SPOTLIGHT
on Ion Exchange and Solvent Extraction in Mineral Processing

by H. E. JAMES*

During the past ten years there has been an upsurge of interest in the development of selective ion-exchange resins and solvents, and of ion-exchange and solvent-extraction equipment tailored to the special requirements of mineral-processing circuits. It is therefore not surprising that the recent Symposium on Ion Exchange and Solvent Extraction in Mineral Processing, held at the National Institute for Metallurgy (NIM) on 7th and 8th February, 1980, was a resounding success. This Symposium, organized jointly by NIM, the South African Institution of Chemical Engineers, and the South African Institute of Mining and Metallurgy, attracted eighteen papers† on a wide variety of ion exchange (IX) and solvent extraction (SX) topics, ranging from fundamental work in the development of resins to engineering applications on a large scale.

Approximately 300 delegates attended the Symposium, including about 30 representatives from 9 foreign countries. An analysis of the list of delegates demonstrates the widespread interest that exists in the application of IX and SX in the mineral field. Company affiliations were approximately as follows: 25 per cent from operating mines, 12 per cent from the head offices of mining houses, 14 per cent from engineering contractors and equipment vendors, 16 per cent from companies engaged in the manufacture of reagents for the mineral-processing industry, 13 per cent from research laboratories in the mining industry, and the remaining 20 per cent from NIM, the Atomic Energy Board (AEB), and university departments.

Opening Address

Louw Alberts, President of NIM, in opening the Symposium, reviewed the historical development of IX and SX in the mineral-processing industry from December 1948, when a worker at the Massachusetts Institute of Technology discovered that uranium could be absorbed by an ion-exchange resin, to the erection in the 1950s of plants in South Africa using fixed-bed ion-exchange columns for the recovery of uranium.

In South Africa, solvent extraction eclipsed ion exchange during the early 1970s, but the latter made a come-back in recent years with the successful development of continuous ion-exchange (CIX) contactors. Five new uranium plants have been commissioned in South Africa within the last three years employing CIX, and a sixth plant using CIX is at present under construction. CIX has not found many large-scale applications outside the field of uranium, but, in a number of laboratories around the world, including NIM, workers are pursuing the goal of the ideal ion-exchange resin for the recovery of base and precious metals. Heavy resins suitable for use on unfiltered pregnant liquors are also the target of research and development.

Turning to solvent extraction, Dr Alberts mentioned that this technique had long been a unit operation for purification in the petrochemical and food industries. Again it was uranium that introduced SX to a large-scale application in mineral work. In 1952, workers at Oak Ridge National Laboratories published the results of investigations into the use of tertiary amines for the recovery of uranium. This process, known in South Africa as the Purlex process, not only displaced all the other SX processes for uranium that were under consideration, but also won considerable ground at the expense of ion exchange. In 1958 the plant of Kerr–McGee in New Mexico was commissioned using the tertiary amine SX process that today is the basis for most operations in the U.S.A. Solvent extraction has spread very quickly to the recovery of other metals. The list of applications now stretches from aluminium to zinc and includes elements like molybdenum and tungsten. However, it has found its widest application with copper, and perhaps the most notable milestone in recent years was the startup of the biggest SX plant in the world at Chingola (Zambia) in 1974, which recovers copper from tailings leach liquor.

Industrial IX Technology

Five papers were presented on this topic, the first by John Litz, of Hazen Research, Colorado, U.S.A. Mr Litz reviewed the process chemistry and the equipment that has been developed in the U.S.A. for the recovery of uranium at *in situ* leaching operations. *In situ* leaching (often referred to as solution mining) can be employed for the extraction of uranium from sandstone ore-bodies that are located under the water table and that are stratigraphically sealed by sandstones or shales of low permeability. An obvious requirement for efficient *in situ* leaching is that the mineralized sandstone should be reasonably permeable to the leaching solutions. It is this requirement that debars the use of this technique for most South African uranium ores. Accord-

*Director, Extraction Metallurgy Division, Atomic Energy Board, Randburg, Transvaal.
†The papers are listed on p. 136 of this issue.

ing to Mr Litz, *in situ* leaching has the advantages of low surface-plant cost and lends itself to the exploitation of small remote ore-bodies. The technique is now being used not only in Texas, where it was first applied on a commercial scale, but also in New Mexico, Colorado, and Wyoming, and is being contemplated in a number of other states. Mr Litz's systematic review of 9 *in situ* flowsheets goes a long way towards bringing order to the confusion that has existed for some time regarding the techniques in use at solution-mining operations in the U.S.A. All the *in situ* operations that Mr Litz described employ ion exchange for the uranium-recovery step. The choice of ion-exchange equipment does not appear to be influenced by the leaching or surface-plant chemistry, but rather by the personal preferences of the operators. This casual approach clearly illustrates that the major costs and operating problems in solution mining are related to the well-field and the leaching chemistry. Mr Litz concluded his paper on the hopeful note that, as the industry matures, there may be greater interchange of information leading to a flowsheet that becomes most popular.

The second paper on industrial IX technology was presented by Anton Hendriksz, of Bateman Uranium Corporation, Denver, U.S.A. He described the application of the NIMCIX contactor to the recovery of uranium from tailings-pond solutions at the mill of United Nuclear–Homestake Partners in New Mexico. Because of the inevitable soluble losses experienced in the solid–liquid separation circuit at this mill, a good deal of the soluble uranium reports to the tailings pond. The dry climatic conditions in the region necessitate recycling of the maximum quantity of decanted tailings-pond solution to the mill. This recycle solution is consequently

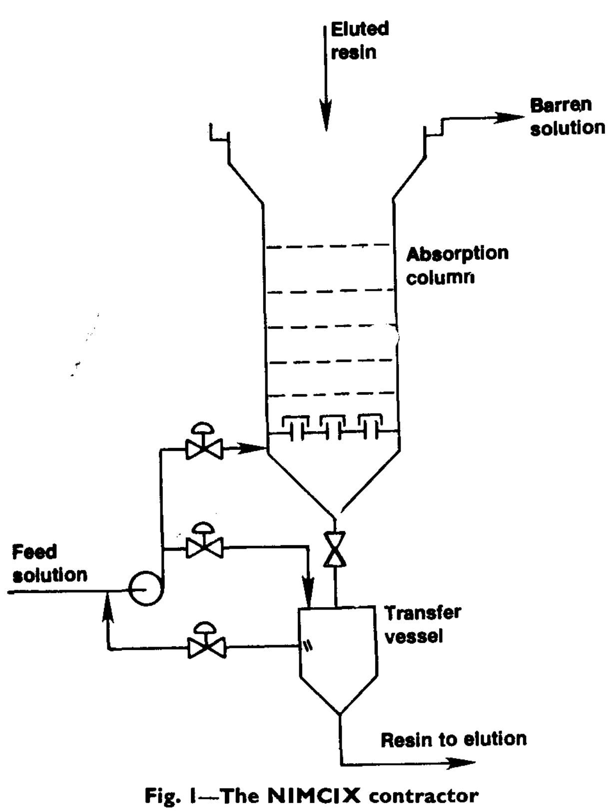

Fig. 1—The NIMCIX contractor

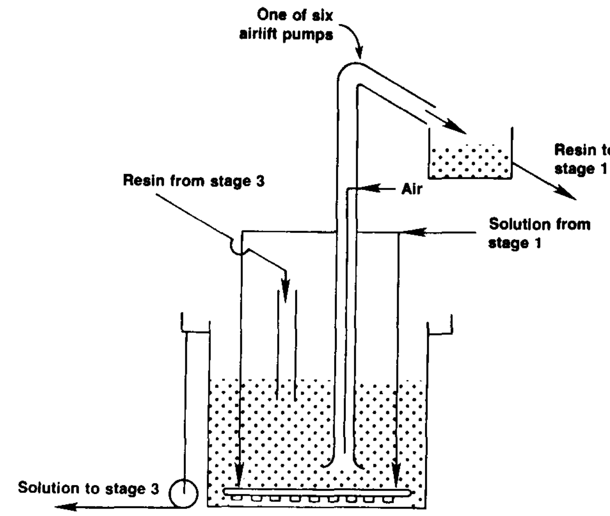

Fig. 2—The Porter CIX contactor

used for washing on the first-stage filters, and is also used for repulping the first-stage filtercake. The recovery of uranium from the solutions being recycled would obviously be advantageous. A continuous ion-exchange plant capable of operating independently of the mill and requiring a minimum amount of operator attention appeared to be attractive for this duty. As a demonstration of the advantages of the NIMCIX contactor for this application, a fully automated pilot NIMCIX unit was operated on the recycle solution for about five weeks. The pilot plant was designed by Bateman Engineering, fabricated in South Africa, and air-freighted to the U.S.A. According to Mr Hendriksz, the NIMCIX system envisaged for mine-water applications is much simpler and more compact than the NIMCIX plants in operation at Blyvooruitzicht and Chemwes. In the mine-water system, elution is done in a fixed-bed column, and the resin inventory between the loading and elution columns is self-balancing. Periodic regeneration of the resin can be conducted in the elution vessel so that there is no need for a separate regeneration circuit. As a result of the pilot-plant tests described by Mr Hendriksz, United Nuclear–Homestake Partners have placed an order for a full-scale NIMCIX plant with Bateman Engineering.

The remaining three papers on IX technology described full-scale plant applications of the NIMCIX, Porter, and Himsley continuous ion-exchange contactors (Figs. 1 to 3) at Chemwes, Rössing, and Vaal Reefs South, respectively. These papers were presented by Alan McIntosh (AEB), Peter Vernon (Rössing Uranium), and Ken Thomas (Anglo American Corporation). Because the speakers were extremely forthright about the problems that had been encountered during the start-up of their respective CIX units, delegates were afforded a rare opportunity of making their own comparisons of the technical and economic merits and demerits of the three techniques. It became very clear from the presentation and the animated discussions that followed that, although CIX has now come of age, there is still considerable potential for further improvement of all three systems. It was equally clear that the open exchange of information between the protagonists of the

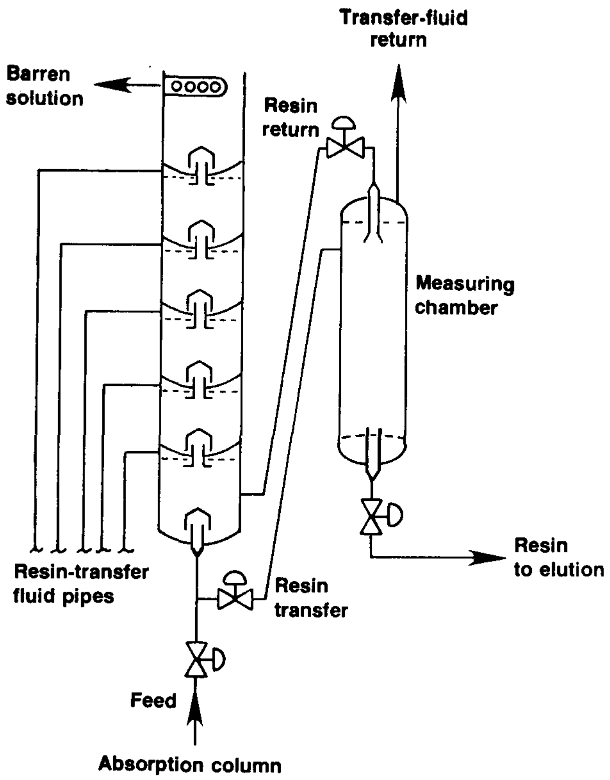

Fig. 3—The Himsley CIX contactor

three systems can result only in further improvements in design, which will ultimately benefit the minerals industry on a world-wide basis. (Additional information will be contained in a paper to be presented by Dr D. W. Boydell, of the AEB, at the Third National Meeting of the South African Institution of Chemical Engineers in Stellenbosch from 1st to 3rd April, 1980. This paper, entitled 'The Recovery of Uranium from Solution by Continuous Ion Exchange', will compare performance data for the five CIX designs that have achieved commercial acceptability at uranium plants in South Africa, South West Africa, the U.S.A., and Canada.)

Industrial SX Technology

One of the disappointments of the Symposium was the lack of papers on solvent extraction, only 5 of the 18 papers being devoted to this topic. (For complementary information refer to the Proceedings of the International Solvent Extraction Conference (ISEC) held in Toronto in 1977, which contain a number of excellent papers on the application of solvent extraction in mineral processing.) Two of the five SX papers presented at the NIM Symposium dealt with practical considerations related to industrial SX operations for the recovery of uranium.

Murdoch Mackenzie of Trochem, Johannesburg, highlighted the major causes of the operating problems at SX installations for the recovery of uranium in the U.S.A. and South Africa. He also offered practical solutions to these problems, drawn from the many years of experience that he and his co-authors had gained in this field. These problems include contamination of solutions by the humic acids dissolved during the leaching of some sandstone uranium ores; interference by molybdenum due to precipitation of an amine–molybdenum–organic complex (at high concentrations of molybdenum) or due to the loading of molybdenum in preference to uranium (at low concentrations of molybdenum); and the formation of crud in the SX stripping section due to dissolved silica present in acid leach liquors (with a warning that the introduction of pressure leaching for Witwatersrand ores might aggravate the silica problem).

Dr R. J. Bosman, of Essochem Europe, presented experimental evidence drawn from the laboratory and from several years of commercial experience in support of the ESCAID range of diluents for use in solvent-extraction applications in the mining industry. He pointed out that the selection of diluents is usually a hard-headed compromise between six factors: hydrometallurgical performance, safety in handling and operation, diluent losses, side reactions in extraction, compatibility with materials of construction, and environmental aspects. As Dr Bosman rightly pointed out at the conclusion of his talk, cost considerations are, in the final analysis, all-important.

Fundamentals of IX–SX Design

Mike Slater, of Bradford University, described the results of a co-operative research programme with Nchanga Consolidated Copper Mines aimed at improving design methods for SX mixer–settlers. The results of the study showed that extraction efficiency is markedly influenced by the hydrodynamics of the mixer. While simple batch tests can be useful in the preliminary design of settlers, they cannot be used for mixer design because hydrodynamic conditions in a batch mixer are different from those in a continuous mixer. Dr Slater made suggestions as to how operating problems in mixer–settlers can be overcome and their efficiency improved by modification of either the design or the operating procedure. The results of his investigations are being taken into consideration in the design of the new mixer–settlers to be used on the Zambian Copperbelt.

Hans-Martin Stönner, of Lurgi, Frankfurt, dealt with three separate topics relating to the design of equipment for the recovery of uranium by solvent extraction. He first presented mathematical models for the correlation of data on the influence of competing ions such as chlorides and sulphates on the extraction of uranium and for the design of settlers, and then went on to describe various techniques and equipment for the recovery of solvent from barren solutions.

Chris Fleming, of NIM, described how information on the rate of gold loading onto activated carbon can be obtained from a carbon-in-pulp plant operating at steady state. It had been found that the change in the loading of gold on carbon was proportional to the concentration of gold in solution and showed a half-order dependence on contact time. Since the proportionality constant had the same value for each of the four stages, he and his co-workers had been able to use this empirical rate expression to relate the amount of carbon in each stage and the number of stages for any extraction duty with the concentrations of gold in the head and barren solutions and on the activated carbon leaving the plant. The model predicts that the carbon should be evenly distributed between the stages, resulting in a constant percentage extraction for each stage.

New Developments in IX Resins

A particular feature of the Symposium was the interest generated by several excellent papers on new developments in the manufacutre of ion-exchange resins.

John Ungar, of Ionac Division, Sybron Corporation, New Jersey, pointed out that the synthesis of chelating resins that have a high affinity for certain metals was a significant breakthrough. Chelating resins can be highly selective for base metals such as copper, cobalt, and zinc at pH values below 3,0. The selectivity is so great that metal ions are removed to below the analytical-detection limits. In tests comparing a conventional resin with a selective resin for the recovery of copper and cobalt, the major differences observed were that the conventional resin had a higher exchange capacity but that the selective resin gave an extremely low barren solution (high recovery). Both of the resins tested were eluted with 2N hydrochloric acid. A macroporous selective resin was tested in the recovery of gold from an acid solution heavily contaminated with base metals such as copper and nickel. The results showed that the gold was completely absorbed onto the resin to the exclusion of the other metals. The gold can be recovered, either by burning of the resin to give free gold, or by elution of the resin with thiourea and electrolytic recovery of the gold. The capacity of the resin for gold was about 150 g/l. Other metals, e.g. platinum and mercury, can also be recovered by these selective resins. According to Mr Ungar, their principal application would be in the recovery of values from waste water, or of valuable metals from a solution containing large concentrations of base metals. The principal advantages of chelating resins is their high selectivity and efficiency of extraction.

Mr Ungar presented a second paper, in which he spoke on the influence of the ion-exchange functional groups and the resin matrix on the performance of IX resins for the recovery of uranium.

Brian Green, of NIM, generated considerable interest by presenting experimental results on the loading and selectivity of commercially available, as well as newly synthesized, resins developed by NIM for the recovery of copper, nickel, and cobalt. Dr Green claimed that the successful development of a new type of resin known as PI4, and the possiblity that its active group could be modified, made him confident that copper-selective resins with much improved capacities and better elution properties would be synthesized in the not-too-distant future. He also made the point that it now appeared feasible to separate copper, nickel, and cobalt from one another and from other metals by the use of a series of columns and selective IX resins. Resins of the PI4 type also promise to play an important role in this area. In reply to a question during the discussion period, Dr Green said that no work had yet been done on the loading and elution kinetics of the new resins, but he had reason to believe that the kinetics for copper recovery would be as good as, or better than what is obtained in the recovery of uranium by strong-base IX resins.

It was clear from remarks made during the discussion periods that the advent of a commercial IX resin for copper is keenly awaited by the suppliers of CIX contactors because of the potentially important area of application for CIX in the recovery of copper from unclarified solutions.

Trevor Giddey, of Klipfontein Organic Products (Sentrachem Group), described laboratory testwork on the performance of a high-density weak-base resin suitable for the recovery of uranium from acid leach liquors in CIX contactors. Weak-base resins have the potential advantage over strong-base resins of not requiring a Bufflex or Eluex configuration (combination of IX and SX). However, conventional weak-base resins are often lighter than their strong-base counterparts, which can be a disadvantage, particularly in upflow fluidized-bed CIX contactors and in resin-in-pulp processes. In addition, the manufacturing techniques used for conventional weak-base resins are such that these always contain a small proportion of strong-base groups. For this reason, the elution circuits that have been developed for commercial weak-base resins have not been attractive, principally because of the reagents necessary to effect complete elution of the uranium. The synthesis, by Sentrachem, of an experimental high-density weak-base resin with zero strong-base functionality opens up the possibility of overcoming both the disadvantages mentioned above. Dr Giddey presented experimental results showing that the new resin could be totally stripped of its uranium by bicarbonate and carbonate ions. Further developments in this investigation will be followed keenly by metallurgists interested in uranium extraction.

Comparative Testing of IX Resins

Graham Pingram, of the AEB, pointed out some of the pitfalls in the evaluation of ion-exchange resins for use in CIX contactors. One of the attractions of CIX is that the absorption section requires a much smaller resin inventory than a fixed-bed IX plant treating the same throughput. This means that the resin has to work harder, and its performance becomes more critical. The performance of resins is determined by their structure and by the concentration of competing ions, like ferric or chloride ions, in the pregnant solution. It is the equilibrium capacity of the resin and the loading rate in the pregnant solution that determine many of the design parameters for the absorption column. For this reason, the evaluation of ion-exchange resins should go hand in hand with design and feasibility studies. Mr Pingram emphasized that resin samples should be preconditioned before being used in laboratory testwork aimed at the selection of a resin based on criteria such as concentration in the barren solution and resin loading. Factors such as fouling by silica can be assessed only under plant conditions. When comparisons are made of resins of widely different physical properties (such as osmotic-shock degradation and fluidization losses of fine beads), the unit purchase price of the resins should be adjusted to allow for the anticipated replacement rate of the resin inventory. It was clear from Mr Pingram's talk that much progress has been made towards the standardization of testing procedures among resin manufacturers, research organizations, and mining laboratories, to the mutual benefit of all concerned.

Combination of IX and SX

David Boydell, of the AEB, discussed some of the chemical factors that complicate the choice of a process route for the recovery of uranium, with particular reference to the Bufflex or Eluex configuration, i.e. continuous ion exchange followed by a relatively small solvent-extraction section. He mentioned that, of the 18 uranium plants at present in operation in Southern Africa, 2 use fixed-bed IX, 9 the Purlex SX process, and 7 the CIX–Bufflex process. Dr Boydell presented a number of equilibrium isotherms illustrating the effect of the composition of acid leach liquors on the efficiency of uranium recovery, with special emphasis on those conditions that are particularly unfavourable to either SX or IX. He concluded that the concentration–purification section of a uranium plant should not be a problem area if it is designed with adequate forethought of the adverse conditions that may occur.

Direct Treatment of Pulps by IX and SX

Two interesting papers were presented on resin-in-pulp (RIP) and solvent-in-pulp (SIP) processes that were investigated on a pilot-plant scale in the early 1970s. Both investigations had been curtailed, but recent renewed interest in the direct treatment of pulps by IX and SX prompted the investigators to present papers on these topics.

Dirk Cloete, of Stellenbosch University, recounted work on the pilot-plant investigation of a resin-in-pulp (RIP) process for the recovery of uranium direct from undiluted leach slurries without any intermediate solid–liquid separation. This work was undertaken in the early 1970s by the Extraction Metallurgy Division of AEB, in collaboration with NIM and with uranium producers who are affiliated to the Nuclear Fuels Corporation of South Africa. The feasibility of the Relix process, as it was called, depends on the ability of the resin to float in a band in the upper part of a leaching pachuca or RIP contactor. The idealized concept involves pulp overflowing from one pachuca to the next in series, being drawn from a zone where there is very little resin. Countercurrent flow of resin is achieved by airlifts drawing from the resin band in the upper part of the pachucas. The resin band acts like an inverted fluidized bed in which the fluidizing medium is pulp flowing slowly downwards. The main advantages of the Relix process over the RIP processes in use on a commercial scale in the U.S.A. and U.S.S.R. are that part of the leaching process is combined with the recovery of uranium onto resin, and the need for interstage screens is eliminated. Mr Cloete explained that the concept of an inverted fluidized bed could not be demonstrated successfully on a pilot plant because the agitation required to keep the pulp in suspension was too severe to permit phase separation by this principle. This resulted in very poor metallurgical performance due to severe back-mixing of both the resin and the pulp between stages.

Hugh Byerlee, of the AEB, created considerable interest with his paper on the recovery of uranium by SIP. Many attempts have been made by workers in a number of countries to develop an acceptable SIP process. The main problem has always been the serious losses of solvent that occurred. Mr Byerlee described an investigation that he undertook in Australia during the 1960s and early 1970s. The first part of his paper dealt with work on the causes of solvent losses and the design of an improved contactor. He had found that the prime cause of solvent loss was the dispersion of one phase in another, a secondary cause being the movement of mineral grains by gravitational and inertial forces to the slurry–solvent interface, where they became wetted by the solvent. He had therefore designed a contactor that would avoid these causes of solvent loss while at the same time effecting efficient mass transfer. The contactor consists of a column filled with grids. The slurry enters at the top and flows as films on the surface of the grids. The solvent, which fills the column, flows countercurrently to the slurry. Preliminary pilot-plant tests at Rum Jungle Mine had demonstrated the potential of the contactor regarding efficient mass transfer and lower solvent losses than in conventional plants.

Mr Byerlee claims that this SIP process could potentially reduce the capital cost of a plant by 30 per cent since it completely eliminates the need for a solid–liquid separation step. To questions regarding the build-up of coarse solid particles on the grids and blockages caused by wood fibres, Mr Byerlee replied that the contactor could handle solids up to 4 mesh in size and wood fibres up to a length of about 17 mm. The most important other requirement for the feed slurry is that it should be sufficiently viscous for stable flow to be achieved on the grids. The rule-of-thumb here was that the viscosity should be similar to that achieved in the underflow from a thickener fed with the slurry in question. Doubt was expressed about the ability of the column to achieve efficient extraction with a small interfacial area, and Mr Byerlee replied that the most important reason for the column's efficient extraction was the differential contact of the two phases in the column. As an example, he quoted uranium, where differential contact may result in a driving force for mass transfer that is fifty times higher than would be encountered in a mixer–settler.

Closing Address

Dave Viljoen, President of the South African Institute of Mining and Metallurgy, presented the closing address. He said that the major part of future increases in the supply of minerals will come from advances in mining and metallurgical technology rather than from the discovery of new deposits. Higher rates of consumption in the future will depend increasingly on the rapid development of technology. The need to develop the most economic process flowsheet for each particular ore is more important now than in the past owing to the rapid rise in the costs of labour and capital equipment, and the generally declining ore grades. In addition, more complex ores are being treated and consumers are demanding products of higher purity. In view of these facts, if the spectacular technological advances in IX and SX technology that have been made in the processing of uranium ore could be applied more widely, these techniques could make a significant contribution towards the future supply of a number of important metals. It had therefore been extremely encouraging to learn during the course of the Symposium that promising results were being obtained in this direction, particularly in the development of new resins.

Social Aspects

Thanks to the efficient luncheon arrangements by NIM and to the generosity of Sentrachem Limited, Davy-Ashmore South Africa (Pty) Ltd, and Ionac Chemical Company, who sponsored the cocktail party, the delegates were given excellent opportunities for an informal interchange of views and ideas.

Ion exchange and solvent extraction

The Symposium on Ion Exchange and Solvent Extraction in Mineral Processing, which was organized jointly by the National Institute for Metallurgy, the South African Institution of Chemical Engineers, and the South African Institute of Mining and Metallurgy, was held in Randburg on 7th and 8th February, 1980.

The following papers, which are summarized on pages 131 to 136 of this issue, were presented:

In-situ uranium extraction: surface plant process chemistry and equipment, by J. E. Litz (Hazen Research, Inc.)

The use of a high density weak base resin for uranium recovery from acid leach liquor, by T. B. S. Giddey (Klipfontein Organic Products Corporation Ltd.)

The Relix process for resin-in-pulp recovery of uranium, by F. L. D. Cloete (University of Stellenbosch)

Practical considerations in diluent selection for hydrometallurgy, by R. J. Bosman (Essochem Europe Inc.)

Selective ion exchange resins for metal recovery, by F. X. McGarvey and J. Ungar (Ionac Chemical Co.)

The optimization of a carbon-in-pulp adsorption circuit based on the kinetics of extraction of aurocyanide by activated carbon, by C. A. Fleming and M. J. Nicol (National Institute for Metallurgy) and D. I. Nicol (Davy-Filtron)

The evaluation of resins for use in continuous ion-exchange contactors, by G. Pingram and R. Lombaard (Atomic Energy Board)

Influence of the ion exchange functional group on uranium recovery, by F. X. McGarvey and J. Ungar (Ionac Chemical Co.)

The development and performance of resins selective for copper, nickel, and cobalt, by B. R. Green and R. D. Hancock (National Institute for Metallurgy)

Solvent extraction of uranium-processor and equipment design, by H. M. Stönner and P. Wiesner (Lurgi Kohle und Mineraloltechnik (GmbH))

Recent advances in understanding the performance of mixer–settlers, by M. J. Slater (University of Bradford)

A contactor for solvent extraction from slurries, by H. W. Byerlee (Atomic Energy Board)

Technical service in uranium solvent extraction; practical problem solving in South Africa and the United States, by J. P. McDonald and P. L. Mattison (Henkel Corporation) and J. M. W. Mackenzie (Trochem Pty Ltd)

Bufflex and related circuits for the recovery of uranium, by D. W. Boydell (Atomic Energy Board)

The extraction of uranium from tailings pond solution at the United Nuclear–Homestake Partners' mill in New Mexico, by A. R. Hendriksz (Bateman Uranium Corporation) and R. D. Lear (United Nuclear–Homestake Partners)

The design, commissioning, and performance of the NIMCIX section of the Chemwe uraniums plant, by A. M. McIntosh and W. M. Craig (Atomic Energy Board) and E. B. Viljoen (General Mining & Finance Corporation Limited)

The Rössing continuous ion exchange plant, by P. N. Vernon and C. W. Sylvester (Rössing Uranium Ltd)

Himsley ion exchange for uranium recovery, by E. J. J. van Vuuren and K. G. Thomas (Vaal Reefs Exploration & Mining Co. Ltd).

It is hoped to publish the above papers in a future issue of this *Journal*.

Analytical chemistry

The Fifth International Conference on Analytical Chemistry, organized by the Chemical Society, is to be held at Lancaster University, England, from 20th to 26th July, 1980.

The conference will cover all aspects of analytical chemistry. The scientific programme will consist of four plenary lectures, contributed papers in three lecture streams, and poster presentations, together with workshops, a comprehensive instrument exhibition, and works visits.

Registration forms and more details about the programme are available from The Secretary, Analytical Division, Chemical Society, Burlington House, London W1V OBN, U.K.

Coal mining

The First International Symposium on Thick and Steep Seam Coal Mining will be held in London from 18th to 21st May, 1980.

The growing demand to increase coal production in many countries is focusing attention on recovery of coal from what many engineers have termed to be 'difficult mining'. Both thick and steeply dipping coal seams meet this definition. Coal mining of these types of seams in Europe is far more important, and growing faster than in the U.S.A.

New mining equipment has been especially designed and built for these types of mining. This equipment mechanizes mining to a degree not heretofore achieved and increases productivity in tons per man shift. These factors are focusing attention on thick and steep seam mining in many parts of the world. There are large known, yet unmined, reserves of this type of coal in the U.S.A. and other countries.

More conventional methods of mining of flatter and thinner seams have produced more coal than the market can burn. This will change. Thick and steep seam mining is growing in importance in many countries.

It is more than ten years since an International Symposium on these types of mining was held. The time is here for an International Symposium to give a complete report on progress and forecast the future of thick and steep seam mining. Any seam over 10 feet thick is considered to be 'thick' for the Symposium. 'Steep' means all seams dipping over 20°.

In addition to the technical programme several post-symposium field trips are being considered to visit thick seam mining operations in Europe.

Further details are available from The Symposium Coordinator, 500 Howard Street, San Francisco, California 94 105, U.S.A.

Mineral processing

The XIV International Mineral Processing Congress will be held in Toronto from 10th to 16th October, 1982. The theme of the congress will be 'Worldwide industrial application of mineral processing technology'.

Sessions will be held on the following:

1. Flotation — plant practice, equipment, design, simulation, control, and economics.
2. Comminution — plant practice, equipment, design, simulation, control, wear, energy consideration, and economics.
3. Round-table seminar on large grinding mills.
4. Round-table seminar on modern and future plant design.
5. Mineral processes to recover precious metals.
6. Mineral processes to recover energy minerals (coal, uranium).
7. Mineral processes to recover industrial minerals.
8. Round-table seminar on the environment and ecology, and how the different countries cope with associated problems.
9. Materials handling, with an emphasis on agglomeration techniques, preconcentration methods, solid–liquid separation.
10. Open session to deal with topics emerging from general demand.

For further details, write to Mr Roland Le Houiller, Technical Program Chairman, 2700 Rue Einstein, Ste-Foy, Quebec, Canada GIP 3W8.