nations headquarters in New York City on 21 May, 22 May and the morning of 23 May 1958 to establish the procedures it would use during its field trip. With only one of the twenty Latin American countries definitely removed from consideration and with seventeen considered as probably issuing invitations for a formal visit by the mission, time was of vital importance. With some of the largest countries having more than one installation requiring inspection it was clear that not more than three days should be spent at any location. Visits to facilities were essential but time consuming and provided subjective, although important information. Time was saved in many instances by one group of the mission visiting the medical facilities while the remainder visited the non-medical installations. In certain instances facilities visited by the mission were associated more closely with the general scientific or industrial level of the country in question than with its atomic energy development. Nevertheless these facilities in general were visited since they were scheduled by those in high authority on atomic energy matters in the country concerned and therefore gave insight into their problems and their interests. With an average two day stay at one location and with time devoted to visits and inspection, it was clear that there would be inadequate time for the collection of complete data on the points listed within the terms of reference for the mission's investigation. Consequently, the mission members prepared a list of subjects the discussion of which they believed would provide an adequate picture of each country's status with respect to atomic energy.

16. The list of subjects was used only as an outline to guide the discussions, thus assuring uniformity from country to country. It gave also consistency

at least in the information requested and also provided for maximum coverage in minimum time. The list was as follows:

1. "The general outline of national atomic energy programmes both existing and prospective including both fundamental research and applications in all phases of the field. This includes also related activities such as prospecting, mining and processing of materials concerned.
2. The apparent potentials of atomic energy and related activities in your economy.
3. Implications of this programme with respect to the requirements for trained manpower.
4. Existing educational facilities and faculties in science and engineering. Special training facilities in fields particularly related to atomic energy.
5. Suggestions with respect to co-operative programmes in atomic energy in Latin America and in particular how a Latin American training centre or centres could be established and be of benefit to your country".

17. The time consumed in "round table" discussions varied from some hours to cases in which over two half days were used. In most instances information had been carefully gathered and prepared for presentation. Additional data requested as a result of the questioning and discussion were generally provided before the mission's departure. Throughout all of those discussions there was a remarkable frankness and realistic evaluation of their position in the atomic energy field on the part of the groups interviewed.

Scope of mission survey

18. The mission visited seventeen of the twenty Latin American countries. In the order in which they were visited, these were Brazil, Paraguay, Uruguay, Argentina, Chile, Peru, Bolivia, Ecuador, Colombia, Venezuela, Dominican Republic, Haiti, Panama, Costa Rica (including the Inter-American Institute of Agricultural Science at Turrialba), Nicaragua, Guatemala and Mexico. In each country the mission conferred with the individuals specified by their government as being responsible for national interests and programmes in atomic energy matters. In many of the countries the mission was received by the President of the country and almost invariably by the Cabinet Minister responsible for atomic energy.

affairs. Undoubtedly the mission did not have the opportunity to consult everyone with strong atomic energy interests in every country. We believe, however, that all of the responsible key people were interviewed. Frequently the questions raised and the advice requested by the national representatives occupied as much time as did the discussion of the subjects listed.

Interest in and potentials of atomic energy in Latin America

19. In all the countries visited there was obviously a deep interest in the possibilities for the peaceful uses of atomic energy. This was true not only of the responsible atomic energy personnel but also of the high government officials we met and of the press, radio and television.

20. The accomplishments and potentials of the various countries visited, in the several aspects of the peaceful uses of atomic energy, have been summarized by the specialists concerned.

Organization of atomic energy activities in Latin America

21. In many instances the organization of the atomic energy activities on a national level within the various countries was indicative of the progress of thinking and planning for the peaceful use of atomic energy within the nation. Organizations varied from a well developed Atomic Energy Commission with a large and competent full time technical staff with obvious technical accomplishments, through almost every stage to that of an advisory committee on atomic energy matters whose last previous meeting had been ever a year earlier. A summary report on the Organization of Atomic Energy Affairs in the Latin American countries visited is in preparation.

Present educational programmes and facilities in the atomic energy field

22. Estimates of the numbers of scientific and technical personnel with specialized training in atomic energy available to implement planned national programmes varied from zero to hundreds. These figures were asked for and presented only as order of magnitude guesses. In general those countries which had given the most careful consideration to atomic energy plans gave the highest estimates of required manpower.

23. Some time was spent in each country in reviewing the educational programme and facilities since the development of a competent staff of research scientists and engineers depends so emphatically on the character and quality of the training in fundamental science. One characteristic pattern appeared in almost every country visited, a swing from the old almost exclusive emphasis on lecture work to a major effort to establish the laboratory approach in teaching science and engineering. The extent to which the change was being accomplished varied widely. However, new laboratory buildings were visited almost everywhere the mission went. Success in securing the necessary laboratory equipment and qualified laboratory instruction in general appeared to lag well behind getting the necessary buildings. Since training centres for the production of specialists in atomic energy research depend directly upon the quality and character of the training received in these universities, aid in completing this change-over is a vital matter if the utilization of atomic energy for peaceful purposes is to become a reality in Latin America in the near future. Help from some source in providing equipment, and assistance in training laboratory instructors are the major needs of many of the Latin American universities at the present time. A report on Present Educational Programmes and Facilities Relative to Training in Atomic Energy has been prepared.

Conclusions

24. A review of existing and proposed atomic energy programmes in Latin America; of present and prospective levels of financial support apparently available for these programmes; of the numbers of present specialized staff, estimates of future needs and prospects for the rate of development of new staff qualified for specialized training; raises a question as to whether the establishment of an integrated regional training centre (or centres) is justified at the present time.

25. The rapid strides being made by Argentina in building up its integrated atomic energy centre in the Buenos Aires area; Brazil's success in establishing its physical science nuclear laboratory and its radio-biology centre; the promise of the medico-biological centre in Venezuela and of the nuclear science courses in the University of Mexico; present the additional question as to whether these projects do not in themselves provide adequate training centres in Latin America.

26. If the Latin American nations should contemplate maintaining only their present levels of atomic energy activities, their present levels of financial support and their present rate of production of young scientists and research engineers, the answer would have to be that the time has not yet come for the establishment of an integrated regional training centre (or centres) and that the projects now under way, for instance in Argentina and Brazil, are probably technically adequate to meet Latin American training needs or will rapidly become so, if open to all Latin American countries. However the present situation constitutes a vicious circle. Few students choose scientific or development engineering careers in the majority of Latin American countries. There are few opportunities open for them at home in these fields. As a result little or no staff is being developed with which to expand atomic energy activities. In this situation the governments, generally hard pressed for funds, have little or no incentive to provide facilities and create jobs which there is no certainty could be used or filled. This situation could persist indefinitely. The relatively few students who do go into scientific or development engineering work are now in many instances lost to their countries because of the demands for such trained scientists and engineers abroad. Frequently, those who return home can make no further use of the specialized training they have received and observation of this fact dissuades many potential young scientists and engineers from entering these careers. Intensifying the present moves to strengthen the university laboratory facilities, equipment, and instruction will provide means for the essential training in fundamental science required for the development of specialists in the atomic energy field, but it will not break the vicious circle.

27. The establishment of an integrated training centre (or centres) may be the best hope for a way out of this impasse. This could justify the creation of such a centre (or centres) even though the present status of atomic energy projects might not appear to warrant it. The laboratories in Latin America would find it impossible to supply adequate staff even to start such a centre and any large contributions toward such a staff that they might make would present a serious check on their present healthy growth. During perhaps the first decade therefore, the success of such a centre would depend to a great extent on the number and quality of the scientists and engineers who could be secured from abroad.

28. Such a staff of highly creative, experienced personnel could only be assembled if adequate and assured financial support were clearly available over a term of years and if the facilities and equipment provided were comparable in excellence and variety with that available at other laboratories offering competitive positions.

29. If such a staff were assembled, however, two results could be anticipated with confidence. The very existence of the laboratory would provide interest to students with scientific and developmental engineering aptitudes. Positions at the laboratory would stand as examples of possible careers in creative scientific and technical work. As the foreign staff returned home and were replaced by qualified Latin Americans these positions would become realities and their values as incentives would remain for oncoming student generations. This would almost certainly generate a flow of students qualified for specialized training in atomic energy work.

30. The second result to be expected would be that the research and development output of the centre (or centres) would provide object lessons in the benefits that research and development can provide. In this connexion it is important in establishing the staff, and therefore the programmes of such a centre (or centres) that a considerable part of the chosen fields should have a high probability of yielding results of immediate impact. If successful, these examples would lead to the establishment of other governmental and industrial research and development laboratories thus creating new scientific and technical positions and finally breaking the vicious circle.

31. Two choices are available in the establishment of training centres, specialized centres or integrated centres. In the long run there is no question that the integrated centre is the preferable choice. The interplay of interest and research contributions between scientific and engineering disciplines is becoming increasingly important and is most effective in an integrated centre. Specialists trained in such an atmosphere have a broader and more flexible command of their fields. Due to the availability of many different disciplines, a wide and complex variety of development projects can be successfully undertaken.

32. On the other hand such a centre to be effective must be large. Due to the large number of disciplines the variety of facilities and equipment which must be

provided is extensive. This means that costs for establishing such a centre are high and the operating costs are bound to be large. Moreover, the problem of staffing such a centre in its initial stages is tremendous and unless this is accomplished successfully the whole project is imperilled.

33. In addition, specialized centres stand a much higher chance of being staffed successfully. They are inherently smaller and consequently costs for facilities and equipment are much less and operating costs are also much lower. In addition use might be made of existing facilities. If the field of interest chosen for such a centre corresponds to a strong regional need such a centre will also serve to break the vicious circle at least in its own field. This example will lead eventually to progress in other fields and the break will spread.

34. One of the specialized atomic energy training centres to be established might well be in the field of radio-botany. Agriculture is a major source of income throughout Latin America. There are many agricultural schools and experimental stations throughout the region, and also the Inter-American Institute of Agricultural Science at Turrialba, Costa Rica, a regional training centre in agriculture supported through the Organization of American States by a group of Latin American member countries.

35. Agriculture is in a real sense applied botany. The rate of agricultural advances can be enhanced by expanding basic botanical understanding and knowledge. Much of this knowledge is lacking. This is an area in which the atomic energy field provides particularly powerful investigative tools. A training centre in radio-botany should provide vitally needed knowledge and vitally needed specialists to all the agricultural installations in Latin America. A training centre like this might provide an excellent model upon which to base training centres in other areas.

Recommendations

36. It is therefore recommended:

1. The Agency should support in any way within its power the appeals of Latin American universities for equipment, funds for purchasing equipment, and for qualified personnel, to expedite the development of laboratory trained scientists and engineers.

2. That at least one specialized training centre be established as soon as possible. Taking as an example the field of radio-botany, such a centre would provide trained specialists in radio-botany to agricultural institutions through Latin America and also provide basic research results vital to agriculture. Such a centre at full strength would require a scientific staff of some 40 scientists and a total of some 175 employees. The cost of new facilities might be of the order of \$7,500,000 depending on the special facilities provided. The operating budget would be of the order of \$1,000,000 per year. Initial operations at approximately half strength would be possible with an annual budget of approximately \$650,000 but the staff should be brought to full strength as quickly as proper personnel can be obtained.

3. That whenever it appears feasible to gather necessary staff of high creative ability and established productivity and when funds can be made available for facilities, equipment and operating costs at least one integrated atomic energy training centre should be established completely equipped with all the special facilities which are characteristic and essential to such an establishment such as reactors, accelerators, high level irradiation facilities, caves, ventilated and shielded facilities for high level and low level chemical and chemical engineering studies, metallurgical facilities for use with normal uranium, enriched uranium and thorium, facilities for radiation biology etc. Such a centre should provide for a staff of roughly 250 scientists and engineers to be adequately "self-critical", approximately 500 supporting personnel, such as laboratory technicians, machinists, glass blowers, technical office assistance, etc. and possibly 450 administrative and operating personnel. The cost of the necessary facilities would be in the neighbourhood of \$40,000,000 and the annual operating budget would be of the order of \$7,500,000. The initial staff could be roughly half that proposed for full operation and the initial operating budget perhaps \$4,000,000/yr.

Note: All costs are simply order of magnitude estimates based on operations elsewhere scaled down somewhat for generally lower construction and labour costs in Latin America.