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FOREIGN TRIP REPORT

ORNL/FTR-3245

DATE: October 20, 1989

SUBJECT: Report of Foreign Travel of Richard G. Haire, a Staff Research Chemist in the Chemistry Division

TO: B. R. Appleton

FROM: Richard G. Haire

PURPOSE: The purpose of the foreign travel was to attend the International Conference, "Actinides-89," which was held in Tashkent, USSR. The traveler was invited to present a plenary lecture at the Conference and was to chair one of the technical oral sessions.

SITES VISITED:	9/24-9/30/89	Cultural Center	Tashkent, USSR	Conference Attendees
	9/27/89	Institute of Nuclear Physics	Tashkent, USSR	Conference Attendees

ABSTRACT:

The primary objective of the foreign travel was to attend the International Conference, "Actinides-89," and present an invited plenary lecture. This International Conference, held every four years, is dedicated to recent research and technology with the actinides. In addition to the scientific presentations, the traveler also benefited from frequent technical discussions with a number of the conference attendees. The traveler received several technical preprints not included in the Conference's written program. These dealt with phase diagrams of plutonium-americium and plutonium-curium, and with high-temperature studies of curium metal. These topics are very pertinent to the traveler's research interests and areas of work. Another important benefit of the travel was learning about the current and future directions of actinide research in other laboratories. The traveler also visited an isotope production reactor at the Institute of Nuclear Physics, Academy of Sciences of UzbekSSR.

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SUMMARY OF ACTIVITIES - ACTINIDES-89 CONFERENCE

During the period of foreign travel the traveler attended the five-day International Conference, "Actinides-89," which was held in Tashkent, USSR. The traveler had been invited by the USSR Academy of Sciences to present a plenary lecture, "Systematic Properties and Recent Investigations of Actinide Metals and Alloys," at the Conference. The traveler also chaired an oral technical session on solid state physics and chemistry, and was a coauthor on two other papers presented at the Conference. This conference is held every four years and is hosted by organizations in different countries. This year's Conference was organized by the USSR Academy of Sciences. The site for the 1993 Conference was selected in Tashkent; it will be Santa Fe, New Mexico, with the organizing group being the Los Alamos National Laboratory.

The Conference consisted of both invited plenary and keynote presentations, as well as contributed oral and poster presentations. The topics represented a wide variety of research and technological interests. The major themes were: production and application of the actinides, which included work on the transactinide elements; electronic structure/ spectroscopy; thermodynamics; solid state chemistry/physics; solution chemistry; analytical chemistry; and environmental chemistry. There were over 290 scientists from 21 countries; the majority of these came from the USSR. This meeting site gave attendees an opportunity to meet and discuss science with many scientists from the USSR that do not attend conferences outside of their country. There were over 80 oral and over 200 poster presentations scheduled for the Conference.

Four of the five days of the Conference were held at the Cultural Exchange Center in Tashkent. The fifth day's sessions were held at the Institute of Nuclear Physics in Tashkent. A portion of that day was allocated for short tours of the facilities at the Institute. Each attendee had a choice of one of these tours. The choice was between facilities for: activation analysis (Cf-252); analytical chemistry; isotope handling; reprocessing chemistry; and isotope production (reactor). The traveler chose the latter tour. The reactor was an older (vintage, late 1950's) natural water reactor, that had been upgraded to a 10 megawatt power level. The control room and reactor appeared to be of modest design compared to requirements presently used in new facilities. The main functions of the reactor appeared to be for isotope production and a neutron source for experiments (e.g., neutron diffraction).

The presentations at the Conference addressed both past and ongoing studies, and served to update the attendees to the status of several different areas of actinide research and development. Some of the speakers touched on areas for future work. Overall, the presentations provided beneficial scientific stimuli for the attendees. Some specific aspects of the presentations are addressed in the following paragraphs.

There were papers that dealt with nuclear energy and power reactors. One outlined the British efforts on actinides in the uranium fuel cycle and their approach for handling wastes. Reprocessing of high burn-up (100 GWd/t) fast reactor fuels (20% U-80% Pu) and the strategy for spent fuel recycling in the USSR was also presented. It was apparent at the Conference that nuclear energy was an active approach to energy problems in the USSR, Japan, and parts of western Europe, where both money and personnel are committed to that goal.

There seems to be a very active effort in the USSR to prepare and study the transactinide elements up to element 110. There were several papers from the USSR that dealt with the chemistry and properties of elements 104 and 105. The main approach used high temperature chromatography of volatile halides. The points stressed in these reports were that 104 is not a p-element like Pb, but behaves like a d-element, (ds^2p), and that its behavior may deviate from extrapolations for it made using the Ti, Zr, Hf elements, which may signify relativistic effects. Relativistic calculations of element 104's electronic atomic structure were also discussed. The status of work at GSI in the Federal Republic of Germany was also presented; it appears that two more atoms of element 109 have been made. The fast-chemistry separation schemes used in these German experiments were also discussed. The approach in the USA has been to use targets of Es-254 for production of new elements; this approach was discussed at the Conference but the lack of production of Es-254 has delayed research efforts here.

There were several papers concerning actinides in the environment. Some papers were to address the results of the Chernobyl accident but many of these were cancelled. Of the information received about Chernobyl, it seems that within a 0.5 km range of the accident, fuel particles up to 1 mm in diameter were found; the size of the particles diminished as the distance from the site was increased. The density of these larger particles was in the range of 8 g/cc. Aerosols were observed for 10-20 days following the accident with the main alpha activity present in them being Cm-242. The U and

Pu species present in these aerosols were believed to represent materials more volatile than their dioxides (e.g., halides).

The topics of solution and separation chemistry covered both the applied aspects (ion extraction, solvent extraction, flow electrolysis, etc.) and a more basic nature (electro-migration, stability constants, modelling) of study.

There were a few papers dealing with actinides under pressure. One dealt with uranium metal under pressure up to one megabar. It appears that there is some evidence that at 70 GPa a new structure may form (orthorhombic to hexagonal). Results from studies of Np and Pu antimonides and tellurides were also presented; results with the tellurides may reflect electronic changes rather than only phase transitions. The Karlsruhe group presented work that combines multiple techniques (optical reflectance/absorption, X-ray diffraction, and X-ray absorption techniques) to study the actinide pnictides and chalcogenides under pressure. This facility represents the state-of-the-art in high pressure work and ORNL should maintain our collaborative ties with this laboratory to benefit from their expertise.

The production and study of the transplutonium elements seems to be well supported in the USSR. Several papers on the solid state chemistry of these elements were presented. One dealt with the preparation of mg amounts of, and subsequent measurements on, Cm-248, Bk-249, and Cf-249 metals. Linear expansion coefficients were also given for Cm and Bk metals. Other work reported on the phase diagrams of Pu-Am and Pu-Cm, and on the high-temperature behavior of Cm metal. A fcc to bcc transition was reported for Cm metal just below the melting point. This transition was detected by DTA measurements but was not verified by X-ray diffraction. This is similar to the case with Am metal, where several years ago a fcc to bcc transition was reported for it on the basis of dialometry results. The USSR workers have also prepared and studied the $AnPt_5$-type compounds of Cm, Bk, and Cf.

It seems that the SM2 reactor in the USSR (counterpart to HFIR in the USA) is producing transplutonium elements on the multi-milligram scale that is needed for solid state research. The impression of this traveler is that at this time the separation techniques may not produce materials with the best purities, and that their Es yields may be lower than have been achieved in the past in the USA. However, this effort in the USSR should allow them to rapidly become a

prominent producer of research in the area of solid state chemistry/physics of the transplutonium elements.

EVALUATION OF TRIP

The traveler found the trip to be technologically and scientifically informative and rewarding. The Actinide Conferences (held every four years) have always been very productive meetings but this particular Conference in the USSR provided the traveler an opportunity to be exposed to a greater amount of Soviet science and to obtain a better perspective of the nature and extent of their research on the transplutonium elements. This was particularly important at this time since the USSR is becoming more prominent in their production and research efforts with the transamericium elements. In general, attending such conferences and interacting with scientists from several different organizations is extremely valuable in maintaining an awareness of scientific developments, both in and outside of one's main area of scientific work. Active discussions held with scientists from other countries during this trip are likely to lead to either future collaborations, or at least to a more rapid exchange of scientific results.

APPENDIX

Itinerary

9/22-24/89	Travel from Oak Ridge, TN, to Tashkent, USSR
9/24-30/89	Actinides-89 Conference in Tashkent, USSR
9/30/89*	Travel from Tashkent, USSR to Samarkand, USSR
10/2/89*	Travel from Samarkand, USSR to Bukhara, USSR
10/2-4/89*	Bukhara, USSR
10/4/89*	Travel from Bukhara, USSR to Moscow, USSR
10/4-5/89	Moscow, USSR
10/5/89	Travel from Moscow, USSR to Frankfurt, FRG
10/6/89	Travel from Frankfurt, FRG to Oak Ridge, TN

(* non-official travel)

Persons Contacted at the Conference

Belgium

Professor W. D'Olieslager	Heverlee
Professor J. Fuger	Karlsruhe, FRG
Dr. J. Goffart	Liege

Czechoslovakia

Professor I. Zvara	Dubna, USSR

Federal Republic of Germany

Dr. U. Benedict	Karlsruhe
Dr. H.-J. Bleyl	Karlsruhe
Professor G. Herrmann	Mainz
Dr. P. Hoffman	Darmstadt
Professor C. Keller	Karlsruhe
Dr. J. R. Naegele	Karlsruhe

France

Dr. M. Beauvy	CAE
Dr. A. Blaise	Grenoble
Dr. S. Dabos-Seignon	Paris
Dr. F. David	Orsay
Professor R. Guillaumont	Orsay
Dr. C. Musikas	Fontenay aux Roses
Dr. R. Pascard	CAE

German Democratic Republic

Dr. S. Niese	Dresden
Dr. U. Niese	Dresden

Great Britain

Dr. G. Lander	Karlsruhe, FRG
Dr. A. Naylor	Manchester

Japan

Professor S. Imoto	Fukui
Dr. H. Matsui	Nagoya
Dr. T. Matsui	Nagoya
Dr. C. Miyake	Osaka
Dr. M. Miyake	Osaka
Professor K. Naito	Nagoya

Poland

Dr. W. Suski	Wroclaw
Dr. R. Troc	Wroclaw

Sweden

Professor B. Johansson	Uppsala

USA

Dr. J. Akella	Livermore
Dr. W. T. Carnall	Argonne
Professor G. R. Choppin	Tallahassee
Professor B. R. Cooper	Morgantown
Dr. N. Edelstein	Berkeley
Dr. D. E. Hobart	Los Alamos
Dr. R. E. Kelley	Los Alamos
Dr. P. D. Kleinschmidt	Los Alamos
Dr. D. Karraker	Savannah River
Dr. R. Lougheed	Livermore
Dr. S. E. Nave	Oak Ridge
Dr. M. Norman	Argonne
Dr. M. Schwab	Livermore
Dr. R. E. Tate	Los Alamos

USSR

Mr. M. A. Afonin	Leningrad
Dr. V. I. Astafurov	Moscow
Mr. V. P. Kapranchik	Leningrad
Dr. A. A. Kist	Tashkent
Dr. E. S. Gureev	Tashkent
Dr. G. V. Ionova	Moscow
Mr. V. V. Korolev	Leningrad
Dr. I. A. Lebedev	Moscow
Dr. E. S. Kalevich	Dimitrovgrad

Dr. N. S. Kosulin	Dimitrovgrad
Dr. N. B. Mikheev	Moscow
Professor B. F. Myasoedov	Moscow
Dr. V. G. Pershina	Moscow
Dr. A. G. Seleznev	Dimitrovgrad
Dr. V. D. Shushakov	Dimitrovgrad

Literature Received

1. "The Temperature and Self-Irradiation Effect on ^{244}Cm Metal Crystal Structure," N. S. Kosulin, A. G. Seleznyev, V. A. Stupin, N. T. Chebotaryev, and V. D. Shushakov, RIAR, Dimitrovgrad and RIIM, Moscow, USSR.

2. "The Pu-Cm Phase Diagram," V. D. Shushakov, N. T. Chebotaryev, N. S. Kosulin, V. A. Stupin, L. N. Konovalov, V. S. Kurilo, V. I. Lenin, RIAR, Dimitrovgrad and A. A. Bochvar, RIIM, Moscow, USSR.

3. "The Plutonium-Americium System," V. D. Shushakov, N. S. Kosulin, and N. T. Chebotaryev, RIAR, Dimitrovgrad and RIIM, Moscow, USSR.

4. "Is Element 104 (Kurchatovium) a p-Element? II. Relativistic Calculations of the Electronic Atomic Structure," V. A. Glebov, L. Kasztura, V. S. Nefedov, and B. L. Zhuikov, Radiochimica Acta 46, 117-121 (1989).

5. "Is Element 104 (Kurchatovium) a p-Element? I. Chromatography of Atoms with Hydrogen as Carrier Gas," B. L. Zhuikov, Yu. T. Chuburkov, S. N. Timokhin, K. U. Jin, and I. Zvara, Radiochimica Acta 46, 113-116 (1989).

6. (a) "Preparation of Rare Metallic Actinides (^{248}Cm, ^{249}Bk, ^{249}Cf) and Investigation of Their Crystalline Structure," A. G. Seleznyov, V. M. Radchenko, V. D. Shushakov, M. A. Ryabinin, P. P. Droznik, L. S. Lebedeva, V. Ya. Vasilyev, Dimitrovgrad, USSR.

   (b) Paper on Bk-249 Metal (in Russian language).

   (c) Paper on Cf-249 Metal (in Russian language).

7. "Die Stellung der Lanthaniden und Actiniden in Periodensystem des Mendeleev," N. B. Mikeev, Naturwissenschaften 76, 107-113 (1989).

8. "Actinides-89," Conference Abstracts.