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Forty Five Years IMPC

Fathi Habashi

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Special contribution

Forty five years IMPC

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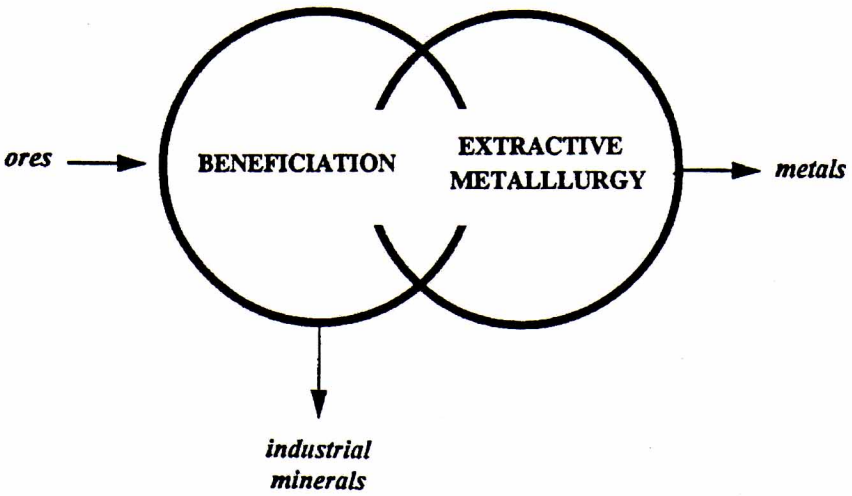
Abstract

During its forty five years of existence, the International Mineral Processing Congress has been a major driving force for promoting scientific and technical knowledge in areas such as comminution, flotation and other separation methods, mineral sciences and hydrometallurgy. The Congress has been a truly international gathering that met twenty times in 12 countries.



MINERAL PROCESSING

Introduction

The history of the International Mineral Processing Congress is the history of modern mineral processing. During its forty-five years of existence from 1952 to 1997, IMPC has been a major driving force for promoting scientific and technical knowledge in areas such as comminution, flotation, and other separation methods, mineral sciences, and hydrometallurgy. The Congress has been a truly international gathering that met 20 times in 12 countries at an average participation of 700 delegates per Congress (Table 1).

The impact of these congresses on the mineral industry of the world may be found in many new processing plants and in substantial changes made in the older plants. Rapid developments in comminution, classification and in heavy-media, magnetic and electrical separation as well as substantial advancements in flotation theory and practice may be traced directly to the proceedings and discussions of these Congresses. The extent of knowledge on the principles of classification in hydrocyclones and the proliferation of research, development and application of autogenous grinding may be cited as specific examples. Most certainly these congresses have contributed in large measure to the current capabilities of the mining industry to support the world-wide expansion of all industries.

Continuity of the congresses is the responsibility of the International Scientific Committee, but the job of organization lies with the sponsoring institution. From the First Congress, hydrometallurgy was considered a part of mineral processing. However, it was poorly represented - - only two papers on cyanidation. Gradually, it increased in importance, e.g., in the 1960 Congress there were 5, and in 1993 there were 30. Pyrometallurgy was sporadically treated at the meetings. Few papers were presented dealing with roasting, chlorination, and thermal segregation processes. Sessions on the environment were introduced only in 1975 and a Round Table Discussion in 1982. At that conference, also biological leaching was discussed for the first time. Interest in modelling and simulation and industrial minerals started in 1982, while recycling using mineral beneficiation methods in 1997.

The symposium of 1952

The first Congress was held in September 1952 as a Symposium on Mineral Dressing in London, organized by the Institution of Mining and Metallurgy, which coincided with 60 years of its foundation[1]. The chairman of the Symposium Committee was C.W. Dannatt, head of the metallurgy Department at the royal School of Mines in London, and was Dean of the School when the Symposium was organized. The Symposium took place at the Imperial College of Science and Technology of which the School of Mines was a part.

[1]The Institution of Mining and Metallurgy was founded in 1892, and incorporated by Royal Charter in 1915, for the advancement of the science and practice of mining in respect of minerals other than coal, and of metallurgy in respect of metals other than iron; and to afford a means for facilitating the acquisition and preservation of that knowledge which pertains to the profession of a Mining Engineer and Metallurgist.

Table 1 - The International Mineral Processing Congresses

	Year	Location	Number of papers	Number of delegates *	Congress Chairman	IMPC President
1	1952	London, England	39	332	C.W. Dannat	
2	1953	Paris, France	28	302	P. Seyer	
3	1955	Goslar,F.R. Germany	30	490	H.J. Salau	
4	1957	Stockholm, Sweden	34	523	P.G. Hihlstedt	
5	1960	London, England	52	714	J.E.. Denyer	
6	1963	Cannes, France	50	750		
7	1964	New York, USA	55	1200	H.R. Spedden	
8	1968	Leningrad*, USSR	69	900	I.A.Strigin	J.E. Astier
9	1970	Prague, Czechoslovakia	55	700	M. Dolezil	J.E. Astier
10	1973	London, England	48	700	M.G. Fleming	J.E. Astier
11	1975	Cagliari, Italy	77	787	M. Carta	J.E. Astier
12	1977	Sao Paulo, Brazil	128	562	J. Maia	J.E. Astier
13	1979	Warsaw, Poland	98	717	J. Laskowski	J.E. Astier
14	1982	Toronto, Canada	110	600	P.D.R. Maltby	J.E. Astier
15	1985	Cannes, France	150	750	P. Blazy	J.E. Astier
16	1988	Stockholm, Sweden	177	550	E. Forsberg	E. Forssberg
17	1991	Dresden, Germany	141	715	H. Schubert	E. Forssberg
18	1993	Sydney, Australia	220	642	R.G. Batterham	E. Forssberg
19	1995	San Francisco, USA	186	585	J.A. Herbst	E. Forssberg
20	1997	Aachen, Germany	350		H. Hoberg	E. Forssberg

* Now Saint Petersburg, Russia

** Excluding companions

During the post war years, there was a great need to increase exploitation of low grade deposits because the growing demand during the first half of the century has resulted in depletion of the rich deposits. The original intention was to organize a symposium of two days' duration, but it soon became evident that at least three days would be required. Only 39 papers were accepted and it was only lack of space and of time for discussion that prevented the acceptance of a still larger number of contributions. The papers were circulated in advance as pre-prints so that the author in his presentation could give only a brief introduction, and therefore a longer time could be devoted to discussion.

Since the Symposium was an IMM affair it was preceded by the third Sir Julius Wernher[2] Memorial Lecture of the Institution. For this purpose Antoine M. Gaudin, Professor of Mineral Engineering at the Massachusetts Institute of Technology was selected to deliver the lecture - - he was at that time the most noted mineral processing scientist. The subject was "Radioactivity in Mineral Dressing" and not on flotation as one would have expected. The reason may be that MIT was heavily involved in the Manhattan Project which necessitated the treatment of uranium ores.

The proceedings of this Symposium were published by the Institution in 1953. Among the participants and authors of this Symposium are naturally those who were heavily involved in research, teaching, or operating mineral beneficiation plants. Some of these with the title of their talks were:

- E.J. Pryor, "Purpose of Fine Sizing and Comparison of Methods
- E.J. Pryor, "Flotation of Oxidized Minerals"
- F.C. Bond, "Mathematics of Crushing and Grinding"
- J.V.N. Dorr, "Classification and Fluidization"
- N. Arbiter, "Surface Chemistry of Flotation"
- M.G. Fleming, "Flotation of Secondary Lead Minerals"
- N. Hedley and H. Tabachnick, "Arsenic and Antimony Sulfide Minerals in Cyanidation"
- P.G. Kihlstedt, "Milling Technique at Boliden, Sweden
- M. Rey and P. Raffinot, "Flotation of Oxidized Zinc Ores".

There were papers on mineral dressing in diamond mining, preparation and grading of asbestos in Canada, as well as other general topics, and the Symposium had an international character.

[2] Sir Julius Wernher (1850-1912) was born in Darmstadt, educated in Frankfurt/Main, employed by a diamond dealer in London, was sent to Kimberly in South Africa, made a fortune in the business. He donated much of it to educational and research institutions of which the Imperial College of Science and Technology was one. He died in London.

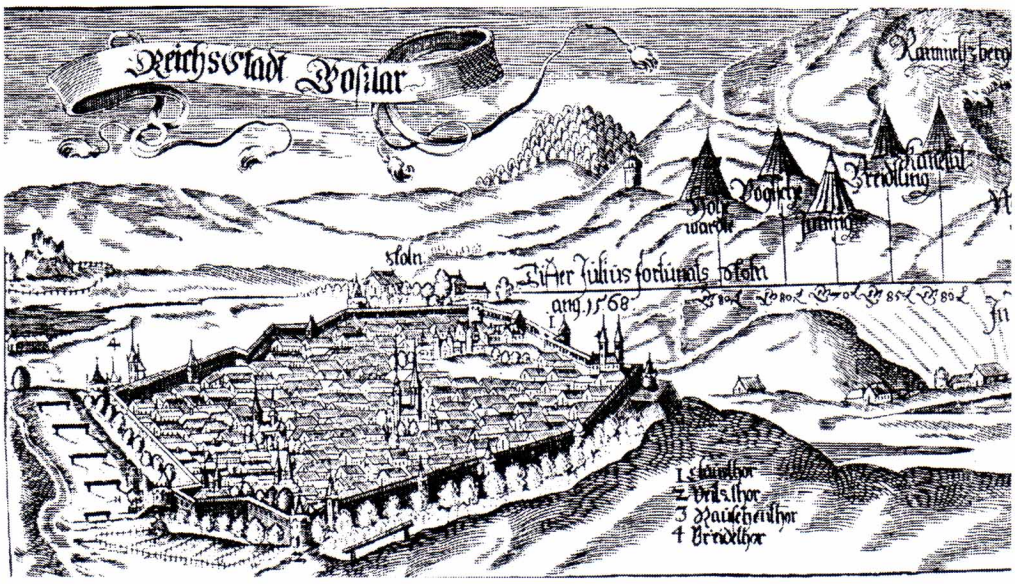
Paris 1953

Following the London Symposium a working party was appointed within the OEEC in Paris to promote international co-operation in the development of methods leading to the utilization of low-grade ores. As a result of this action, study tours were organized, first in Europe and later to the USA and Canada. In these tours, 24 technical leaders and administrators emphasized the need for periodic, international meetings. A symposium was held in September 1953 in Paris at the École Nationale Supérieure des Mines, organized by P. Seyer and the Société de l'Industrie Minérale at Saint-Étienne as the "Congrès des laveries des mines métalliques françaises". The success of the program led to the formation of a cohesive but informally organized group of individuals dedicated to the concept of improving mineral processing technology by further meetings.

Jaques E. Astier

Proceedings of the Congress were published in *Revue de l'Industrie Minérale* in November 15 and December 15, 1953 and 1954. Among the notable participants at this Congress were P. Gy and J.E. Astier. The latter became heavily involved in the activities of the IMPC and was president of the Scientific Committee from 1953 to 1985 and was elected president of the IMPC from 1968 to 1985.

Goslar 1955



Goslar in 1606

In May 1955 the "Internationaler Kongress für Erzaufbereitung" held in Goslar in the Federal Republic of Germany drew participants from a great number of countries around the world. Goslar is an old mining town in Central Germany at the foot of the Harz mountains famous for its one-thousand years old lead-silver Rammelsberg Mine. The Organizing Committee was chaired by Dr. H.J. Salau from Preussag Harzer Berg- und Hüttenwerke at Bad Grund in Germany and included:

- E. Bierbrauer, professor at the Montanistische Hochschule in Leoben, Austria
- A. Juagey, General Secretary of the Société de l'Industrie Minérale in Saint-Étienne, France
- P.G. Kihlstedt, professor at the Royal Institute of Technology in Stockholm
- T. de Magree, professor at the Université Libre de Bruxelles in Belgium
- M. Mortenson, professor at the Norwegian Institute of Technology in Trondheim
- E.J. Pryor, lecturer at the Imperial College of Science and Technology in London
- A. Reggiori, from the Breda Institute of Scientific Research Applied to Industry in Milano, Italy
- N. Weiss, mining engineer at the American Smelting & Refining Company in Salt Lake City, Utah and Associate Chairman of the Minerals Beneficiation Division of the AIME in New York
- W. Koch, Secretary at the Gesellschaft Deutscher Metallhütten- und Bergleute in Clausthal, Germany.

The Organizing Committee came to the conclusion that an International Union of Ore Beneficiation Engineers should be founded. Further, a committee composed of five specialists from Belgium, Britain, France, Germany, and Sweden met and recommended the following:

- Establishing an international information service in mineral processing.
- Establishing a permanent Secretariat for the IMPC.
- A representative from each participating country should send a collection of research reports from his country to the IMPC Secretariat for distribution to other participants.
- A budget of about DM 70 000/year should be allotted for this activity.
- H.J. Salau was given the responsibility of carrying these recommendations to reality.

The papers presented at the Goslar Congress were translated in *Zeitschrift für Erzbergbau und Metallhüttenwesen* known as Erzmetall. Among the new participants: P. Gy, H.R. Spedden, E. Cohen, P. Ramdohr and others. At the Goslar Congress, the Svenska Gruvföreningen and Jernkontoret invited the participants to hold their next meeting in Stockholm. The invitation was accepted.

Stockholm 1957

The Fourth Congress was held in Stockholm at the Royal Institute of Technology in 1957. In addition to the conventional topics of mineral beneficiation, there was a session devoted to "Roasting and Sintering". Among the new participants: R. Hukki, S. Eketorp, S.I. Mitrofanov, H. Hohn, G. Björling, V.A. Glembotsky.

At this Congress, H. J. Salau reported on the possibility of forming the proposed International Union. The idea was very ambitious because beside having a central office, it was also suggested to have an information center and a proposed name "European Mineral Processing Association". Billiton proposed providing the necessary rooms for the secretariat at the Hague and a person who could serve as secretary. Salau, however, was doubtful that the Association could raise the required fund of 70 000 DM (about £ 6 000 or 7 million French francs) at that time and the idea was shelved.

London 1960

In April 1960, the fifth IMPC was convened again in London by the Institution of Mining and Metallurgy, but it had an Overseas Advisory Committee which included L.E. Djingheuzian (Canada), M.Rey (France), L.N. Plaksin (USSR), P.G. Kihlstedt (Sweden), and others. It was at this meeting that the title *International Mineral Processing Congress* was adopted for the proceedings volume.

Pre-prints were again prepared, this time, with French, German, and Russian summaries. There was simultaneous translations in the four official languages during the presentations. The fifth Sir Julius Wernher Memorial Lecture was delivered by I.W. Wark with the title "The Exploitation of Minerals for Mankind", the text of which was published in the May 1960 issue of the Transaction of the Institution. The proceedings were then published in the same year by the Institution.

During the Congress, representatives of learned bodies and organizations in the different interested countries discussed proposals for further Congresses. As a result of these discussions, P. Seyer, at the concluding session of the Congress, confirmed an invitation from the Société de l'Industrie Minérale de France to hold the sixth Congress at Cannes in the Spring of 1963. The Société planned, he said, to invite appropriate bodies in Italy, Spain, Portugal and Yugoslavia to take a share in the organization of the Congress, particularly in connection with visits to treatment plants. H. Rush Spedden also conveyed an invitation from the American Institute of Mining, Metallurgical and Petroleum Engineers to hold the seventh Congress in New York in the autumn of 1964. These invitations were accepted with acclamation by those attending. The Congress also received with the greatest satisfaction a suggestion made by I.N. Plaksin on behalf of scientific bodies in the USSR that a future Congress should be convened in Moscow[3].

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[3] The Eighth IMPC was convened in Leningrad (now Saint Petersburg) in 1968.

Cannes 1963

The Sixth IMPC was held from May 26 to June 2, 1963 in Cannes in the French Riviera. Although not as large as Nice, it is one of the most elegant resorts. Cannes is also known by the fact that Napoleon disembarked there when he returned from his exile in Elba on March 1, 1815.

The Congress was organized by the Société de l'Industrie Minérale and was attended by 750 delegates from 55 countries. Among the themes dealt with in the various technical sessions were the beneficiation of iron ores, hydrometallurgy, and techniques of measurement, control, and automation in mineral dressing. Of over 200 papers submitted some 50 were presented at the Congress.

Among the noted participants one may mention: N. Arbiter, D.W. Fuerstenau and P. Somasundaran, F.L. Holdereed, T.G. Fulmor from USA, F.A. Forward, A. Vizsolyi, and H.L. Noblitt from Canada, D.A. Everest, R.A. Wells, A.R. Burkin and E. Napier from England, M. Carta, G.F. Ferrara, and G. Rinelli from Italy, I.A. Kakovesky from USSR, and M. Durand from France.

New York 1964

The Seventh IMPC was convened in New York on 20 September 1964 with opening ceremonies at Columbia University in commemoration of the Centennial of its School of Mines, the first of the mining schools in the USA. The Welcoming Luncheon on the following day was highlighted by the first Arthur F. Taggart[4] Memorial Lecture presented by Professor A.M. Gaudin who chose as his theme "The Next One Hundred Years". Technical sessions filled the four days of the 21st to the 24th of September. All

[4] Arthur Fay Taggart (1884-1959), professor of Mineral Engineering at Columbia University from 1919 until his retirement in 1951, well known as editor of *Handbook of Ore Dressing* (1927), and *Handbook of Mineral Dressing* (1947), and as author of *Elements of Ore Dressing* (1951).

sessions were conducted with simultaneous translation in the official Congress languages. Congress papers were published in a pre-print volume in English with abstracts in French, German, Spanish, and Russian. Members who registered sufficiently in advance for mail service received their volumes some weeks prior to the sessions. In addition, a companion volume, "Milling Methods in the Americas" was presented to each member. Both volumes were edited by Nathaniel Arbiter.

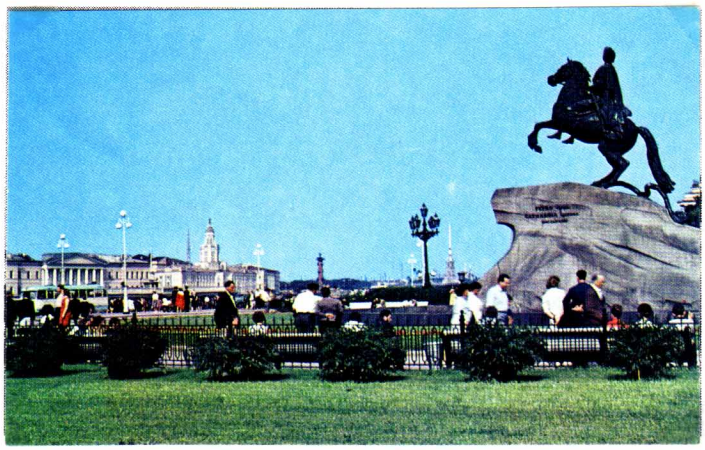
The Fall Meeting of the Society of Mining Engineers was held concurrently with the Congress during the period of 23rd to 25th September. This added program provided an opportunity for Congress members to hear papers on exploration, geology, mining, industrial minerals and coal preparation. The Seventh IMPC was sponsored by the American Institute of Mining, Metallurgical, and Petroleum Engineers and by Columbia University. Generous financial support was provided by a large number of industrial firms, both in the USA and Canada. Post-Congress tours to the Southwestern USA copper district and to the Great Lakes iron and copper district were conducted during the week following the Congress.

During the Congress, representatives of the professional organizations in the different interested countries met to plan future Congresses. An Interim Committee of the International Mineral Processing Congress was organized consisting of:

- D.F. Kelsall for the Australasian Institute of Mining and Metallurgy
- B.S. Crocker for the Canadian Institute of Mining and Metallurgy
- J. Astier for the Société de l'Industrie Minérale
- E. Puffe for the Gesellschaft Deutscher Metallhütten und Bergleute
- M.G. Fleming for the Institution of Mining and Metallurgy
- P.G. Kihlstedt for the Swedish Miners Association
- H.R. Spedden for the American Institute of Mining, Metallurgical, and Petroleum Engineers
- I.N. Plaksin of the USSR.

The Chairman of the Interim Committee was H.R. Spedden for the AIME and the co-chairman was J. Astier for the Société de l'Industrie Minérale. The Interim Committee was charged with the responsibility of arranging the time and place for the next two Congresses.

Leningrad 1968



The Eighth IMPC was held in Leningrad at the invitation of Academician I.N. Plaksin. Unfortunately, however, Plaksin was not there to participate - - he already passed away. Leningrad was founded by Peter the Great in 1703 as Saint Petersburg, and was capital of Russia from 1703 to 1918. At the beginning of World War I the German name was replaced by the Russian Petrograd, since Russia was at war with Germany. When Lenin died in 1924 the city changed its name to Leningrad in his honor. After the fall of the Communist Party of the Soviet Union in 1991 the old name was retained.

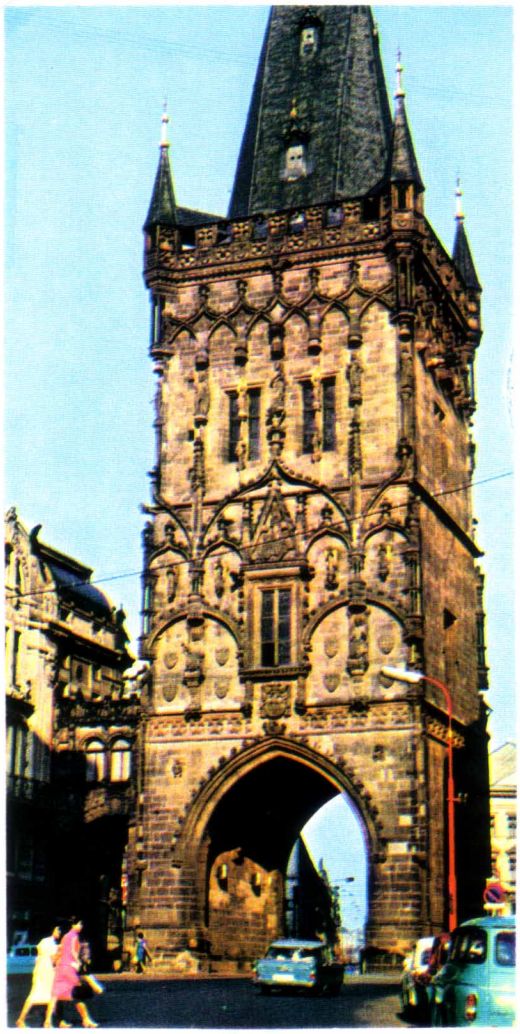
In Leningrad, the pre-prints were translated in Russian and published in two volumes. These included the following sections:

- Crushing, grinding, and screening
- Magnetic, electrical, and special methods of ore preparation
- Gravity concentration, classification and dewatering
- Flotation technology and flotation machines
- Hydrometallurgy and combined processes
- Methods of research, control, and automation

A Symposium on Flotation Theory in 24 papers and a Seminar on Asbestos Ores were also held.

New participants include: H. Majima, E. Peters, J. Leja, and H. Woodrooffe from Canada, J. De Cuyper from Belgium, J. Cases, P. Blazy, R. Houot, J. Predali from France, T. Meloy from USA, R.T. Hukki from Finland, V.I. Revnivtsev, S.I. Mitrofanov, V.A. Glembotsky, from USSR, H. Schubert from German Democratic Republic, M.R. Zaki from Egypt, and others.

Prague 1970



The Ninth IMPC was held in 1970 in Prague, at that time the capital of Czechoslovakia now the capital of the Czech Republic. These involved in the organization of the Congress were as follows:

- International Scientific Committee

  J. Astier, France *President*

  O.S. Bogdanov, USSR *President*

  O. Burghardt, Federal Republic of Germany

  M. Carta, Italy

  P.G. Kihlstedt, Sweden

  H. Kirchberg, German Democratic Republic

  J.G. Sabariegos, Spain

  H.R. Spedden, USA

  L. Balla, Czechoslovakia

- National Committee

  L. Balla, *Chairman*

  M. Bawer, O. Dinter, M. Delevil, M. Gregor, J. Kaspar, F. Kyntera, J. Mazacek, V. Mihali, J. Odvarka, F. Spaldon, and F. Spetl.

- Organizing Committee

  M. Dolezil, *General Secretary*

  J. Reznicek, *Scientific Secretary*

  M. Patera, *Chairman of Excursions Commission*

  V. Svaga, *Chairman of Social Commission*

The Proceedings volume contained papers in English, German, Russian, and French, and was divided in the following groupings with the number of papers in each:

Comminution and classification	5
Electrostatic and Magnetic Separation	6
Gravity Separation	4
Flotation	10
Hydrometallurgy	8
Pyrometallurgy	3
Control and Automation	4
Dewatering and Waste Water Treatment	4

In addition, there was a Symposium on Agglomeration that included 16 papers.

London 1973

The Tenth IMPC took place in London in April 1973. The International Scientific Committee was chaired by J.E. Astier from France and was composed of nine other members:

O.S. Bogdanov, *USSR*

O. Burghardt, *Federal Republic of Germany*

M. Carta, *Italy*

M.G. Fleming, *Great Britain*

P. G. Kihlstedt, *Sweden*

H. Kirchberg, *German Democratic Republic*

J.G. Sabariegos, *Spain*

F. Spaldon, *Czechoslovakia*

H.R. Spedden, *USA*

The Organizing Committee was set up by the Institution of Mining and Metallurgy in March, 1970 and was chaired by M.G. Fleming from Imperial College. One of its first actions was to appoint Corresponding Members from those most active mining countries not already represented on the International Scientific Committee. These were:

D.F. Kelsall, *Australia*

H.J. Steiner, *Austria*

J. Semkov, *Bulgaria*

H.M. Woodrooffe, *Canada*

G. Tarján, *Hungary*

T. Imaizumi, *Japan*

J. Laskowski, *Poland*

I. Huber Panu, *Romania*

R.E. Robinson, *South Africa*

D. Lešlić, *Yugoslavia*

With their assistance it solicited papers on a world-wide basis; more than 250 abstracts were received in response. The selection process that followed was long and difficult, many papers being read by six or seven referees before a final decision was reached. From it emerged the 48 papers that were presented at the Congress and which are published in the proceedings volume.

The Congress itself was attended by some 700 members. The largest overseas delegation, from the USSR, was headed by the Deputy Minister of Non-Ferrous Metallurgy. Simultaneous translation into Russian, German, French, and English made it possible for these and other foreign visitors from more than 40 countries to take an active part in the proceedings. With the President of the Institution of Mining and Metallurgy in the Chair, the Congress was officially opened on the afternoon of 2 April by Christopher Chataway, Minister for Industrial Development. This was followed by the Tenth Sir Julius Wernher Memorial Lecture, which was delivered by M.G. Fleming and was entitled, "Man and Minerals - A Viable Contract".

There were sixteen technical sessions: two on comminution, four on flotation, two on chemical processing, and one each on screening and classification, gravity concentration, electrodynamic and magnetic separation, process appraisal, plant design and practice, fine particle processing, computer control and sorting. An exhibition of mineral processing equipment was provided by more than 35

companies from different parts of the world and the Imperial College facilities for student training and research in mineral technology and related subjects were also on show. The proceedings volume was edited by M.J. Jones and published in 1974 by the Institution of Mining and Metallurgy. At this congress an invitation was received to hold the next congress in Cagliari, Sardinia.

Among the participants at this Congress one may mention M.J. Cahalan, E. Cohen, H. E. Rose, J.A. Kitchener, A.W. Fletcher, D.S. Flett from United Kingdom, Paolo Massacci, and Anna Maria Marabini from Italy, John A. Herbst, M.C. Fuerstenau from USA, Gordon E. Agar from Canada, H.J. Steiner from Austria, and many others.

Cagliari 1975

The Eleventh IMPC took place from April 20-26 1975 in Cagliari (the former capital of the Kingdom of Sardinia), together with the Seminar on the *Beneficiation of Lean Phosphates with Carbonate Gangue*, both were organized by the Institute of Mining and Mineral Processing of the University of Cagliari under the patronage of the Sardinian Regional Government, Assessor for Commerce and Industry, with contributions from various boards, associations and industrial companies. The Organizing Committee was chaired by Prof. M. Carta. Simultaneous translation into five languages, English, French, German, Russian, and Italian was assured throughout the Congress. The International Mineral Processing Exhibition was also organized with the participation of Italian and foreign exhibitors.

There was some change in the International Scientific Committee chaired by J.E. Astier: new members N. Arbiter (USA), and H. Schubert (German Democratic Republic), while H.R. Spedden (USA) left. The corresponding members also showed some changes: new representations from Algeria, Tunisia, Morocco, Belgium, and Brazil.

The program was divided into technical sessions covering the following main subjects: Comminution and Agglomeration; Screening, Classification, Thickening and Gravity Separation; Flotation; Electric and Magnetic Separation; Chemical and Biological Processes; control and Testing; Process Design, Plant Management and Practice; Special Processes and Fine Particle Processing; Ecological Problems and Waste Treatment. Of the 77 papers received which involved 253 authors from 33 countries, 53 were discussed in the plenary sessions and were published in the proceedings volume. The remaining 24 papers have been collected in a special volume and published through the assistance of the Sardinian Mining Board.

New names appeared at this Congress. One may mention Heinz Hoberg, and F.U. Schneider from Aachen, Roberto C. Villas Bôas from Rio de Janeiro, Gilles Barbery from Orleans (France), J. Leja from Canada, A.J. Lynch from Brisbane, and many others.

São Paulo 1977

The Twelfth IMPC was held in Sao Paulo, Brazil 1977 and was hosted by two ministries:

- Industry and Commerce
- Mines and Energy

The Organizing and Executive Committee was composed as follows:

J. Maia (*Chairman),* Paulo Abib Andery (Executive Secretary; however he died few months before the opening of the Congress and was therefore substituted by W.T. Hennies), W. Constantino, C.D. Brosch, Milton N. Silva, G.S. Albuquerque, L.C.A. Bothello, Professor Elcio Marquos Coelho, Arthur Lakschewitz Jr., Astor Viana Fillho, Irene Carvalho Balbino, Luiz Francisco Gomes D'Assumpção, Roberto Villas Bôas, Rodrigo Azeredo Frisquina Werneck, Rui Carnida Hasse, Ferreira and Vañia Lucia de Lima Andrade.

An important feature of the Congress was organizing a visit to Jacupiranga mine and beneficiation plant -- the first of its kind to solve successfully the old problem of calcite/apatite separation, on a commercial scale. The proceedings were published in three volumes. At that time mineral research in Brazil was neglected and it is possible that this event was a driving force in accelerating the Mineral Research Center in Rio de Janeiro one year later, i.e., in 1978.

Warsaw 1979

The Thirteenth IMPC took place in Warsaw June 4 to 9, 1979 in the Palace of Culture. It was organized by Polish scientists and engineers under the chairmanship of Prof. Janusz Laskowski from the Institute of Inorganic Chemistry and Metallurgy of Rare Elements, Technical University of Wroclaw. The Organizing Committee received more than 200 abstracts from 29 countries. Some 70 papers were preliminarily selected. Priority was given to papers in which emphasis was placed on the fundamentals of processes, fine particle technology, optimisation and automatization, and treatment of raw materials with total utilization of all mineral constituents. The papers which were finally accepted together with discussions were published in two pre-print volumes in the Congress languages in which they were originally written with abstracts translated into all the official Congress languages. Eight of the initially accepted papers were published in a special issue of the Polish professional journal *Rudy i Metale Niezelazne* (Ores and Non-ferrous Metals) and were discussed at the technical sessions.

The Congress also included two seminars and a Round-Table Discussion:

- Processing of Oxidized and Mixed Oxide-Sulfide Lead-Zinc Ores, under the chairmanship of M. Carta.
- The Treatment of Iron-Titanium Ores, under the chairmanship of S. Zielinski.
- Round-Table on the "Beneficiation of Clay Raw Materials" was held in Boleslawiec on the 12th of June and was included in the program of one of the Congress Tours.

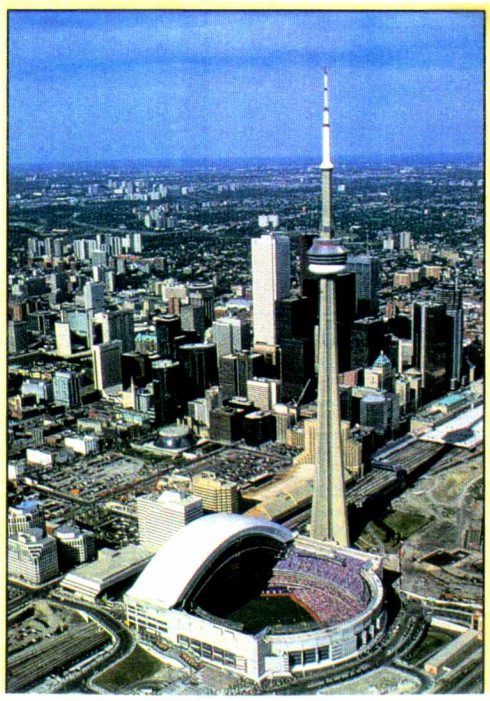
The papers discussed at the seminars were published separately in three volumes: the first volume contains 8 papers dealing with the processing of oxidized lead-zinc ores, the second contains 10 papers on the treatment of iron-titanium ores and the third contains 13 papers on the beneficiation of clay raw materials. The papers in the seminar volumes were published in the Congress languages in which they were originally written with abstracts translated into all the other Congress languages. These volumes were available on registration. The Congress was attended by over 700 participants from 39 countries. All sessions were conducted with simultaneous translation into English, Russian, French, German.

The Proceedings contain the 61 papers accepted for the technical sessions, 6 invited lectures, the inaugural lecture, as well as the opening and closing addresses. The Proceedings also contain discussion, contributions sent in later in written form and the author's replies. The Inaugural Lecture was given by T. Laskowski[5] entitled "Mineral Processing in Poland".

The International Scientific Committee was still presided by J.E. Astier but there was some changes in the membership. For example, J. Maia from Brazil became co-president, Prof. D.W. Fuerstenau represented USA, V.I. Revnivtsev the USSR, and H. Schubert the German Democratic Republic. The new corresponding members included M.H. Buckenham (New Zealand), H. Kattani (Morocco), R.T. Hukki (Finland), L. Sirois (Canada), A. Sutulov (Chile), G. Zambrana (Bolivia), and B. Yarar (Turkey).

Among the new participants the following names may be mentioned: R. Bertram, D.J. Spottiswood, and J.T. Woodcock from Australia, G. Bolton, F. Habashi, M.L. Mular, and H. Veltman from Canada, H. El-Shall, I. Harris, S. Raghavan, and J.D. Miller from USA, E. Forssberg from Sweden, R. Houot and V.I. Klassen from France, and many others.

Toronto 1982



The Fourteenth IMPC took place on October 12-23, 1982 in Toronto, and was hosted by the Canadian Institute of Mining and Metallurgy. The Organizing Committee received more than 200 abstracts from over 30 countries. From these, 120 papers were selected for the nine Technical Sessions and one Round-Table seminar on "Submarine and Lake Disposal of Mill Tailings". Priority was given to papers that best met the main theme of the Congress "Worldwide Industrial Application of Mineral Processing Technology". the selected papers were published in six pre-printed volumes in English with abstracts in the four official Congress languages: English, French, German, and Russian. This Proceedings Volume contained an edited version of the technical discussion taken from tapes, as well as the opening and closing remarks, the Keynote Address, and contributions sent in later in written form and the author's replies. The Congress was attended by over 600 participants from 43 countries. Much of the success of the Congress was due to the ladies' and social programs.

5 Janusz Laskowski's father

New members of the International Scientific Committee included E. Forssberg (Sweden), and M. Digre (Norway). New Corresponding Members included: P.D.R. Maltby (Canada), Alhaji Inuwe Gombe (Nigeria), J.Q. Rogado (Portugal), D. Ocepek (Yugoslavia), and a representative from China. The Organizing Committee was chaired by Peter Maltby.

Among the new names that participated are the following: D.M. Doyle, L. Duval, M.D. Everell, G.M. Ritcey, and F. Flament from Canada, C. Ek from Belgium, R.D. Hagni from USA, P. Oliveri and G. Rossi from Italy, K. Schönert from Germany, and others.

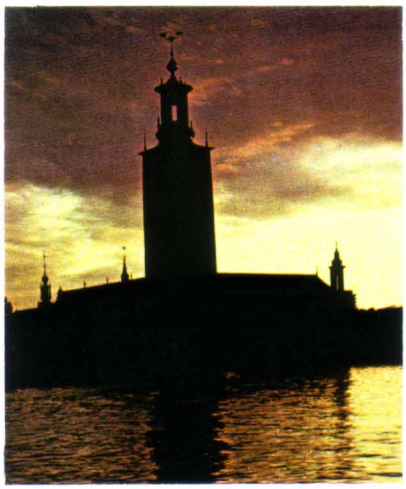
Cannes 1985

The Fifteenth IMPC was held in Cannes on June 2-9, 1985. It was organized by the Société de l'Industrie minérale in Saint-Étienne and the Bureau de recherche géologiques et miniéres in Orléans. The chairman of the Scientific and Technical Committee was Professor Pierre Blazy, director of the École Supérieure de Géologie in Nancy. The theme of the conference was the "Beneficiation of Complex Ores". The Organizing Committee received 315 abstracts from which 145 were selected. The proceedings were published in four volumes:

- Complex Mineralization: Methods and Techniques of Study. Grinding and Concentration by Gravity and Magnetic Methods.
- Flotation, Hydrometallurgy
- Beneficiation of Complex Minerals: Technical and Economic Aspects
- Discussion

The first three volumes were distributed to the delegates at the Congress and the fourth was published later at the end of the year. The Congress included a poster session for the first time. Among the new names that participated one may mention: F.F. Aplan, L. Iwasaki, and A.R. Rule from USA, V.A. Arsenityev, I. Shabalin and V.A. Luganov from USSR, R. Bloise, J.L. Cécile, J.M. Demarthe, and R. Durand from France, J.W. Evans, D. Laguitton, W. Petruk from Canada, S.N. Groudev and V.I. Groudev from Bulgaria, A.A. Khazback from Egypt, and others.

Stockholm 1988



The Sixteenth IMPC took place in Stockholm on June 5 to 10, 1988, and was chaired by Eric Forssberg, Director of the Division of Mineral Processing at Luleå University of Technology in Sweden. The Organizing Committee received 368 abstracts from which 184 were selected. These were presented in parallel sessions for the first time. The Proceedings were published in two volumes:

- Plenary and Review Papers, Comminution, Dewatering and Classification, Flotation, Magnetic, Electric, and Gravimetric Separation.
- Nonferrous and Precious Metals, Ferrous Metals, Industrial Minerals, Modelling, Simulation and Control, Waste Handling.
- The plenary and review papers, eight in number, summarized the situation of mineral processing during this period. They were as follows:
- J.E. Astier (France), "Future of Mineral Processing "
- P.G. Broman (Sweden), "Environmental Management issues in Swedish Mining. Past, Present and Future"
- A. Broussaud (France), "Advanced Computer Methods of Mineral Processing".
- M. Digre (Norway), "Developments in Autogenous Grinding".
- D.W. Fuerstenau (USA), "Flotation Science and Engineering".
- A.V. Glembotsky et al (USSR), "New Flotation Reagents for Sulfide and Non-Sulfide Ores in the USSR".
- V.I. Revnivtsev (USSR), "We Really Need Revolution in Communition".
- J.T. Woodcock (Australia), "Innovations and Options in Gold Metallurgy".

Among the new names that participated one may mention: B.A. Wills from United Kingdom, D.N. Sutherland from Australia, Z. Dogan from Turkey, C. Bazin, D. Hodouin from Canada, G. Bonifazi from Italy, S. Chander from USA, and others.

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[6] This was the Marston Fleming Memorial Lecture that was published by the Institution of Mining and Metallurgy

Dresden 1991

The Seventeenth IMPC was held in September 1991 in Dresden the capital of Saxony in the former German Democratic Republic immediately after its unification with the Federal Republic of Germany (in 1990). It was near there that Napoleon defeated the Allies in August 1813 but two months later, he was defeated in the Battle of Leipzig 80 km west of Dresden. Dresden is a famous art center and is about 40 km from Freiberg where one of the oldest schools of mines was founded. The papers presented at the Congress were made available as preprints:

Volume 1 - Comminution and Classification. Modelling and Process Control (34 papers)

Volume 2 - Fine Particles Processing. Flotation (35 papers)

Volume 3 - Fine Particles Processing. Gravity Separation, Magnetic Separation, Solid Liquid Separation, and Other Topics (31 papers)

Volume 4 - Flotation of Nonsulfide Minerals and Complex Ores. Industrial Minerals Recovery (32 papers)

Volume 5 - Hydrometallurgy and Other Topics (18 papers)

Volume 6 - Processing of Potash Ores (17 papers)

Volume 7 - Recovery of Metals from Scrap, Municipal Waste and Other Secondary Material (22 papers)

In addition to the preprint volumes there were 46 posters.

Sydney 1993

The Eighteenth IMPC was hosted by the Australasian Institute of Mining and Metallurgy in Sydney May 23 to 28, 1993. The Congress coincided with the 100th Anniversary of the Institute. Five hundred delegates and 100 companions attended from 31 countries. Two hundred and twenty papers were presented in 5 parallel sessions during 4 days. One of these sessions was on hydrometallurgy; where 30 papers were presented. Proceedings were published in 5 hard cover volumes, total pages 1 500. Chairman of the Organizing Committee was R.J. Batterham, Vice president of the Institute. The plenary speakers and their topics were as follows:

- Eric Forssberg (Luleå University of Technology, Sweden), "Grinding, pulp chemistry and particle floatability".
- H. Hoberg, (Technical University in Aachen, Germany),. "Applications of mineral processing in waste treatment and scrap recycling".
- R. Peter King (Utah Comminution Center, University of Utah, USA), "Comminution research - a success story that has not yet ended".
- Alban J. Lynch (University of Queensland, Australia), "Mineral processing beyond 2000 - Education for new technology".
- Colin Palethorpe (BHP World Minerals, San Francisco, USA), "The strategic role of mineral processing for BHP Minerals".
- Frank Lederman (Noranda Inc. Canada), "Why is the mineral processing field behind in the application of new technology ?".
- Richard Mozley (Richard Mozley Limited, Redruth, England), "Resistance to the introduction and testing of new technology in mineral processing - examples in gravity concentration".
- Tom W. Healy (Advanced Mineral Products Special Research Centre, University of Melbourne, Australia), "Particulate fluids - a key link in advanced mineral processing".

In conjunction with the NSW Department of School Education, the International Mineral Processing Congress held an Education Day on 26 May 1993 which was attended by some 1200 high school students (Years 10 to 12). At a separate function for teachers, some 300 teachers were introduced to the mining industry. The mining companies contributing to Education Day concentrated specifically on current and relevant curriculum topics for students, prepared in collaboration with the Department of School Education, and provided materials, lectures, information, and much more to assist students in the preparation of their project assignments. Students were able to visit the Exhibition, talk to mining industry professionals and consider a wide range of prospective careers in science, technology and in ecologically sustainable environment. This was an excellent idea to introduce young people to the mineral industry for choosing as a career.

San Francisco 1995

The Nineteenth IMPC was held in San Francisco October 20-25, 1995 under the theme *Leading Mineral processing into the Twenty First Century Through Advanced Technology*. It was hosted by the Society for Mining, Metallurgy, and Exploration of AIME. The Organizing Committee Chairman was John A. Herbst, and the Program Committee was chaired by D.W. Fuerstenau and P. Somasundaran. The plenary speakers and their topics were:

- A.M. Edwards (MINTEK, Randburg South Africa), "The Role of Government in Supporting R & D".
- K. Schönert (Technical University, Clausthal, Germany), "Comminution from Theory to Practice".
- B.C. Flintoff (Brenda Technology, B.C., Canada), "Control of Mineral Processing Systems".

- M.E. Wadsworth (University of Utah, Salt Lake City), "Advances in Gold and Silver Leaching Practice".
- F. Concha (Concepcion, Chile), "First Principles and Phenomenological Modelling in Mineral Processing".
- D.W. Fuerstenau (University of California, Berkeley), "Where We Are in Flotation Chemistry After 70 Years of Research".
- R.J. Batterham and S.H. Algie (CRA, Australia), "The Role of Technology in the Minerals Industry".
- H.M. Conger (Homestake Mining, USA), "Another Man's Poison".

The International Mineral Processing Congress Lifetime Achievement Award was given for the first time to Douglas W. Fuerstenau from the University of California.

IMPC Steering Meeting San Francisco February 1994 from left to right: R. Villas Bôas, H. Hoberg, Peggy Fuerstenau, Kal Sastry, Eric Forssberg, J.A. Herbst, Douglas Fuerstenau, Gianfranco Ferrara, Paolo Massacci (photo by F. Habashi)

Aachen 1997

The Twentieth Congress coincides with forty five years of existence of IMPC. It will be held in Aachen at the invitation of the GDMB German Society for Mining, Metallurgy, Resource and Environmental Technology. The Organizing Committee is chaired by Heinz Hoberg at the Technische Hochschule Aachen. A year earlier, Hoberg's students celebrated his 25th anniversary as professor at the Hochschule. The celebration was timed with the IMPC Steering Committee meeting on May 1996.

Aachen, also known as Aix-la-Chapelle, is an old Roman town, famous for its hot springs and its Technical University. It was Charlemagne's capital of the Holy Roman Empire in the ninth century.

Topics of the Congress are the following:

- Material Analysis and Characterisation
- Mineral Processing Fundamentals
- Comminution, Classification and Agglomeration
- Physical Enrichment Processes
- Flotation and other Physical-Chemical Processes
- Solid-liquid Separation
- Hydro- and Biohydrometallurgy
- Waste Treatment and Recycling
- Soil Remediation
- Computer Aided Mineral Processing, Modelling and Controlling

Charlemagne

The Organizing Committee selected 200 papers for oral presentation and 150 for a poster session from 750 abstracts submitted. The plenary speakers

- Alexander A. Abramov, Moscow State Mining University, Russia, "Principles of Physico-Chemical Optimisation of Mineral Flotation"
- Lynn Hales, EIMCO Process Equipment Company, Salt Lake City, Utah, "Intelligent Enterprise - Wide Adaptive Optimising Control"
- John A. Herbst, J.A. Herbst & Associates, Hawaii, USA, "Networking of Technical Resources. The Future of Mineral Processing Plant Optimisation"
- Manfred Pütz, State Department of the Environment, North-Rhine Westphalia, Düsseldorf, Germany, "Avoidance and Re-Use of Industrial Wastes. The Role of the Federal Emission Control Act"
- John Raimondo, African Environmental Solutions, Cape Town, South Africa, "Attempts to Close Material Cycles in the Industrialised Countries: Threat, Challenge or Opportunity for Mineral Exporting Countries"

- Hellmut Trienekens, Federation of the German Waste Management Providers, Bonn, Germany, "Germany's New Waste Legislation in Its First Year"
- Roberto Villas-Bôas, Mineral Research Center, Rio de Janeiro, Brazil, "Technological Challenges Faced by the Mining and Metallurgical Sector in Development Countries"

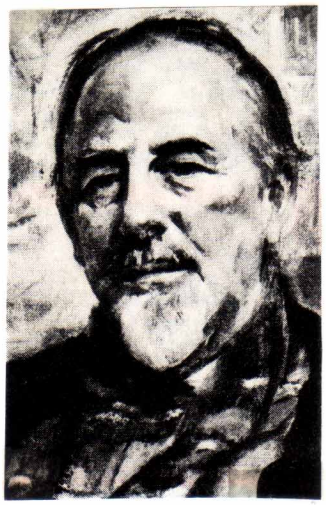
The International Mineral Processing Lifetime Achievement Award will be presented for the second time. The recipient will be Klaus Schönert.

Reception by Professor and Mrs. Hoberg on May 1, 1996 at Kasteel Vaalsbroek, Netherlands (near Aachen) for the IMPC Steering Committee of the 20th IMPC. Shown from left to right: Mrs. Hoberg, H. Hoberg, P. Massaci, E. Forssberg, J.A. Herbst, Mrs. Herbst, R. Villas Bôas, F. Habashi, A.P. Chaves (photo by Nadia Habashi)

Distinguished delegates

It is not possible to mention all the delegates who participated actively in IMPC. A selection is given here for those distinguished members of the mineral processing community who are no longer with us. They are arranged in chronological order of the date of birth.

John Van Nostrand Dorr (1872-1962)



Dorr began his career in the laboratories of Thomas Alva Edison at the age of 16. After graduating from Rutgers University he worked as an assayer, and metallurgist in the gold mills of South Dakota and Colorado. In 1913 while in South Dakota he invented the classifier, an apparatus for separating fine and coarse material in an ore slurry on a continuous basis rather than through the single-batch processing technique.

Although the Dorr classifier was initially used for continuous extraction of gold by the cyanide process, its application also permitted the profitable recovery of silver and other materials from sources previously considered worthless. Its use spread to similar processing operations in many industries. At approximately the same time, he invented the Dorr thickener for the continuous settling and thickening of ore slurry, and the Dorr air-lift agitator for the continuous mixing of liquids or the extraction of solubles from finely divided solids by means of an air lift. These three inventions had a huge impact on mining and beyond by hastening the transition from intermittent to continuous processing, thus allowing mass production in many different industries. The terms classifier and thickener, first used by Dorr to describe his inventions, rapidly became part of standard engineering vocabulary.

The thickener and the clarifier became the basic tools used in water and sewage treatment plants. The sedimentation processes developed by Dorr made the desilting of water from the Colorado River economically feasible. Such water is used for irrigating California's rich Imperial Valley. Dorr in collaboration with F.L. Bosqui wrote a book in 1950 entitled *Cyanidation of Gold Ores*.

C.W. Dannatt (1892-1961)

Dannatt graduated as metallurgist from the Royal School of Mines in 1914. He was in military service during World War I. From 1918 to 1920 Dannatt was assistant director of the Technical Section, Ministry of the Interior, Cairo, and subsequently spent two years as geologist to Naparima Oilfields to Trinidad. In 1923 he returned to the Metallurgy Department of the Royal School of Mines as a demonstrator, becoming Professor of Metallurgy in 1945. He was elected President of the Institution of Mining and Metallurgy in London for the session 1956-57. He was chairman of the Symposium on Mineral Dressing held in London in 1952 that became later known as the first IMPC.

Lazare Ervant Djingheuzian (1896-1967)

Djingheuzian was technical advisor to the director, Mines Branch, Department of Energy, Mines and Resources known as CANMET, in Canada. He was born in Batoum, Caucasus, where he received his primary and secondary education. In 1920, he went with his family to London, England, where he entered the Royal School of Mines, graduating in mining engineering in 1924. He went to Canada in 1926 to join the Huronian Belt as a field mining engineer. In 1931, he went to Kirkland Lake as a research and mill engineer at Lake Shore Mines, and subsequently became assistant managing director. In 1935, Djingheuzian was appointed mill superintendent of Simcoe Gold Mines, remaining in the capacity until 1943, when he went into consulting practice in Montréal.

In 1948, he joined the Mines Branch as a metallurgical engineer. He was subsequently made head of the Mineral Dressing Section. On the reorganization of the Mines Branch Divisions in 1959, he was appointed chief of the Mineral Processing Division. He retired in mid-1965, and was appointed technical advisor to director of the Mines Branch. He was an active member of the Canadian Institute of Mining, Metallurgy, and Petroleum and was president of its Metallurgical Society in 1958-60. He was also a member of the Institution of Mining and Metallurgy in London and had been the Overseas Member of Council for Canada since 1952.

Fred Chester Bond (1899-1977)

Bond graduated from Colorado School of Mines as a mining engineer in 1922, then earned a M Sc. in Chemistry from the same school in 1926. From 1922 to 1924, Bond worked for the New York and Honduras Rosario Mining Co. in Honduras as an assayer, mine surveyor, and cyanide mill shifter. Later, he installed the mill for what was then the largest uranium-producing operation in the world: the Eldorado Mining Company in the Northwest Territories, Canada. In 1936, Bond installed the gold-producing mill and smelter for Compania Mineral Nacional in Peru.

For 45 years, Bond was employed by Allis-Chalmers, where he served in various positions, including Manager of the Ore Dressing Laboratory. Bond made an enormous impact on the science of ore crushing and grinding through his development of the Theory of Comminution and Work Index. For many years, Bond's Theory provided the standard method for calculating the energy input necessary for crushing rock. Bond received several awards for his great contributions to the mining industry, including the Richards Award given by the American Institute of Mining Engineers.

Maurice Rey (1899-1984)

Rey was born in Liège in Belgium and graduated as chemical engineer from the University of Liège in 1924. He was on a scholarship at Stanford University in California for one year then joined the Research Department of Union Minière du Haut Katanga in the Belgian Congo (now Democratic Republic of Congo), then in 1932 was appointed professor at the University of Liège. During World War II he was evacuated from Dunkirk and joined the Belgian Forces in Great Britain. In 1945 he was appointed director of research at the Société Minière et Métallurgique de Peñarroya in Paris, and became a lecturer in nonferrous metallurgy at the School of Mines, Paris. From 1945 until his retirement in 1972 he was employed in the study of various ores at the Société Minerais et Métaux.

Rey was well known by his papers on the flotation of oxides and the concentration of low-grade copper oxide ores by the segregation process. In 1973 he was elected Honorary Fellow of the Institution of Mining and Metallurgy in London.

Antoine Marc Gaudin (1900-1974)

Gaudin was one of the distinguished pioneers of the mineral industry. Best known for his textbooks *Flotation* (first published in 1932 and revised in 1957) and *Principles of Mineral Dressing* (published in 1939). Gaudin was active in research but above all he was a first class educator, with his many students now filling leading positions in the mineral industry and in education.

Gaudin was born in Smyrna, Turkey to French parents. His father was the engineer and manager of a French-owned railroad in Turkey, and his grandfather a chemist and mineralogist and for many years Secretary of the Academie des Sciences in Paris. Later, the Gaudin family moved to Haifa when the father was commissioned to construct and operate the Hijaz railroad, connecting Mecca in Arabia to the Ottoman Empire. Following the "Young Turk" revolution in 1908, the family returned to France, where the young Gaudin studied at the Lycée in Versailles and Toulon, and in 1917 completed requirements for the bachelor's degree at the University of Paris.

During World War I, Gaudin senior was sent to the United States as a member of the French War Mission in charge of purchasing railroad materials. The young Gaudin joined him in 1917 and entered the Columbia University School of Mines, where he took courses leading to the degree of Engineer of Mines. His studies were interrupted when he joined the U.S. Army, serving until shortly after the Armistice, when he returned to Columbia. In 1926 he became an American citizen.

Gaudin taught at Columbia University (1924-1926), University of Utah (1926-1929), Montana School of Mines (1929-1939), and Massachusetts Institute of Technology (1939-1966). He was awarded an

honorary degree of Doctor of Science from Montana School of Mines (now Montana College of Mineral Science and Technology) in 1941, and was invited by the USSR Academy of Sciences to lecture in the Soviet Union in 1957.

During his stay at the MIT, Gaudin directed the research that led to the first production of uranium from ores. The research was first sponsored by the Manhattan District of the Army Engineers Corps, and later by the Atomic Energy Commission. Gaudin and his group were pioneers in leaching the low-grade uranium ores with acid and enriching the metal on anion exchange resins which opened the door to the large scale production of uranium.

Gaudin was a member of Société des Ingénieurs Civils de France, honorary member of the Institution of Mining & Metallurgy in London, founding member of the National Academy of Engineering (USA), fellow of the American Academy of Arts & Sciences, member of the American Institute of Mining, Metallurgical & Petroleum Engineers, the Canadian Institute of Mining & Metallurgy, the American Chemical Society, and the American Institute of Chemical Engineers.

Igor Nikolaevitch Plaksin (1900-1968)

Plaksin was born in Orefa in the Urals and graduated from the Far Eastern University in Vladivostok in 1926. He got Doctor of Technical Science Degree from Moscow in 1937. Appointed Professor of Extractive Metallurgy, then Head of the Department of Metallurgy of Precious Metals at Moscow Institute of Steel and Alloys (formerly Moscow Institute of Nonferrous Metals and Gold). He was decorated by Order of Lenin (1951) and recipient of Stalin prize (1952). He became member of the USSR Academy of Science (1963). He authored the following books:

1937 - The Interaction of Alloys and Native Gold with Mercury and Cyanide Solutions

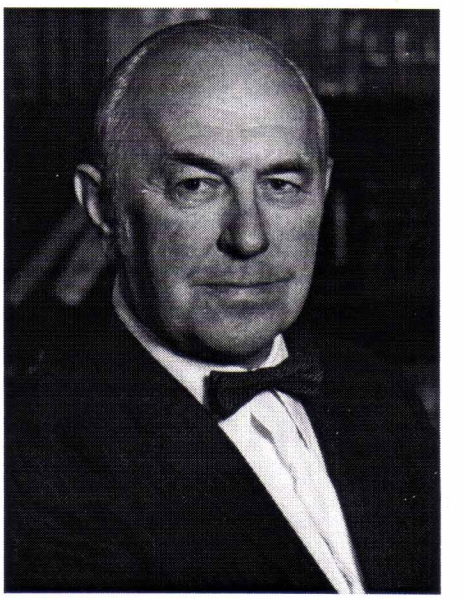
1943 - The Metallurgy of Precious Metals (2nd edition 1958)

1947 - Assaying and Assay Analysis

1947 - Hydrometallurgy (co-author)

1955 - The Technological Equipment of Ore Enriching Plant

Frank Arthur Forward (1902-1972)



Forward was one of the most important hydrometallurgists of his time. He graduated as a chemical engineer from the University of Toronto in 1924. He worked in the metallurgical industry in Canada and Australia for nine years. In 1935 he joined the University of British Columbia in Vancouver as an Assistant Professor, becoming Professor of Metallurgy in 1941, then Department Head in 1945, a post he held for nineteen years. In 1964 he was assigned to organize the Science Council of Canada in Ottawa, and in 1967 he returned to the University of British Columbia as an Emeritus Professor to act as a consultant on the administration of research.

Forward was an active member of the Canadian Institute of Mining & Metallurgy to which he was elected President for the term 1965-66. He was also associated with the institutions of mining and metallurgy in England, USA, Australia, and Germany, and was nominated a Fellow of the Chemistry Institute of Canada. Forward's most brilliant achievement resulted from his preliminary studies on the extraction of nickel from a sulfide ore sample submitted to him in 1945 while at the University of British Columbia. At that time, nickel was extracted from its ores exclusively by pyrometallurgical methods. There was, however, some indications in the patent literature that nickel can be solubilized from its sulfide ores by leaching with ammonia in presence of air at high temperature and pressure. However, nothing was done until 1948 when Forward tested the ore sample from Lynn Lake mine and found that nickel can be extracted economically from this ore by ammonia pressure leaching.

The second phase of this work resulted towards the end of 1948 when the Chemical Construction Corporation was assigned to investigate the design of the ammonia pressure leaching plant. By coincidence, Chemical Construction had been studying techniques for pressure leaching sulfides ores in acid solution at that time. Further, they were developing a method for precipitating nickel from leach solutions by hydrogen under pressure a process discovered about forty years earlier in Russia by V.N. Ipatieff. The two operations were therefore combined to give a unique and most progressive process for the treatment of nickel ores by hydrometallurgical techniques. The process was piloted then went into commercial production in 1954. Forward's contribution is not only doing a good piece of organized research in metallurgy and engineering but also in convincing industry to adopt this new technology - - something which proved rewarding.

Forward was awarded medals from numerous professional organisations of which can be mentioned the Engineering Institute of Canada, the International Nickel Company, the Canadian Institute of Mining & Metallurgy, the Institution of Mining & Metallurgy, the Chemical Institute of Canada, the University of

Toronto, the American Institute of Mining & Metallurgy, the Institute of Metals, and an honorary degree from the University of British Columbia.

Gudmar Kihlstedt (1909-1991)

Gudmar Kihlstedt was born in Örebro, Sweden. He attended the Royal Institute of Technology in Stockholm and received his master's degree in mining and metallurgy in 1933. He started his career with Boliden as a process engineer at the Ronnskar processing plant (now closed). He was later promoted to the post of chief metallurgist. In 1952 Kihlstedt was offered the chair of mineral processing at the Royal Institute.

He kept the position until his retirement in 1976. One of his major achievements during his tenure as professor was the introduction of science into an empirical subject. He had strong links with the Swedish mineral industry and managed, with its financial support, to gather a large group of young scientists around him, one of these was Eric Forssberg who is presently the President of IMPC. He also established links with manufacturers of equipment for mineral processing and together they succeeded in gaining wide recognition for Swedish technology in this area.

His achievements in the area of sulfide flotation, industrial minerals, magnetic separation, and agglomeration deserve special mention. Kihlstedt's great capacity for work enable him to devote much effort to various national and international organizations, such as the Royal Academy of Engineering Sciences and the International Mineral Processing Congress. He was a member of many professional organizations including the Society of Mining Engineers (AIME). He was awarded an honorary doctorate from the Montanuniversität in Leoben, Austria and received many other awards both in Sweden and in other countries, including the Georgius Agricola medal from the Gesellschaft Deutscher Metallhütten und Bergleute.

Mario Carta (1910-1985)

Mario Carta was born in Iglesias, Sardinia, Italy. He graduated in Mining Engineering from the University of Rome in 1933 and went to specialize in electrotechnical engineering. From 1935 to 1950 he pursued a career in the State Mining Corps, which culminated in his appointment as Chief Engineer for the district of Sardinia in 1942.

His University career began in 1940 with a temporary appointment as lecturer in mining and mineral dressing as well as electrotechnics at the University of Cagliari. In the same year he created the Institute of Mining and Mineral Dressing, now the Department of Geoengineering and Environmental Technologies, where he remained chairman until he died. Carta was also instrumental in the constitution of the Italian

Research Council's Center for Mining and Mineral Processing of which he was director for many years. During this period Carta held the office of regional councillor at the Department of Industry and Commerce of the Autonomous Regional Government of Sardinia. From 1954 until his death, apart from two brief interruptions, Carta was Dean of the Engineering Faculty of Cagliari University. In this capacity he modernized and consolidated the courses in civil, mechanical, chemical and electrotechnical engineering.

It was for his expertise in mining and mineral processing, that he was invited by the Armistice Commission, immediately after World War II to collaborate in reorganizing the Sardinian mining industry, and in particular its coal field. For many years Carta was president of the Mines Committee for the Government of Sardinia, and a member of the Senior Council of Mines as well as of the advisory committee on regional planning. He was president of the Sardinian Association and of the National Association of Mining Engineers. He invited the IMPC to hold its Eleventh Congress in Cagliari in 1975.

Marston Fleming (1913-1982)

Fleming was born in Canada and educated at Queen's University, Kingston, Ontario, where he graduated B.Sc. (mining and metallurgy) in 1936. Subsequently, in 1951, he was awarded the degree of Ph.D. by the University of London. He joined Paymaster Consolidated Gold Mines as assistant mill superintendent in 1937 and from 1938 to 1941 was chief metallurgist and mill superintendent. During World War II he served with the Royal Canadian Air Force.

In 1946 he was appointed lecturer at Imperial College, London, becoming in 1961 the first professor of mineral technology. He was head of the Department of Mining and Mineral Technology from 1967 to 1974 and Dean of the Royal School of Mines from 1968 to 1971. In 1974 he was appointed Pro-Rector of Imperial College - a position that he held until 1979, when he returned to the Royal School of Mines as head of the Department of Mineral Resources Engineering. He retired in 1980, but remained at the College as a senior research fellow. A member of the Governing Body of Imperial College from 1968 to 1980, he also served as a Governor of Camborne School of Mines from 1971. He was deeply involved in the establishment and early development of the Warren Spring Laboratory.

He was closely associated with the International Mineral Processing Congresses for thirty years - as British representative on the International Scientific Committee (Chairman 1973-75) and Chairman of the Organizing Committee for the London congress in 1973. Fleming was honorary Fellow of the South African Institute of Mining and Metallurgy, and was President of the Institution of Mining and Metallurgy for the session 1971-72. He received the Institute's first Gold Medal. He co-authored *Identification of Mineral Grains.*

Paulo Abib Andery (1922-1976)

Paulo Abib was born in the Minas Gerais State in Brazil of Lebanase descent. He graduated from Escola Politécnica at Sao Paolo University in mining engineering. He started working for the Petroleum

National Bureau in geological surveying. In 1954 he was associated with the Mining Department of Escola Politécnica, expanding his activities to perform several research works in mineral processing and economic geology.

Paulo Abib developed, from 1962 to 1966, a new technology to separate apatite from the carbonatic gangue by froth flotation. This process, made feasible the exploitation of ore that was considered waste at that time. Also a Portland cement plant using the tailings of the preparation plant was later installed.

In the beginning of the 1970s, Paulo Abib organized an engineering and process development team, which expanded to all the mining engineering specialities. This team was influential in the 1970s and at the beginning of 1980s on the Brazilian mining scene. This engineering company became responsible for a significant portion of Brazilian mining projects. Among these are: "Projeto Conceiçao", a 26 000 000 tonne/year iron ore venture of Compania Vale do Rio Doce, and "Projeto Catiboaba", a 240 000 tonne/year magnesite concentrator (from dolomitic gangue), for Magnesita S.A... Another important scientific contribution was adaptation of the mathematical models for classifying equipment to Brazilian ores.

Paulo Abib was member of the Organizing Committee of the Twelfth IMPC that was held in Sao Paulo in 1977, but unfortunately he passed away before opening of the Congress at the age of 54. Memorial in his honour has been erected in the building of the Mining Engineering Department of Escola Politécnica da Universidade de Sao Paulo.

Alexander Sutulov (1925-1991)

A well known professional engineer, and author of numerous books, Alexander Sutulov was vice-president of research and development for Corporation del Cobre in Chile. Born in Bileca in Yugoslavia and graduated from the Superior Technical School of the University of Belgrade in 1950, Sutulov moved to Chile in 1955. He spent five years as research engineer at Kennecott's Braden Copper Company (El Teniente, Chile) before his appointment as professor of mineral processing at the University of Concepcion, where he later became director of the Institute for Technological Research and head of the Department of Minerals and Metallurgy. From 1970 to 1975, he was a visiting professor in the Department of Mining, Metallurgical and Fuels Engineering at the University of Utah.

He was a founder and the first president of the Latin American Association for Metallurgy and became general secretary of that organization in 1970. Sutulov has served as a consultant for United Nations agencies, the Pan American Union, and other groups. Publications accredited to Sutulov are:

- 1962 Molibdeno
- 1962 Proceso de Segragacion
- 1963 Flotacion de Minerals
- 1965 Molybdenum Extractive Metallurgy
- 1966 Mineralurgia Latinoamericana
- 1967 Copper production in Russia
- 1970 Molbydenum and Rhenium Recovery from Porphyry Coppers
- 1971 The Soviet Challenge in Base Metals
- 1972 Minerals in World Affairs
- 1973 Mineral Resources and the Economy of the USSR
- 1974 International Encyclopedia of Molybdenum, 3 volumes
- 1975 Minerai Chilena 1545

Vladimir Ivanovitch Revnivtzev (1931-1989)

Revnivtzev graduated in 1953 from the Sverdlovsk Mining Institute in Sverdlovsk, now Ekatarinenburg, in the Urals in the former Soviet Union. He earned his Doctor of Science degree in 1960 after submitting a thesis entitled "Electrostatic Separation of Dielectric Minerals having Similar Conductivity Values".

From 1953 to 1973 he was with the Ural Mekhanobr Institute in Sverdlovsk. His research work concerned the theory and practice of beneficiation process, based on the application of modern concepts of solid-state physics and chemistry. He then moved to Leningrad (now Saint Petersburg) to become Deputy Director of Research at the Mekhanobr Institute. From 1976 to his death he was Director General. Revnivtzev was Corresponding Member of the Academy of Science of the USSR. He authored over 250 scientific papers and reports, 7 patents, and the following monographs:

- 1970 Feldspars and Quartz Beneficiation
- 1974 Gravity Classification of Fine Particles
- 1990 X-Ray Separation of Nonferrous and Rare Metal Ores
- 1992 Technological Mineralogy of Fine Particles
- 1992 Directed Transformation of Mineral Properties

Gilles Barbery (1943-1989)

Gilles Barbery was professor in the Department of Mining and Metallurgy at Université Laval in Quebec City, Canada when he died at the age of 46 after a short illness. He was born in St-Germain-en-Laye, France. He received his Bachelor's degree in engineering from the Paris School of Mines. He undertook graduate studies in the Department of Mineral Engineering, Columbia University, New York, and at the Imperial College of Science and Technology, London University, where he obtained an M.Sc. and a Diploma of Imperial College in mineral process design (1968).

His first professional assignment was in Bolivia (1966-67), where he participated in a project on the beneficiation of tin ores. After graduation from Imperial College he joined Université Laval, Québec City, as an assistant professor. From 1971 to 1976, Barbery occupied a lecturer position at Imperial College whereupon he returned to France as director of the Mineral Processing Department of the Bureau de Recherches géologiques et minières at Orléans. At the same time he was an adjunct professor at the Paris School of Mines and the University of Orléans. In 1982 he became an associate professor at Université Laval, and in 1987 he was promoted to professor. He was head of the department from 1986 to 1988.

Gilles Barbery was well known through his publications in the field of mineral liberation and separation. He authored a book entitled *Mineral Liberation: Measurement Simulation and Practical Use in Mineral Processing*, which was posthumously edited and published. Gilles Barbery served on the Advisory Councils of many organizations in Canada and in Europe. He was also an active member of numerous scientific societies: Société de l'industrie minérale, where he served a president of the Mineral Processing Committee (1980-82), the European Federation of Chemical Engineering where he was a member of various committees, the Society of Mining Engineers of AIME where he was a member of the Process Mineralogy Committee and The Canadian Institute of Mining and Metallurgy. Barbery served also on the editorial boards of numerous journals.

EPILOGUE

The International Mineral Processing Congress started as a special Symposium of the annual event of the Institution of Mining and Metallurgy in London in 1952. The event immediately interested the Organization of European Economic Community (OEEC) and subsequently five similar meetings were held in France, Germany, Sweden, and England from 1953 to 1963. During the London meeting of 1960 two eminent mineral engineers: H. Rush Spedden from Kennecott Corporation in USA and Igor Nikolaevitch Plaksin from the Russian Academy of Science in Moscow were among the participants. They invited the delegates to meet in their countries in the future. Thus, the IMPC became an international body that united mineral scientists and engineers from Western as well as the Eastern block at a time when the Cold War was at its highest point. It was in 1960 that the title *International Mineral Processing Congress* was adopted for the proceedings volume, which was translated in German to

Internationaler Kongress für Erzaufbereitug and *Congrès International de Minéralurgie* when the event was held in France in 1985.

In 1964, IMPC was held for the first time in North America on the occasion of the Hundredth Anniversary of the founding of the first School of Mines on that continent. In 1977, IMPC moved to South America for the first time. In 1993, IMPC was hosted in Australia for the first time on the occasion of the Hundredth Anniversary of the Australasian Institute of Mining and Metallurgy.

The 1952 Symposium in London marks the beginning of a modern era of international co-operation in mineral processing. However, it was not the first gathering of its type. In 1786 Ignaz von Born (1742-1791) the distinguished Transylvanian mineralogist, mining engineer, and metallurgist was the first to convene an international congress in Sklené Teplice near Banská-Štiavnica (formerly known by its German name Schemnitz) in present day Slovakia, which at that time was a part of the Austrian Empire. At this conference Born demonstrated his new method of amalgamation for the recovery of silver from ores as a substitute for the energy intensive process used at that time and involving production of metallic lead then cupellation to get the precious metal.

During the conference, the participants agreed to form an organization "Sozietät der Bergbaukunde" which can be translated as the Society for Mining Science for the purpose of improving diffusion of information among the different workers in the field. The Society published two yearbooks in 1789 and in 1790. The activities of the Society stopped, however, due to the French Revolution in 1789 and the subsequent Napoleonic Wars, and the death of Born in 1791.

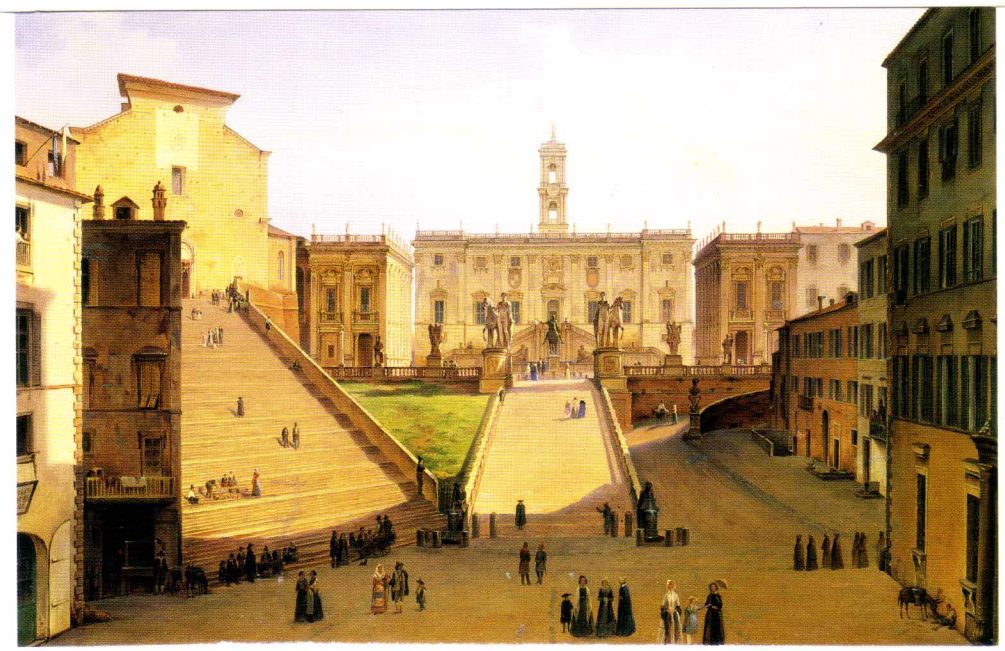
Although IMPC is a truly international organization that has representatives from many countries, it lacks a Headquarters or a Permanent Secretariat. Such an office would be useful for the following purposes:

- Creating a directory of scientists, engineers, and educators in the area of mineral processing.
- Diffusing information on mineral processing and co-ordinating efforts of national organizations of similar objective.
- Normalizing terminology in the area of mineral processing to facilitate communication.
- Giving special attention to the mineral industry in developing countries.
- Keeping record of the activities of IMPC and particularly the availability of its proceedings volumes and news about its members.
- Creating a Newsletter to facilitate communication with those working in mineral processing.

IMPC is the only international organization developed to mineral processing. At present it is limited to mineral beneficiation and hydrometallurgy, but, its scope may well be widened to involve pyro- and electrometallurgy. In fact Jacques E. Astier the first president of the Scientific Committee has expressed such ideas in his Plenary Lecture delivered at the sixteenth IMPC in Stockholm in 1988. IMPC can and should play a role similar to the International Union of Pure and Applied Chemistry. The Congress is well accepted by the academic and professional communities as can be judged from the following:

- The number of abstracts received is much more than the number accepted.
- There is a strong competition between many countries to attract the Congress.
- The Congress is well attended and usually generates a monetary surplus.

Rome 2000



The next IMPC will take place in the year 2000 in Rome. The ancient city is preparing for celebrating two thousand years the birth of Christ. Bring your colleagues and join us in Rome for the Twenty First IMPC which will also be a window for the twenty first century.

Acknowledgement

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APPENDIX I

CONSTITUTION OF IMPC

Objectives

The objectives of the Scientific Committee for the International Mineral Processing Congresses (hereinafter referred to as "The Committee") are to convene successive International Mineral Processing Congresses to provide means of promoting the development of the treatment of minerals and wastes and encouraging technical efficiency. The ordinary period between the International Mineral Processing Congresses shall be three years.

Powers

The Committee shall have power to advise and make recommendations to the bodies that are responsible for the organization of Congresses, but it shall not commit them to any financial obligation without their sanction.

Membership

All countries in which, in the view of the committee, there is a sufficient level of mineral processing interest and activity shall be entitled to nominate a representative and an alternate to the Committee. Such nominations shall be made by the appropriate national professional organization and/or learned society in each country for approval by The Committee. Past chairmen of the International scientific Committee will remain as members for life.

Meetings and Voting Rights

The Committee shall meet at least once on the occasion of each congress. Any matter submitted to The Committee shall be decided by majority vote of those present and voting. The Chairman of any meeting of The Committee shall have a second or deciding vote.

Officers and Steering Committee

The Steering Committee shall consist of the Chairman, the Vice-Chairman and those members of the Committee, and their alternates, who are representatives of countries in which a congress has been held or in which The Committee has determined that a congress shall be held. The Steering Committee shall meet at such intervals and in such locations as the Chairman shall deem necessary and the results of its deliberations shall be reported to The Committee.

A Chairman shall be nominated by the Steering Committee for election by The Committee for a period of two congresses and shall be eligible for re-election. The Chairman shall chair all meetings of The Committee at which he is present and shall regulate and keep order in the proceedings. In the absence of the Chairman, the Vice-Chairman shall assume the responsibilities of the Chairman, but in the absence of the Vice-Chairman the meeting shall elect any representative present to take the Chair.

The immediate past president of each IMPC will automatically become Vice-Chairman of the Steering Committee and The Committee for the period until and during the next IMPC. If this is not possible, the Steering Committee shall elect a replacement for the period of remaining part.

APPENDIX II

Proceedings Volumes of IMPC

Year	Editor	Title	Publisher
1952	Anonymous	Recent Developments in Mineral Processing	Institution of Mining & Metallurgy, London
1953	P. Seyer	Congrès des Laveries des Mines Métalliques Françaises*	Société de l'Industrie Minérale, Saint-Étienne, France
1955	W. Andrae	Internationaler Kongress fhr Erzaufbereitung	Gesellschaft Deutscher Metallhhtten- und Bergleute
1957	E. Öhman	Progress in Mineral Dressing	Almqvist and Wiksell,Stockholm (Published 1958)
1960	Anonymous	International Mineral Processing Congress 1960	Institution of Mining and Metallurgy, London
1963	A. Roberts	Mineral Processing	Pergamon, Oxford
1964	N. Arbiter	VII International Mineral Processing Congress, 2 volumes	Gordon & Breach, New York
1968	Anonymous	VIII International Mineral Processing Congress 2 volumes (in Russian)	Leningrad (Published 1969)
1970	Anonymous	Proceedings of the Ninth International Mineral Processing Congress (2 volumes)	USTAV pro Vykurn Rud, Prag, Czechoslovakia
1973	M. J. Jones	Tenth International Mineral Processing Congress 1973	Institution of Mining and Metallurgy, London
1975	Anonymous	Proceedings of the Eleventh International Mineral Processing Congress, 3 volumes	Instituto di Arte Mineraria, Universita di Cagliari, Italy (Published 1975)
1977	Anonymous	Proceedings of the Twelfth International Mineral Processing Congress, 3 volumes	Ministerio des Minas e Energia, Brazilia (Published 1980)
1979	J. Laskowski	Mineral Processing	Elsevier, Amsterdam (Published 1981)
1983	P.D.R. Maltby	Proceedings XIV International Mineral Processing Congress, 7 volumes	Canadian Institute of Mining and Metallurgy, Montréal
1985	Anonymous	XV Congrès International de MinJralurgie, 4 volumes	Société de l'Industrie Minérale, Saint-Étienne, France
1988	E. Forssberg	XVI International Mineral Processing Congress, 2 volumes	Elsevier, Amsterdam
1991	Anonymous	XVII International Mineral Processing Congress, 7 volumes	Mining Academy Freiberg
1993		XVIII International Mineral Processing Congress, 4 volumes	Australasian Institute of Mining and Metallurgy
1995	Anonymous	Proceedings of the XIX International Mineral Processing Congress, 4 volumes	Society of Mining Metallurgy and Exploration, Littleton, Colorado
1997	H. Hoberg, H. v. Blottnitz	Proceedings of the XX International Mineral Processing Congress, 5 volumes	GDMB Gesellschaft fhr Bergbau, Metallurgie, Rohstoff- und Umwelttechnik

*Published as special issues of *Revue de l'Industrie Minérale* (15 November, 15 December 1953 and 1954).