

# **CATALYSIS IN CANADA**

*2<sup>nd</sup> Edition*

**The Catalysis Division, 1971-2005**

Compiled, edited and written by

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on behalf of

The Catalysis Division,  
The Chemical Institute of Canada

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Ottawa                      Edmonton

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This book is dedicated with respect to the builders of a catalysis organization for Canada: the Canadian Committee on Catalysis, the founders of The Catalysis Division of The Chemical Institute of Canada, and those today who continue the drive to promote catalysis and its applications for Canada.

## **CORPORATE SPONSORS**

Financial support from the Canadian Catalysis Foundation for the production of the 2<sup>nd</sup> Edition is gratefully acknowledged. Without its generous contributions it would not have been possible to produce that volume.



## PREFACE TO THE 1<sup>ST</sup> EDITION

In 1994 I was approached by representatives of The Catalysis Division of The Chemical Institute of Canada to either write or to oversee the writing of a history of the Division, to celebrate its silver anniversary in 1996. I volunteered to attempt the task. Respected and knowledgeable colleagues in turn volunteered to provide assistance, by contributing from their singular or collective wisdom, by proofreading, and by searching their several and various memory banks. In particular, I.G. Dalla Lana and M. Ternan offered me the use of their earlier retrospective of events leading to the formation of the Division. A structure for the anniversary volume was proposed and accepted, and a plan of action was then made to address each issue and component of the volume. A number of corporate bodies were approached for financial support to enable the printing and distribution of the volume. I am pleased to be able to acknowledge the generous commitments which were made by the organizations listed opposite.

I have designed this volume around the efforts of the members of The Catalysis Division. The strength and importance of a professional organization such as the Division is directly related to those of its members. Several of the outstanding efforts in catalysis in Canada have been recognized since the 1960s through The Catalysis Award. The winners of this award are each noteworthy in their own right, and as a body they are representative of the depth and breadth of catalysis in Canada. For each winner of this award a descriptive overview of his career and achievements has been composed by one or more persons knowledgeable of the winner and his areas of work. For each of these descriptions I have made amendments only for style and integration with the other sections of the volume.

Other members who have contributed strongly to the Canadian catalysis community are those who have dedicated their time and efforts on the executive of the Division and in the organization of meetings. I have taken pains to include the names of all who have served so constructively as members of the executive of the Division. If I have inadvertently omitted any name, I apologize. The success of an international, national or local meeting depends upon the hard work and skills of several volunteers. There have been so many successfully organized catalysis meetings over the past 25 years that it would require reams of paper to name every volunteer. I have therefore chosen to name only the chairpersons of the organizing committees and the program organizers for such meetings. To those valuable colleagues whom I have not listed, please accept both my thanks for your efforts and my regrets at the necessary brevity of the listings.

As with any effort made entirely by volunteers, the realities of life, especially pressing commitments to clients, employers, and students, caused minor to severe amendments to the schedule! It is to the credit of the contributors to this volume that the work was completed at all, that it was achieved in reasonable time, and that the effort made by each colleague constitutes an interesting and valuable contribution.

Special thanks are due to the following colleagues. Marten Ternan and Ivo Dalla Lana recounted events leading to the origins of the Division, and their input forms the basis of Chapter 1. The description of the Ninth International Congress on Catalysis is based on the reports of that event by Harry Habgood (Co-Chairman), John Moffat (Secretary) and Yoshi Amenomiya (Program Sub-committee Chairman). John Moffat also confirmed my data on the origins of the Canadian Catalysis Foundation. The accounts of the achievements by the winners

of The Canadian Catalysis Award were written by or based upon data provided by the following persons, in alphabetical order: Elm Alyea, Yoshi Amenomiya, Ted Calverley, Richard Fiederov, Ed Furimsky, Jan Galuszka, Brian James, Jerry Kriz, Jacques Monnier, Don Singleton, Kevin Smith, Mike Wilson, and myself. My thanks go to all the contributors, without whom this volume would not have been possible. The manuscript was typed by Diane Reckhow, without whose magnificent efforts this project could not have been completed.

This volume is in celebration of the silver anniversary of a special professional organization. The Catalysis Division is strong today because of the efforts in the past. The stars who will be recognized tomorrow are among the unsung heroes of today. In 2021 we can celebrate their achievements!

*Alan R. Sanger, Edmonton, 1996*

## **PREFACE TO THE 2<sup>ND</sup> EDITION**

The impact of the 1<sup>st</sup> Edition was such that The Catalysis Division of The Chemical Institute of Canada decided that the 2<sup>nd</sup> Edition should be prepared after The Catalysis Division served as hosts for the 17<sup>th</sup> Meeting of the North American Catalysis Society, Toronto, 2001. We agreed to serve as editors, compilers and writers. We received all the help for which we asked from our colleagues in the catalysis community. In particular, Michael Wilson and Graeme Norval provided generously from their resources of knowledge of the affairs of The Catalysis Division and the activities it continues to support so vigorously, and Bryce McGarvey assisted greatly with the revisions.

The preparation of this edition has allowed us to correct some errors of fact that were made in the 1<sup>st</sup> Edition. We apologize for the errors. In particular, we apologize to Ron Mann, a stalwart in development of catalysis in Canada, whose name was inadvertently omitted twice from the recognition of those who have served us so well. We hope that no similar omissions or errors have made it into this 2<sup>nd</sup> Edition.

*Jacques Monnier, Ottawa, 2006*  
*Alan R. Sanger, Edmonton, 2006*

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# 1 THE ORIGINS OF THE CATALYSIS DIVISION

Although The Catalysis Division has formally existed since June 7, 1971, its origins really date back to the early 1960s. It should be of interest to the membership of the Division to learn how the scientific community in Canada interested in chemical catalysis came together and eventually formed The Catalysis Division. Some of the past Chairmen of the Division have dug into the files and fading memories of Division stalwarts, and then reconstructed this chronological account. Apologies are made for errors of omission, inaccuracy, or failure to recognize contributions from deserving but unknown members of the catalysis community in Canada.

Scientists in Canada, particularly in the field of physical chemistry and certainly within the Physical Chemistry Division of The Chemical Institute of Canada (CIC), have been involved in surface chemistry and heterogeneous catalysis throughout the 1900s to date. Similarly, members of the Inorganic Chemistry Division and the Organic Chemistry Division have been interested in the design and applications of homogeneous catalysts for an extended period. However, it was only in the early 1960s that a very informal group (history refers to them as the “Canadian Committee on Catalysis”) attempted to organize distinct technical sessions at the annual conference of the CIC. The first such program appeared in June 1965, when sessions containing catalysis technical papers were organized. The persons active in the original Committee and participants in the 1965 program included, in alphabetical order, C. Amberg, Y. Amenomiya, B.E. Conway, R.J. Cvetanovic, H.W. Habgood, K.E. Hayes and M.J. Phillips.

Under the auspices of the Physical Chemistry Division of The Chemical Institute of Canada, a much more ambitious program was organized by R.B. Anderson at McMaster University in June 1967, and this was labelled the Second Canadian Symposium on Catalysis. This was really the initial conference fully dedicated to chemical catalysis and kinetics, in which 34 papers were presented and participants from Canada, U.S.A. and several other countries met together in the student residences in Hamilton, Ontario.

The momentum from this Hamilton program led to planning of further stimulating events which will be summarized in the following pages. Drs. H.W. Habgood and I.G. Dalla Lana approached the Physical Chemistry Division and the Canadian Society for Chemical Engineering, respectively, to sponsor jointly the proposed third Canadian Symposium on Catalysis during the October 1969 Chemical Engineering Conference to be held in Edmonton, Alberta. The intent was to bring together the catalytic chemists and the chemical engineers, in this one intellectual interface where both chemists and chemical engineers still move freely. The success of this Third Symposium, in broadening interest in catalysis in Canada and, more importantly, financially, resulted in a re-examination of the loosely organized “Canadian Committee” with the objective of perhaps stabilizing the structure by forming a “society”.

This group of scientists and engineers with a common interest in catalysis was an early precursor of The Catalysis Division. It was formally labelled the “Canadian Committee on Catalysis”, and in 1969, their executive comprised: H.W. Habgood (Chairman), C.H. Amberg (Vice-Chairman), E.L. Tollefson (Secretary-Treasurer), J.R.B. Boocock, R.J. Cvetanovic, and B.E. Conway. The 1969 activities of the Committee addressed the following documented objectives:

1. To promote and encourage growth and development of science of catalysis in Canada.
2. To establish and maintain close contact between Canadian chemists and chemical engineers interested in catalysis.
3. To assume responsibility for organizing symposia and technical sessions.
4. To maintain contact and/or Canadian representation with international catalysis organizations.

This Committee was affiliated with the Physical Chemistry Subject Division of the CIC. In 1969 a meeting of the Committee was held to discuss the organizational structure necessary to attain representation as a member organization of The Catalysis Society, the international society providing both a forum and organization for workers in all aspects of catalysis. To this end it was proposed that a Catalysis Division of CIC be formed. After the 1969 Edmonton meeting, the Physical Chemistry Division and the CSCChE both agreed to permit the fledgling Catalysis Division to retain the money provided for working capital in organizing the Edmonton Symposium. In previous years these monies had been returned to the Physical Chemistry Division from conference revenues, whereas in 1969 they provided the “seed capitalization” for the proposed Division. In 1970, the formal machinery started, whereby the CIC Council was approached to approve formation of the proposed Catalysis Subject Division. The persons who served on the Canadian Committee on Catalysis are shown in Table 1.

The founding meeting of The Catalysis Division was held on June 7, 1971 in Halifax, N.S. during the 4th Canadian Symposium on Catalysis, chaired by R.J. Cvetanovic, in the absence of the initially appointed Chairman, H.W. Habgood. The following is an incomplete list of those persons who attended the founding meeting.

C.H. Amberg	R.J. Cvetanovic	J.H. Rolston
Y. Amenomiya	M.J. Dignam	D.M. Ruthven
R.B. Anderson	O.M. Fuller	G. Strathdee
J.R.B. Boocock	K.E. Hayes	M. Ternan
H.C. Chen	R.R. Hudgins	E.L. Tollefson
B.E. Conway	S. Kaliaguine	K.P. Wagstaff

Professor R.B. Anderson was elected as the first Chairman of The Catalysis Division. The other officers of the first and subsequent executives are listed in Appendix 1, and the present Constitution and By-Laws of The Catalysis Division are in Appendix 2.

In the first few years The Catalysis Division sponsored symposia, and members participated vigorously in the programs of both the CIC and CSCChE. The value of The Catalysis Division as a common forum for chemists and chemical engineers became established. Early in the 20<sup>th</sup> century the two disciplines were more strongly related, as the distinction between chemistry and chemical engineering was less distinct. For example, physical chemists such as Edward H. Boomer established reputations for catalysis work in what would today be considered chemical engineering. By the time Keith J. Laidler and John C. Polanyi became renowned for their work on kinetics and mechanisms of molecular processes they were perceived as chemists. Similarly, for several decades Canadian researchers with a background in inorganic chemistry have made innovations and resolved issues related to both heterogeneous and homogeneous catalysis (*e.g.* see the topical overview by B.R. James, “Inorganic Catalysis”, in *Chemistry in Canada*, **30**(11), 13, December 1978). Examples include J. Halpern, J. Harrod, B. James, D. Ruthven, B. Conway, and others too numerous to list.

**Table 1. The Canadian Committee on Catalysis**

<b>Time Period</b>	<b>Chairman</b>	<b>Vice-Chairman</b>	<b>Secretary</b>	<b>Members at Large</b>
<b>The Initial Committee, August 1965</b>	R.J. Cvetanovic <sup>1,2</sup>			H.W. Habgood C.H. Amberg <sup>2</sup> B.E. Conway
<b>Prior to November 1967</b>	R.J. Cvetanovic			H.W. Habgood C.H. Amberg B.E. Conway D.S. Alexander <sup>3</sup> E. Tollefson
<b>Approximately March 1969</b>	H.W. Habgood	C.H. Amberg	E.L. Tollefson	R.J. Cvetanovic <sup>4,5</sup> B.E. Conway J.R. Boocock
<b>Approximately October 1969</b>	H.W. Habgood <sup>6</sup>	C.H. Amberg	E.L. Tollefson	R.J. Cvetanovic B.E. Conway J.R. Boocock D.M. Ruthven R.B. Anderson

<sup>1</sup> R.J. Cvetanovic (CIC Councillor) was delegated by the executive of the Physical Chemistry Division at the 1965 CIC meeting to form a Canadian Committee on Catalysis.

<sup>2</sup> R.J. Cvetanovic and C.H. Amberg were the first two Canadian delegates appointed to the International Congress on Catalysis.

<sup>3</sup> D.S. Alexander resigned prior to March 1969.

<sup>4</sup> In March 1969 R.J. Cvetanovic (as outgoing Chairman) appointed I.G. Dalla Lana and H.W. Habgood to nominate two additional members. They were added to the Committee in October 1969.

<sup>5</sup> R.J. Cvetanovic was asked to attend (as an observer) a meeting of the Board of Directors of The Catalysis Society held in Atlantic City in conjunction with the First North American Meeting of The Catalysis Society, February 20-22, 1969.

<sup>6</sup> The Committee Meeting October 22, 1969 at the Macdonald Hotel in Edmonton approved a motion "that the executive of the Canadian Committee on Catalysis make application to the Board of Directors of the CIC to form a separate subject division within the bylaws of the CIC".

The economic and intellectual impact of catalysis work in Canada in the period before the establishment of The Catalysis Division had not had a specific award by which excellence in the field could be recognized. To rectify this deficiency The Catalysis Award was established by The Catalysis Division in 1977. The recipients of the award are listed and each is recognized in this volume. After formation of The Catalysis Division, most of the symposia and catalysis sessions from 1972 to 1976 were held at CIC and CSChE meetings, as detailed in the next chapter. In 1980 the 7th Canadian Symposium on Catalysis was held in Edmonton, and Canadian Symposia have been held more or less regularly in alternate (even-numbered) years since that time.

One of the reasons for forming The Catalysis Division was to be a part of The Catalysis Society. The Catalysis Society holds its North American meetings in odd-numbered alternate years. To avoid conflict, the Canadian Symposia on Catalysis are now held in even-numbered alternate years. In addition, The Catalysis Society has sponsored the Ciapetta lecturer, who has usually given one or more presentations in Canada. Initially a lecture was given at one location in Canada each year. This has been increased to two locations, and in 1981 the Ciapetta lecture was given at three Canadian locations. A description of The Catalysis Society is presented later.

In addition there have been several single-day catalysis meetings held at various locations. A local catalysis discussion group (not sponsored by The Catalysis Division) was formed primarily from people in the Montréal-Chalk River-Ottawa-Kingston area. The first one-day meeting was organized by Dr. A.H. Hardin at the Energy Research Laboratories in Ottawa on May 14, 1976. Meetings have continued once or twice a year since that time.

Members of The Catalysis Division have participated in each of the International Congresses on Catalysis. At the 1980 International Congress Y. Amenomiya and R.B. Anderson presented a letter signed by the Chairman, B.W. Wojciechowski, indicating The Catalysis Division's interest in inviting the Congress to Canada in 1988.

At the 1984 meeting in Berlin Canada was awarded the ICC. Canada hosted the 9th ICC in Calgary in 1988, as described in Chapter 6. This was truly a Canadian effort, with local and national efforts in the organization of the event. A post-congress symposium was also held in Québec City, on the use of organometallic complexes in heterogeneous catalysis.

In 2001 The Catalysis Division hosted the 17<sup>th</sup> Meeting of the North American Catalysis Society, Toronto. The organizing committee was co-chaired by John Moffat and Marten Ternan. The entire Canadian catalysis community contributed strongly to the organization of this major and successful meeting, as described in Chapter 5.

Since its formation in 1971, The Catalysis Division has grown to the point where its members are involved in a number of activities. These include local one-day meetings, the annual Ciapetta lecture, biennial Canadian Symposia on Catalysis and biennial North American meetings of The Catalysis Society. The organization is now mature, and functioning well.

The Catalysis Division and its sister organization, the Canadian Catalysis Foundation, are each active in support and sponsorship of organization and attendance at meetings related to catalysis throughout Canada and abroad. Examples include not only the meetings of NACS and the ICC, but also major international events such as the Sixth International Symposium on Homogeneous Catalysis, Vancouver, 1988 chaired by Brian James, and the International Zeolite Symposia, Québec City, chaired by Serge Kaliaguine. Other meetings containing sponsored sessions on catalysis include the annual Canadian Chemical Engineering Conference and the Canadian Society for Chemistry's annual conference and exhibition.

## 2 THE CANADIAN SYMPOSIA ON CATALYSIS

In 1996, the silver anniversary year of The Catalysis Division of The Chemical Institute of Canada, the 14th Canadian Symposium on Catalysis was held at Whistler, British Columbia. This series of meetings is even older than The Catalysis Division, having first been held as a component of the 1965 annual conference of CIC, at Montréal. The symposia enable chemists, engineers and professionals in related disciplines to meet at a common forum, to present papers, and to discuss issues within their common interest in catalysis.

Since the inaugural meeting the symposia have grown in both size and scope. At the 1965 meeting there were two invited papers and 15 contributed papers, and the authors came from three countries. At the 1996-2004 meetings there were typically about four invited speakers and well over 50 diverse contributed papers. Speakers came from several parts of Canada, the United States, South America, Europe, Asia and Australia. The topics presented covered all aspects of catalysis: from exploratory to applied chemistry and engineering; from disclosure of new methods and materials to insights into the use of known systems; from microscopic examinations to macroscopic applications; from creation of products to protection of the environment.

### **The Evolutionary Sequence**

In 1965 the “Canadian Committee on Catalysis” was an informal group. It was decided to hold sessions dedicated to catalysis at a national meeting. At that time catalysis issues within CIC fell largely within the aegis of the Physical Chemistry Division. Thus, the meeting which the Committee organized was held within the 1965 annual meeting of the CIC, at Montréal. This meeting later became recognized as the inaugural Canadian Symposium on Catalysis.

Following the success of the first meeting it was decided to hold an independent conference fully dedicated to catalysis and kinetics. Two years later the 2nd Canadian Symposium on Catalysis was held at Hamilton. The number of invited speakers and contributions greatly increased from those at the first symposium, the meeting had a higher level of international participation, and the potential for a stand-alone format was proven. Subsequently the symposia have been held in western Canada, the Maritimes, Ontario and Québec. The criteria for selection of a location have included local interest and efforts in catalysis, strengths of the local organizers, attractiveness of the site and facilities, and the need to address the needs of the whole Canadian catalysis community.

The symposia have largely been very successful in both technical and financial terms. When meetings have been held in conjunction with either CIC or CSChE the financial arrangements have necessarily been directed principally towards the objectives of those organizations. Stand-alone meetings sponsored by The Catalysis Division are now preferred by the majority of the members. Each stand-alone meeting has received good support from industry, local institutions, and (since 1990) the Canadian Catalysis Foundation. Indeed, The Catalysis Division now draws no funds from CIC or CSChE to support these meetings.

An outline of the symposia is shown in Table 2. For each the site, date, principal organizers, and extent of the program are given. Strong organizational support from both the local catalysis community and the national organization are constant features of these meetings. The evolution

of the Canadian Symposium on Catalysis will be seen, from a limited size, local forum for Canadians to a national meeting of significant size with a strong international flavour.

**Table 2. The Canadian Symposia on Catalysis.**

---

**1st Canadian Symposium of Catalysis, Montréal, 1965.**

The 1st symposium was held as a component of the CIC annual meeting.

- **Organizers:** included C. Amberg, Y. Amenomiya, B.E. Conway, R.J. Cvetanovic, H.W. Habgood, and others.
- **Invited Speakers (2):** R.B. Burwell and B.E. Conway.
- **Contributed Papers: 15**  
Authors presenting the papers represented three nations: Canada (15), USA (1), and one other country.

**2nd Canadian Symposium on Catalysis, Hamilton, 1967.**

The 2nd symposium was the first stand-alone meeting.

- **Chair of the Organizing Committee:** R.B. Anderson.
- **Invited Speakers (5):** G.C. Bond, F.G. Ciapetta, M. Cohen, W.K. Hall, and H. Marsh.
- **Contributed Papers: 30**  
Authors presenting the papers represented seven nations: Canada (21), USA (6), and five other countries (8).

**3rd Canadian Symposium on Catalysis, Edmonton, 1969.**

The 3rd symposium was held in conjunction with the CSChE annual meeting.

- **Chairs of the Organizing Committee:** H.W. Habgood and I.G. Dalla Lana.
- **Invited Speakers (5):** V. Haensel, H. Kubota, P.W. Selwood, J.M. Smith, and J. Wei.
- **Contributed Papers: 49**  
Authors presenting the papers represented eight nations: Canada (34), USA (10), and six other countries (10).

**4th Canadian Symposium on Catalysis, Halifax, 1971.**

The 4th symposium was held in conjunction with the CIC annual meeting.

- **Chair of the Organizing Committee:** T.J. Gray.
- **Invited Speaker:** R.B. Anderson (Catalysis Award lecture).
- **Contributed papers: 39**  
Authors presenting the papers came from Canada (35) and USA (4).

**5th Canadian Symposium on Catalysis, Calgary, 1977.**

The 5th symposium was held in conjunction with the CSChE annual meeting.

- **Chairs of the Organizing Committee:** I.G. Dalla Lana and E.L. Tollefson.
- **Invited Speaker:** M.A. Vannice.
- **Contributed Papers: 37**  
Authors presenting the papers represented eight nations: Canada (22), USA (9), and six other countries (7).

A volume of preprints of papers was published.

### 6th Canadian Symposium on Catalysis, Ottawa, 1979.

The 6th symposium was an independent meeting.

- **Chair of the Organizing Committee:** Y. Amenomiya.
- **Program Chairs:** C.H. Amberg and J.F. Kelly.
- **Invited Speakers (2):** H.W. Habgood and G.A. Somorjai.
- **Contributed Papers:** 34  
 Authors presenting the papers represented six nations: Canada (22), USA (5), and four other countries (9).

A volume of preprints of papers was published.

### 7th Canadian Symposium on Catalysis, Edmonton, 1980.

The 7th symposium was held in conjunction with the CSCChE annual meeting. The decision was made to hold the symposia in even-numbered years, to avoid conflicts with the meetings of The North American Catalysis Society, held in odd-numbered years.

- **Chair of the Organizing Committee:** A.R. Sanger.
- **Program Chairs:** S.E. Wanke, S.K. Chakrabartty, and S. Prakash.
- **Invited Speakers (2):** W.K. Hall and C.N. Satterfield.
- **Contributed Papers:** 54  
 Authors presenting the papers represented 13 nations: Canada (22), USA (13), and eleven other countries (19).

A volume of preprints of papers was published.

### 8th Canadian Symposium on Catalysis, Waterloo, 1982.

The 8th symposium was an independent symposium.

- **Chair of the Organizing Committee:** R.R. Hudgins; **Vice-Chair:** P.L. Silveston.
- **Invited Speakers (5):** D. Barthomeuf, B.C. Gates, J. Haber, J.D. McIntyre, and J. Rabo.
- **Contributed Papers:** 66 (57 oral, 9 posters)  
 Authors presenting the papers represented nine nations: Canada (42), USA (19), and seven other countries (10).

A volume of preprints of papers was published.

### 9th Canadian Symposium on Catalysis, Québec, 1984.

- **Chair of the Organizing Committee:** S. Kaliaguine.
- **Program Committee:** A. Adnot, E. Chornet, H. De Lasa, Z.M. George, and P.C. Roberge.
- **Invited Speakers (8 papers):** R.B. Anderson, R.A. Armstrong and J.P. Hobson, R.L. Burwell, Jr., E.G. Derouane, K. Klier, A. Nielson, J.M. Smith, and J.G. Speight.
- **Contributed Papers:** 61  
 Authors presenting the papers represented 18 nations: Canada (28), USA (13), and sixteen other countries (27).

A volume of preprints was issued to attendees. Full papers were published as proceedings, entitled "Catalysis on the Energy Scene", ed. S. Kaliaguine and A. Mahay, Studies in Surface Science and Catalysis, vol. 19, Elsevier, Amsterdam (1984).

### 10th Canadian Symposium on Catalysis, Kingston, 1986.

- **Chair of the Organizing Committee:** R.F. Mann.
- **Program Chair:** J. Downie.
- **Invited Speakers (7):** C.H. Bartholomew, I.B. Dicker, H.W. Habgood (Catalysis Award lecture), A. Kiennemann, R.J. McKinney, J.M. Stencel, and H. Topsøe.
- **Contributed Papers:** 69  
 Authors presenting the papers represented 6 nations: Canada (54), USA (8), and four other countries (11).  
 A volume of preprints was published in advance of the meeting.

### Calgary, 1988

There was no symposium in 1988. The Canadian catalysis community concentrated its organizational efforts into hosting the 9th International Congress on Catalysis in Calgary.

### 11th Canadian Symposium on Catalysis, Halifax, 1990.

The 11th symposium was held in conjunction with the CIC (73rd Canadian Chemical Conference) and CSChE (40th Canadian Chemical Engineering Conference) joint annual meetings, as it provided an ideal opportunity for the interaction of members of each community.

- **Organizing Committee member representing The Catalysis Division:** M. Wilson.
- **Program Committee:** J.F. Kriz, J. Monnier, and J.R. Brown.
- **Invited Speakers included:** B.C. Gates, M. Wilson, B.R. James (Catalysis Award lecture), and G. Rempel.
- **Contributed Papers:** 50  
 A volume of preprints was published in advance of the meeting.

### 12th Canadian Symposium on Catalysis, Banff, 1992.

The 12th symposium was an independent meeting, with the theme “Catalysis: Partnership Among Universities, Government and Industries”.

- **Chair of the Organizing Committee:** A.R. Sanger.
- **Program Committee:** E.C. Sanford, K.T. Chuang, A. Krzywicki, and K.J. Smith.
- **Invited Speakers (4):** R. Chianelli, R. Grubbs, E.L. Tollefson, and B.W. Wojciechowski (Catalysis Award lecture).
- **Contributed Papers:** 50  
 Authors and co-authors presenting the papers represented 11 nations: Canada (40), USA (7), and nine other countries (9).

A volume of abstracts was published in advance of the meeting. A volume of full papers and, at the authors’ discretion, preliminary communications was published as “Progress in Catalysis”, ed. K.J. Smith and E.C. Sanford, Studies in Surface Science and Catalysis, vol. 73, Elsevier, Amsterdam (1992).

### 13th Canadian Symposium on Catalysis, Sarnia, 1994.

The 13th symposium was an independent meeting.

- **Chair of the Organizing Committee:** D.J. Laycock.

- **Program Committee:** J.B. Moffat, I. Cody, J. Hsu, C.A. Mims, and F. Ng.
- **Invited Speakers (5):** M.M. Bhasin, B.H. Davis, M. Daage, J.M. Garces, and K.C. Taylor.
- **Contributed Papers:** 44 (30 oral, 14 posters)  
Authors and co-authors presenting the papers represented 13 nations: Canada (34), USA (8), and eleven other countries (11).  
A volume of abstracts of papers was published.

#### **14th Canadian Symposium on Catalysis, Whistler, 1996.**

The 14th symposium was an independent meeting, and the first of this series held in B.C.

- **Chair of the Organizing Committee:** K.J. Smith.
- **Program Committee:** A.R. Sanger, B.R. James, A. Krzywicki, and E.C. Sanford.
- **Invited Speakers (4):** J.N. Armor, K.T. Chuang, M. Ternan (Catalysis Award lecture), and T.T. Tsotsis.
- **Contributed Papers:** 58  
Authors presenting papers came from North and South America, Asia, Australia and Europe.  
A volume of abstracts was published.

#### **15th Canadian Symposium on Catalysis, Québec, 1998.**

The 15th symposium was an independent meeting.

- **Chair of the Organizing Committee:** S. Kaliaguine.
- **Program Committee:** L. Benneviot (Chairman), S. Giasson (Co-chairman), F. Béland, C. Danumah, and G.Y. Xu.
- **Invited Speakers (5):** R.J. Farrauto, G. Rempel, R. Sheldon, D.W. Goodman and S. Kaliaguine (Catalysis Award lecture).
- **Contributed Papers:** 60.  
Authors from North and South America, Asia, Australia and Europe presented papers.  
A volume of abstracts was published.

#### **16th Canadian Symposium on Catalysis, Banff, 2000.**

The 16th symposium was an independent meeting, with 135 delegates from 21 countries.

- **Chair of the Organizing Committee:** R.A. Kydd.
- **Program Committee:** Abdel Sayari.
- **Invited Speakers (6):** J.R. Grace, E. Iglesia, J.C. Stevens, J. Weitkamp, S.L. Scott, T. Ziegler and G. Rempel (Catalysis Award lecture).
- **Contributed Papers:** 128 (54 oral, 74 posters).  
Authors presenting the papers represented North and South America, Asia, Australia and Europe.  
A volume of abstracts was published.

#### **17th Canadian Symposium on Catalysis, Vancouver, 2002.**

- The 17th symposium was held in conjunction with the annual meeting of the Canadian Society for Chemistry.

- **Chair of the Organizing Committee and the Program Committee:** Bob Hayes.
  - **Invited Speakers (5):** T. Kreuzer, R. Farrauto, S. Wanke, C. Crudden, and Michael C. Baird (Catalysis Award lecture).
  - **Contributed Papers:** 84 (66 oral, 18 posters)  
Authors from North and South America, Asia, Australia and Europe presented papers.
- The combined conference issued a volume of brief abstracts.

#### **18th Canadian Symposium on Catalysis, Montreal, 2004.**

- The 18th symposium was held as an independent meeting.
- **Chair of the Organizing Committee:** Jitka Kirchnerova.
- **Program Committee:** Jacques Monnier (Co-chair), Faiçal Larachi (Co-chair), Dimitrios Berk, Philip Jessop, Peter McBreen, Michel Poirier, Marten Ternan, Davit Zargarian
- **Invited Speakers (17):**
  - **Plenary Lectures (4):** Gabor A. Somorjai, Tobin J. Marks, Douglas W. Stephan (Ciapetta Lecture) and Colin A. Fyfe (Catalysis Award Lecture)
  - **Keynote Lectures (13):** M. Mavrikakis, J.-P. Dodelet, F. Jerome, S.T. Oyama, B.A. Peppley, W. Leitner, S. Collins, V.I. Birss, V. Murphy, J.C. Yu, M.A. Abraham, V.A. Kirilov and A. Trovarelli
- **Contributed Papers:** 138 (94 oral, 44 posters)

The meeting organizers issued a volume of abstracts. Conference participants came from 16 countries. A special issue of "Topics in Catalysis" (J. Kirchnerova, F. Larachi, R. Le Van Mao and D. Zargarian, guest editors) will be published in 2006.

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### 3 THE CATALYSIS AWARD

Prior to 1977 there had been no award dedicated to recognition of the work and achievements within the Canadian catalysis community. This deficiency was addressed by the formation in 1974 of a committee under the chairmanship of Dr. B.W. Wojciechowski with the objective of establishing a Catalysis Award. Under the auspices of The Catalysis Division of The Chemical Institute of Canada (CIC) an award was inaugurated for 1977, to be awarded biennially, and was designated "The CIC Catalysis Award". The award consists of a rhodium-plated silver medal and funds to enable the winner to attend a national meeting at which a paper is presented. The design of the medal was made by Mrs. P. Kruus, and is shown on the cover of this volume.

On behalf of the Division, Dr. J.R. Boocock negotiated sponsorship for the medal. The offer of Johnson, Matthey and Mallory Ltd. was accepted in late 1975, and continued to 1990. The costs for the travel of the winner were initially borne by the Division. From 1992 the full costs associated with the award have been generously covered through sponsorship by the Canadian Catalysis Foundation, and the award is now entitled "The Catalysis Award". The present terms of reference for the award are presented on the following page.

The winners of the award (Table 3) are each outstanding representatives of the Canadian catalysis community. Profiles of each are presented in the following pages. Their contributions are related in these brief biographies.

**Terms and Conditions**

**The Catalysis Award**  
**(Sponsored by the Canadian Catalysis Foundation)**  
**(Established 1977, Revised 1995)**

1. The Award shall be known as The Catalysis Award, sponsored by the Canadian Catalysis Foundation.
2. It shall be awarded biennially to an individual who while resident in Canada has made a distinguished contribution to the field of catalysis.
3. The Award Selection Committee shall consist of the Vice-Chair of The Catalysis Division as non-voting Chair, the Past Chair of The Chemical Institute of Canada Board of Directors as non-voting Vice-Chair, together with the three most recent Catalysis Award recipients, unless they have nominated or have supported the nomination of a candidate. In this case, The Catalysis Division Executive shall appoint replacements. Should the Vice-Chair of The Catalysis Division be unavailable, the position of non-voting Chair of the Award Selection Committee shall be filled by either the Chair or Secretary/Treasurer of the Division.
4. The recipient shall give The Award Lecture and receive the award at the Canadian Symposium on Catalysis or at the Annual Conference of the CSC or the CSCChE, the choice to be made by the recipient in consultation with The Catalysis Division Executive.
5. The Award shall be made biennially unless the Award Selection Committee feels that no suitable nominee exists. The Committee shall select the recipient by November 1st of the year preceding the award year.
6. The recipient shall be known as The Catalysis Award Lecturer and shall receive a rhodium-plated silver medal and travel expenses to present the Award Lecture.
7. A call for nominations for the Award shall be published biennially in the June and July/August issues of the official journal of The Chemical Institute of Canada, "Canadian Chemical News". A call for nominations shall also be published in The Catalysis Division Newsletter in the Spring issue of the same year.
8. Nominations for the Award shall be submitted in writing to the Program Manager Awards, The Chemical Institute of Canada, over the signatures of no fewer than three professional members of The Institute. Nominations shall be submitted in quadruplicate by October 1st of the year preceding the award year using The Chemical Institute of Canada award nomination form and shall follow the criteria detailed therein. All nominations shall remain in good standing for a period of three successive award selections.
9. The name of The Catalysis Award recipient shall be announced in the official journal of The Chemical Institute of Canada, "Canadian Chemical News", together with other award winners, and will include a photo and biographical write-up. Additional publicity will be gained through advertising in the Conference/Symposium program announcing the Award Lecture. The above information will be provided to The Institute by the Vice-Chair of The Catalysis Division.
10. The Executive Committee of The Catalysis Division of the CSC and CSCChE is responsible for ensuring that the Terms of Reference are followed.
11. Any amendments or alterations to the Terms of Reference shall be the responsibility of the Executive Committee of The Catalysis Division in consultation with the Canadian Catalysis Foundation as sponsor and requires the approval of the CIC Board of Directors.

**Table 3. Winners of The Catalysis Award<sup>1</sup>**

<b>Year</b>	<b>Winner(s)</b>	<b>Institute</b>	<b>Topic</b>
1977	Y. Amenomiya and R.J. Cvetanovic	National Research Council of Canada	Development of a Technique for Catalyst Studies
1979	R.B. Anderson	McMaster University	Some Catalysts I Have Known
1982	C.H. Amberg	Carleton University	(No award lecture, due to illness)
1984	H. Alper	University of Ottawa	Processes Catalyzed by Metal Complexes
1986	H.W. Habgood	Alberta Research Council	Research in Catalysis - A Personal View
1988	J.B. Moffat	University of Waterloo	Multifunctional Microporous Heterogeneous Catalysts
1990	B.R. James	University of British Columbia	Ruthenium Complexes - The Elite of Homogeneous Catalysts?
1992	B.W. Wojciechowski	Queen's University	Chain Mechanisms in Hydrocarbon Cracking
1994	I.G. Dalla Lana	University of Alberta	Rational Catalysis: Mechanism, Kinetics and Design
1996	M. Ternan	CANMET, Ottawa	Pore Diffusion of Vacuum Residue Molecules and Hydrogen Dissociation on Reaction Sites: Essential Steps in Hydrocracking Catalysis

<sup>1</sup> Until 1995 the award was known as "The CIC Catalysis Award".

Table 3 (continued). Winners of The Catalysis Award

<b>Year</b>	<b>Winner(s)</b>	<b>Institute</b>	<b>Topic</b>
1998	S. Kaliaguine	Université Laval	
2000	G.L. Rempel	Rempel Research Incorporated <i>and</i> University of Waterloo	Polymer Modification via Homogeneous Catalysis
2002	M.C. Baird	Queen's University	Catalysis by Organotransition Metal Compounds; Synergism between the Pure and the Applied
2004	Colin A. Fyfe	University of British Columbia	Investigations of Zeolite Molecular Sieve Catalysts and Structure Determinations of Their Host/Guest Complexes with Organic Molecules by High Resolution Solid-State NMR Spectroscopy

## Yoshimitsu (Yoshi) Amenomiya

Yoshimitsu (Yoshi) Amenomiya was born in Tokyo, Japan, on May 13, 1924. His father was an industrial chemist who established the paint industry in the Mitsubishi group. In a way, therefore, Yoshi followed his family tradition when he obtained a Bachelor's degree in industrial physical chemistry from the Tokyo Institute of Technology (TIT) in 1947. He continued as a research assistant at TIT conducting research in heterogeneous catalysis under the direction of Professor Shiba. This eventually led to his Ph.D. which he obtained in 1959 from Hokkaido University. He came to Canada in the same year and joined the Chemistry Division of the National Research Council of Canada in Ottawa as a postdoctoral fellow. He stayed with the Division for the next 28 years, first as an Associate Research Officer and then since 1968 as a Senior Research Officer. Then, over vigorous protests from his scientific peers, Yoshi was retired from NRC. He then joined the Department of Chemistry at the University of Ottawa as a Visiting Professor, reestablished himself and achieved great success. Currently, Yoshi Amenomiya holds the position of an Honorary Visiting Professor at the University of Ottawa.

Dr. Amenomiya has worked in the field of heterogeneous catalysis for more than 40 years. He has published about 60 papers and reviews, authored one book, contributed to three others and delivered over 30 invited presentations. His line of research covers a wide range of aspects of catalysis carried out on oxide-supported metal catalysts. Catalyst surface characterization utilizing probe molecules and test reactions for elucidation of the concept of the catalytically active centre, the role of surface acidity and kinetics of adsorption and desorption have constituted major themes. Temperature programmed desorption/reaction (TPD/R), infrared spectroscopy (IR), mass spectrometry (MS), gas chromatography (GC) and microreactors with on-line BC/MS analysis of products have been his preferred research techniques. Yoshi's most substantial contributions have been made in the areas of C<sub>1</sub> chemistry, the mechanism of methanation, small hydrocarbon isomerization and hydrogenation, the water gas shift reaction mechanism and surface characterization of alumina. He has made significant inroads in the above areas of catalysis. Clarity and a focussed approach are trademarks of his widely cited papers.

In 1963, Dr. Amenomiya's most brilliant idea came to fruition, and it has since had an enormous long-term impact on heterogeneous catalysis. "Application of flash-desorption method to catalyst studies. I. Ethylene-alumina system" was published in the Journal of Physical Chemistry. An extensive summary of the new technique for catalyst characterization was published in 1967 as a chapter of volume 17 of the Advances in Catalysis under the title "Application of a temperature-programmed desorption technique to catalysis studies". These publications marked the beginning of the temperature-programmed desorption (TPD) technique and the field of catalyst characterization was permanently altered. TPD is an elegantly simple and remarkably effective method for in-situ catalyst characterization. In TPD experiments, the surface of the catalyst is exposed to one or several volatile species, which are adsorbed, and which may react on the surface to form new surface bound moieties. Then the temperature of a catalyst having adsorbed species is increased linearly with time. The number of various surface species, their amounts and strength of adsorption are determined as they desorb as a function of temperature. The first detection system for the desorbed species was based on a thermal conductivity detector (TCD).

In the early sixties, technical advancements in the equipment required were relatively limited. For instance, linear temperature programmers were not commercially available. The

development of the TPD technique was only made possible through the application of the exceptional experimental skill, combined with an outstanding multi-disciplinary knowledge covering scientific and technical aspects possessed by Yoshi Amenomiya and Bob Cvetanovic (q.v.). The multitude of microprocessors, computers and various powerful and selective detection systems, have enabled commercial versions of the TPD method, also termed temperature-programmed reaction (TPR). Recent application of the combined Fourier transform infra-red spectroscopy (FTIR) with mass spectrometry (MS) has enabled the specific identification of surface species and their various concentrations in a time resolved fashion during TPR/TPD experiments, enhancing even further the power of this methodology. Thousands of reports have been published in which TPD/TPR was employed. There is no question that the impact of TPD methodology on the advancement of knowledge in heterogeneous catalysis has been profoundly significant.

Almost upon the thirtieth anniversary of conceiving the TPD idea, Yoshi became a co-author of another international success. In 1990, Dr. Amenomiya and a group of Canadian scientists (Birss, Galuszka, Goledzinowski, Sanger) published an extensive review on oxidative coupling of methane. Oxidative coupling of methane became one of the most researched catalytic processes in the past decade and in the late eighties and early nineties yielded well above a hundred publications annually and numerous patents. Commercialization of the process appeared imminent. Substantial industrial support was provided with the objective of removing the 25% C<sub>2</sub> yield limitation. During the hey-day of oxidative coupling, it was daring to openly conclude that the 25% limitation in C<sub>2</sub> yield could not be circumvented catalytically. The review, after a sober analysis of the huge amount of experimental data, did just that. Yoshi Amenomiya with his Canadian colleagues saved many research dollars because of this publication.

Dr. Amenomiya's impact on the direction of national and international catalysis has been widely recognized and honoured through numerous awards and representations. Only a few of the most outstanding examples from a much longer list are mentioned here. In 1973, he was elected a Fellow of The Chemical Institute of Canada (FCIC) and between 1978-1979 served as a Chairman of the Catalysis Division of CIC. He received **the first** Catalysis Award of CIC (jointly with Cvetanovic) in 1977 and **the first** Canadian Catalysis Lectureship of CIC in 1995. He served as a council member of the International Congress on Catalysis (ICC) and its Canadian representative between 1979-1989. He was elected to the Secretariat of the ICC between 1984-1988 and served as a Program Chairman of the 9th International Congress on Catalysis in 1988. He has been a Director and Vice-President of the Canadian Catalysis Foundation since 1990.

Yoshi has substantially contributed to the development of young Canadian and international scientific talent in catalysis through his active participation in NRC's Research Associate International Program. At various times between 1967-1987, he hosted eleven young scientists from Canada and abroad in his laboratory at NRC, sharing with them his immense expertise and providing guidance and mentorship. Despite his status as a scientist with a well-established international reputation, Yoshi has always made himself easily available to his younger colleagues and peers whenever they desired his assistance in quenching their thirst for knowledge in catalysis. He is a role model for scientific excellence and the finest imaginative science carried out with an elegant simplicity and striking effectiveness. Throughout his career, he has contributed immensely to a better understanding of the art of catalysis in its basic and applied aspects. He has augmented the popularity of catalysis in Canada to put Canadian catalysis on the international map.

### **Ratimir J. (Bob) Cvetanovic**

Bob Cvetanovic received his first degree in 1936, a B.Sc. in Forestry from the University of Edinburgh, Scotland. His studies were supported by a scholarship from the Serbian Minister's Fund. He received the Harry Younger Medal for Practical Forestry, also in 1936. Bob then returned to Yugoslavia to work in the Ministry of Agriculture, and obtained his second degree, a B.A.Sc. in Chemical Engineering, in 1942 from the University of Belgrade. During World War II Bob was a lieutenant in the Royal Yugoslavian Army. As a prisoner of war he was given leave to fill the civilian post of superintendent of a vegetable oil factory from 1942 to 1945. During this period he demonstrated his diverse capabilities by also authoring an English-Serbian / Serbian-English dictionary.

After the war Bob became an Assistant Lecturer at the University of Belgrade and also undertook graduate studies. In 1948 Bob immigrated into Canada, and then entered graduate studies at the University of Toronto. He received his M.A. in Chemistry in 1950, and his Ph.D. and the Nadine Phillips Scholarship in 1951. Thereafter he joined the National Research Council of Canada, initially (1951-52) as a postdoctoral fellow and then as an Assistant Research Officer in the Division of Applied Chemistry (1952). Throughout his career Dr. Cvetanovic continued to contribute through academia as well as NRC. He acted as supervisor of Dr. D.J. LeRoy's laboratory and students during a period of absence through illness. He has held distinguished visiting academic positions at Cornell University, the University of California at Davis, and Churchill College, Cambridge.

Dr. Cvetanovic was an early leader in catalysis and molecular processes. He studied the reactions of molecules, radicals, and ions, both during his career at the National Research Council of Canada and afterwards. Significant contributions were made in photochemistry, kinetics and catalysis. Dr. Cvetanovic's interests cover all phases of matter. An early contribution involved the development of a mercury photosensitization method for generating oxygen atoms. Using this method he studied the kinetics and mechanisms of reactions of ground state oxygen atoms with organic compounds. Other submolecular species of interest were excited oxygen atoms, O(1D), and the hydroxyl radical. This work led to the determination of radical rearrangement processes. These fundamental gas phase studies also contributed to our understanding of the role of O(1D) and hydroxyl radicals in atmospheric chemistry, especially in the stratosphere and troposphere.

Dr. Cvetanovic took advantage of improvements to the state of the art in gas chromatography. Using these tools he identified the products of reactions of atoms and radicals, and thereby determined the mechanisms of the reactions.

Applying his knowledge of reactions of atoms, ions, radicals and molecules, Dr. Cvetanovic provided insight into catalytic reactions. This led to an interest in the interactions of gas phase species with surfaces of solids, and the natures of the surface species so formed. In collaboration with Yoshimitsu Amenomiya (q.v.), the temperature programmed desorption (TPD) technique was developed. In this technique molecules are adsorbed from the gas phase onto a solid surface, the temperature of the solid is then steadily increased and the amount and nature of the molecules desorbed are measured. In this manner quantitative insights are gained into the nature of the surface. For this work Drs. Amenomiya and Cvetanovic became the first recipients of The Catalysis Award (1977).

Dr. Cvetanovic was an active member of the Canadian Committee on Catalysis. This informal body provided a focus for the Canadian catalysis community, and was instrumental in

the creation of the Catalysis Division of CIC. Dr. Cvetanovic was also one of the organizers of the first of the continuing series Canadian Symposia on Catalysis.

Dr. Cvetanovic was required to retire from NRC in 1978, the same year in which he received the CIC Medal in recognition of his major contributions to the chemical sciences. He accepted a position as Visiting Professor at the University of California, Irvine, where he worked with F.S. Rowland (Nobel Prize, 1996). His style was so well appreciated that his students applauded him at the end of his first lecture. From 1980-1988 he was a Visiting Scientist at the National Bureau of Standards, Washington, D.C. There he developed a chemical kinetics data base, and software for the NIST computer to facilitate searching. The task was complicated, lengthy, and required considerable judgement on Bob's part. In addition to several publications, the result was NIST Standard Reference Database 17, NIST Chemical Kinetic Database. The continuing value of this work is recognized, as it is currently available (version 6.01). For this work Bob received a Certificate of Appreciation from the U.S. Department of Commerce.

In 1989 Bob retired from active scientific endeavours, but he retained his interest in the developments at the institutions to the reputations of which he has made such a strong contribution. Bob died peacefully in his sleep on February 23, 2002. An appreciation of his life and his research was published in *Canadian Chemical News*, July-August 2002, p.9.

## Robert B. Anderson

Professor Robert B. Anderson came to Canada from the United States and joined the Department of Chemical Engineering at McMaster University in 1965. He had established a distinguished record in Fischer-Tropsch synthesis (FTS) research at the United States Bureau of Mines, which he joined in 1944. Prior to this, Professor Anderson had completed doctoral studies at Iowa State University in physical chemistry followed by two years of postdoctoral work with P.H. Emmett at Johns Hopkins University.

While at the U.S. Bureau of Mines he developed new catalysts for FTS and was the first to show that iron nitrides are unique, durable catalysts for FTS that have high selectivities to alcohols. Professor Anderson also worked on the kinetics and mechanism of FTS. Perhaps the most significant contribution in this area was made in 1950 when Anderson and Friedel published the equations that predict the isomer and carbon number distributions of the FTS products. Although the original version of their equation was later improved by Anderson and others, the basic form remains valid fifty years later and is used in most FTS publications that report product distributions. Anderson later referred to the equation as the “Bureau of Mines equation” but it is now most often referenced as the “Anderson-Schulz-Flory equation”. Many of Anderson’s contributions from this period were published in Emmett’s series on Catalysis and in the now classic reference text by Storch, Golumbic, and Anderson titled “The Fischer-Tropsch and Related Syntheses” (1951). In recognition of the very significant contributions Professor Anderson made in this area, he was awarded the Ipatieff Prize of the American Chemical Society in 1953 and its Pittsburgh Award in 1960. In 1966 the U.S. Department of the Interior bestowed on him its highest honour, the Distinguished Service Award.

At McMaster University, Professor Anderson established one of the strongest catalysis research laboratories in Canada. He was a teacher and mentor to undergraduate and graduate students, postdoctoral fellows and other visiting scholars, many of whom remain active in catalysis research. Under his guidance, his students and postdoctoral fellows were able to make significant contributions in many areas including hydrocarbon hydrogenolysis, preparation and characterization of catalysts, Fischer-Tropsch synthesis and alcohol synthesis. He published more than 200 scientific papers, and authored and edited several books and monographs.

Professor Anderson officially retired from McMaster University in 1981, but as Professor Emeritus continued an active research program at the university. As a retirement project he wrote the book titled “The Fischer-Tropsch Synthesis”, published in 1984, which was an update of research on the Fischer-Tropsch synthesis from 1955 to 1983.

He was a member of the Editorial Board of the Journal of Catalysis, session chair at various international conferences, and served on the executive of The Catalysis Division of The Chemical Institute of Canada. In recognition of these contributions, Professor Anderson received a number of awards including The Catalysis Award of The Chemical Institute of Canada in 1979, Fellowship of The Chemical Institute of Canada, and Fellowship of the Royal Society of Canada in 1983. In 1984, a Special Fischer-Tropsch Session was held in his honour at the 9th Canadian Symposium on Catalysis in Québec.

As co-chairman (with Harry Habgood (q.v.)) he was in the midst of organizing the 9th International Congress on Catalysis held in Calgary, Alberta in 1988, when he died suddenly on October 24, 1987. Professor Anderson was a caring individual with good humour who was more than mentor and supervisor to most of his students. His friendly demeanor made it a pleasure to work for him and experience his kindness and hospitality. The latter was often expressed with

an invitation to his home for a meal and description of the latest antique clock added to his impressive collection.

## Carl H. Amberg

Dr. Carl H. Amberg obtained his doctorate from the University of Toronto (1952), and joined the (then) Applied Chemistry Division of National Research Council where he established a catalysis research group with postdoctoral fellows from various countries. After acquiring an international reputation as a catalysis researcher, he moved to the Department of Chemistry of Carleton University in 1964. He became the Chairman of the Department in 1976 and later the Dean of Graduate Studies and Research. Throughout his career he devoted himself not only to catalytic research but also to the education of the succeeding generations.

His significant contributions to catalytic science and to the catalytic community were recognized by The Catalysis Award presented to him in 1982. He was one of the founding members of The Catalysis Division and an important contributor to the understanding of heterogeneous catalysis. Unfortunately an illness forced him to retire early.

Dr. Amberg's dedication to the promotion of Canadian research in catalysis is highly appreciated by his colleagues and successors. He was a member of the so-called Canadian Committee on Catalysis (1965-1971) throughout its period of activity, and then active in The Catalysis Division of which the "Committee" was a predecessor. After The Catalysis Division was officially established in 1971, according to the recommendation of the "Committee", he served as Vice-Chairman (1972-1973) and then as Chairman (1973-1974). He was appointed as Director of The Catalysis Society (of North America) from 1977 to 1980. Carl Amberg served as Canadian representative to the International Congress on Catalysis as a Councillor in 1972-1973 and again in 1976-1977.

Following his doctorate, Carl Amberg's research career began at NRC, where he was influenced by Dr. Ira Puddington, the leading Canadian scientist whose interests were focussing on the utilization of Canadian resources such as the Athabasca tar sands. Carl pioneered the microreactor technique to study the mechanism of catalytic hydrodesulphurization (HDS) using sulphur-containing heterorings as model compounds, in both the continuous and pulse modes. The HDS reactions were chosen in anticipation of new environmental regulations. The first detailed insights into the mechanism of HDS resulted from this work. Several proposed routes included in this mechanism were later confirmed by the intense efforts of Dr. Amberg and other researchers. Dr. Amberg focussed his attention on  $\text{MoS}_2$  as the main species responsible for catalytic actions in commercial molybdate catalysts. Thus, much of his research at NRC involved the use of  $\text{MoS}_2$ , either alone or doped with promoters, as catalysts. Although a significant fraction of this research was conducted some thirty-five years ago, the works co-authored by Carl are still extensively cited by many scientists around the world.

After joining Carleton University, Dr. Amberg continued to pursue his interests in catalysis, especially research into the promoting effects of Co and Ni on the catalytic actions of unsupported  $\text{MoS}_2$  and  $\text{WS}_2$  during HDS. The observed differences in the promoting effects could be used for interpreting differences in the performance of the commercial molybdate and tungstate catalysts. Also, during this research, the importance of the experimental method used for the addition of the promoters to the sulphides was recognized. Carl has expanded his research on unsupported catalysts to include supported Mo and W catalysts during his international collaboration with scientists at the Eindhoven University in the Netherlands. Several research groups at Canadian universities and in government laboratories have benefited from this collaboration, especially from Carl's leadership and active participation.

The work on sulfide catalysts performed by Dr. Amberg has found applications in the use of catalysts for the upgrading of Canada's heavy hydrocarbon resources, including those used at the Suncor and Syncrude Canada oil sands plants.

Carl Amberg has also undertaken studies in other areas of catalysis and surface science, such as the diffusibility study on silver catalysts, infrared studies of CO adsorption on zinc oxide catalysts as well as the adsorption and adsorption hysteresis studies of CO<sub>2</sub> and N<sub>2</sub>O on charcoals and Vycor glass. His involvement in the development of applications of gas-liquid chromatography is sometimes overlooked. At the time of his involvement (late 50s) chromatography was still an emerging method. He was the first in Canada, if not in the world, who determined the elution times of many sulphur-containing compounds and subsequently applied this technique for determining the type and concentration of sulphur-containing compounds in distillates obtained during the cracking of the Lloydminster crude.

Carl Amberg's contribution to catalysis and surface science has influenced many scientists in Canada and abroad.

## Howard Alper

The 1984 Canadian Catalysis Award was presented to Professor Howard Alper, of the University of Ottawa, for his accomplishments in development and understanding of metal complex catalyzed reactions in synthetic organic chemistry.

Howard Alper is a native of Montréal, and received his B.Sc. from Sir George Williams University and his Ph.D. from McGill University (1967). After NATO postdoctoral studies at Princeton Dr. Alper joined the faculty at the State University of New York, Binghamton, in 1968. In 1975 he accepted a position at the University of Ottawa, was appointed full professor in 1978, and he has developed his research there ever since. Professor Alper has served two terms as Chairman of the Chemistry Department. Professor Alper has been extremely active in professional affairs, both within Canada and internationally, has published widely, and has received several awards in addition to The Canadian Catalysis Award.

Outstanding contributions have been made by Professor Alper in the development of new organic reactions, as well as in the significant improvement of known processes of both fundamental and applied interest. In the first 6-7 years of his career, he investigated the application of organometallic complexes as reagents and intermediates in organic synthesis. For instance, he and his co-workers reported the first examples of sulfur-donor ligand ortho-metalated complexes, which proved to be valuable intermediates in the preparation of several classes of heterocyclic compounds of pharmaceutical importance. In subsequent years Professor Alper's group has investigated the use of metal complexes as catalysts for a number of processes. He is recognized as a pioneer in the application of phase transfer catalysis to metal catalyzed reactions. Of particular note was his discovery of exceptionally mild, regiospecific oxidation, reduction, and carbonylation reactions. Examples include the oxidation of olefins to ketones catalyzed by palladium, ruthenium, or rhodium complexes; the reduction of aromatic hydrocarbons or carbonyl compounds using rhodium(I) compounds; and the palladium, nickel, or cobalt catalyzed mono carbonylation of halides to acids, ketones, and lactones. Novel double carbonylation reactions of halides to keto acids, and of halodienes or epoxides to  $\alpha$ -keto lactones have also been described. Other significant developments include the first examples of a triple carbonylation reaction, the use of lanthanides in phase transfer catalysis, and carbon monoxide trapping in a manganese(III) induced oxidation system. Quaternary ammonium salts, crown ethers, polyethylene glycols, and cyclodextrins have been employed as phase transfer agents in many of these studies.

Studies on processes effected under biphasic conditions have led to excellent methods for the dechlorination of chloroarenes (including polychloroarenes), and the carbonylation of chloroarenes to carboxylic acids under exceptionally mild conditions using a palladium catalyst. The mechanistic investigations are of broad significance, being applicable to a variety of other reactions including the Heck and Suzuki reactions. In addition, by use of a biphasic system of chloroform and alkali, Alper has discovered a novel method of achieving the carbonylation of halides (and presumably other substrates) to acids without involving carbon monoxide gas as a reactant.

Exciting results have been obtained by Professor Alper in other areas of homogeneous catalysis. A major achievement by Alper's group has been in the area of carbonylation-ring expansion reactions. The ability to "stitch" a carbonyl unit into an aziridine to give a  $\beta$ -lactam is a process of considerable potential, since the rhodium(I) catalyzed reaction occurs in a regio-

stereo-, and enantiospecific manner. Furthermore, one can realize the preparation of  $\beta$ -lactams in high optical purity by using a racemic aziridine, the rhodium catalyst, and a chiral ligand.

In pursuing the synthesis of piperidinones by the cobalt carbonyl catalyzed carbonylation of pyrrolidines, Alper discovered the remarkable rearrangement of N-ketopyrrolidines to pyrrolidinones in high yield using a dual catalytic system consisting of cobalt and ruthenium carbonyls. This process is of value in alkaloid synthesis (*e.g.* vincamine alkaloids). Another unique and useful reaction was the synthesis of thiazolidinones (including fungicides of this class) by the rhodium catalyzed double carbonylation and ketene elimination reaction of thiazolidines.

The above achievements are examples of Professor Alper's capabilities in design, investigation, and accomplishment of significant advances in molecular catalysis. He has made several other contributions of similar complexity and importance, for example in syntheses of heterocycles, hydroformylation of alkenes, and routes to isocyanates. More recently he has turned his attention to applications of molecular catalysts supported on a clay matrix.

Professor Alper is a scientist who loves a challenge, and who makes strenuous efforts to attain his goals.

## Henry W. (Harry) Habgood

Dr. Habgood received The Catalysis Award in 1986 for his innovative work in catalysis science and his pioneering efforts in the development of applications of technologies for the study of catalysts and catalytic processes.

After receiving a B.Sc. and M.Sc. from Queen's University, Dr. Habgood initially applied his skills at Naugatuck Chemicals. He then returned to University, earning his Ph.D. from the University of Michigan. Following a postdoctoral fellowship at the National Research Council and one year teaching at Queen's, Dr. Habgood joined the Research Council of Alberta in 1954, where he led efforts in catalysis research until 1984. Following his retirement from Alberta Research Council Dr. Habgood remained highly active, with strong involvements with the Technical University of Nova Scotia and the professional affairs of catalysis science.

Dr. Habgood continued to pursue his interests in catalysis. In particular, he was vigorous in his efforts as co-chair for the 9th International Congress on Catalysis in Calgary (1988), especially following the lamentable and untimely loss of his long-time friend, colleague, and co-chair, Dr. R.B. Anderson (q.v.). Following this enormously successful meeting, Dr. Habgood was instrumental in the application of the financial resources which this meeting created, and provided leadership within the team which had shown such organizational capability in their efforts toward the establishment of the Canadian Catalysis Foundation (CCF). He was subsequently elected its first President. He served the CCF with dignity and drive until passing the responsibility and honour to Dr. J.B. Moffat (q.v.) in 1990. Dr. Habgood is now actively enjoying his retirement in Cape Breton, and remains interested in the science and the scientists with whom he worked.

Dr. Habgood's career was characterized by his foresight in recognizing the future value of materials and processes, and to focus his attention on their development and applications. In the early 1950s he recognized that zeolites, with their precisely sized diffusion channels, offered a wide range of opportunities for applications in separations of molecules and in catalysis, through highly selective diffusion of molecules of specific sizes. Dr. Habgood's contributions were among the early studies of zeolites which have now led to industrial applications of immense economic and environmental value, including conversions of hydrocarbon resources, highly selective and efficient syntheses of organic chemicals, and removal and destruction of pollutants in gaseous and liquid effluent.

In the 1960s the technique of gas chromatography was being recognized as widely applicable and highly useful for the analysis of mixtures of chemicals in the vapour phase. In collaboration with Dr. W.E. Harris, University of Alberta, Dr. Habgood made a strong contribution to elucidating the principles of the technique. From this position of interest and the vantage point attained from his experience, Dr. Habgood recognized the potential of using the diffusion coefficients obtained for calculating intrinsic rate constants for reactions, and thereby gaining insights into catalytic reactions.

Today infrared spectroscopy is so widely used for characterization of materials that the technology is sometimes taken for granted. Dr. Habgood was one of the first to recognize the potential of the method for examining surface species, and therefore for studying adsorption or reactions at catalyst surfaces. In addition to his own efforts applying infrared spectroscopy to the study of catalytic systems, Dr. Habgood encouraged and supported parallel work of colleagues using it and other spectroscopic techniques.

As Dr. Habgood's career progressed so did the breadth of his responsibilities. As Chief of the Fuels Branch at the Research Council of Alberta or, later, as Head of the Chemistry Department and then Vice-President of the renamed Alberta Research Council, Dr. Habgood built a team with strong capabilities in catalysis, physical chemistry, chemical engineering, environmental applications, and separations science. Several of the scientists and engineers recruited to this team have since become significant contributors in industrial and academic catalysis laboratories.

## John B. Moffat

The 1988 winner of The Catalysis Award has made many notable contributions to the catalysis field during his career at the University of Waterloo. This tribute will attempt to highlight John's research activities while outlining his numerous contributions, both of a scholastic and administrative nature.

John's undergraduate and graduate training at the University of Toronto (Ph.D. in Physical Chemistry under the supervision of R. McIntosh) and five-year stint in industry (with DuPont of Canada) doubtless sowed the seeds of his research interests that have developed during his academic career in the Chemistry Department at the University of Waterloo. His first independent paper, in 1964, concerned LCAO-MO calculations on nitriles. Related quantum-theoretical studies on species such as HCN, BCN and dimers of cyanamide extended into the 1980s. An invited chapter entitled "General and Theoretical Properties of Triple-Bonded Molecules" was contributed to the 1983 book on The Chemistry of Functional Groups. The merger of this long-standing interest in fundamental physical chemistry with catalytic studies, which became dominant in the 1980s, culminated in 1990 with John's editorship of a book on "Theoretical Aspects of Heterogeneous Catalysis", published by Van Nostrand-Reinhold.

John's entry into the heterogeneous catalysis field focussed on boron phosphate in the 1965-1982 period. Beginning with surface area, acidity and adsorbed molecule studies, surface properties were pursued using such techniques as diffuse reflectance, infrared spectroscopy and temperature programmed desorption. Catalytic properties of boron phosphate were also investigated using various alcohols, as well as iodide, H<sub>2</sub> and D<sub>2</sub> in these earlier studies.

John's initial papers on the catalytic properties of heteropoly acids appeared in 1982 (with H. Hayashi as co-author). Contributions continue to flow from the Moffat laboratory on several aspects of these metal-oxygen cluster compounds having the Keggin structure. Studies concern the methods of synthesis, structural stability, solution species, ion exchange and surface and catalytic properties. The effect of preparative conditions and ion exchange on the microporous structures, obtained for monovalent cations, were examined. Catalyzed reactions of various substrates (alkanes, alcohols, acids) were related to the physical, structural and surface chemistry of these heteropoly oxometalates. In one series of papers (with J.G. Highfield), FT-IR photoacoustic spectroscopy was employed to characterize sorbed species and to aid elucidation of mechanisms. Most recently, John has studied the microporosity of several of these metal-oxygen cluster compounds using <sup>129</sup>Xe NMR (with J. Fraissard) and the adsorption and reaction of nitrogen oxides (with R. Belanger).

Another area of heterogeneous catalysis in which John has achieved international recognition is that of the oxidative coupling of methane. Beginning in 1987 (with S. Kasztelan), an active program has been pursued to relate the nature of the catalyst, alkali-alkaline earth and lanthanide as well as heteropoly oxometalates, with the mechanism of the catalyzed process. In particular, it was discovered that very small quantities of a halogenated species (such as CCl<sub>4</sub>) have remarkable effects on both the conversion and selectivity to ethane and ethylene. Recent work on this important process extends to cation-exchanged hydroxyapatites and to experiments to unravel the nature of the observed enhancement of methane conversion.

The area of "Microporous Heterogeneous Catalysts" was reviewed in a book edited by Bill Moser (1996). John edited "Theoretical Aspects of Heterogeneous Catalysis" published in the Van Nostrand Reinhold Catalysis Series (1990). Cesar Sequeira and he co-edited "Chemistry, Energy and the Environment" for the Royal Society (1998). More recently, he

wrote “Metal-Oxygen Clusters - The Surface and Catalytic Properties of Heteropoly Oxometalates” for Kluwer Academic /Plenum (2001).

In addition to his research efforts, John has made invaluable “administrative” contributions on behalf of the catalysis community. John works tirelessly. In parallel with his highly productive research programme, as evinced by his 63 research papers and 29 conference presentations since 1991, John finds time to serve on several editorial boards and conference organization committees. Space only allows mention of some recent and current activities. John was a Director of CSC from 1987-90 and the Chair of The Catalysis Division, CIC from 1984-86. John has served on the editorial boards of the Journal of Applied Catalysis, the Journal of Molecular Catalysis, and Catalysis Letters. He is a Past President of the Canadian Catalysis Foundation. He served diligently as a member of the International Congress on Catalysis Board. John was the Program Chairman for the 13th Canadian Symposium on Catalysis in Sarnia in 1994 and a member of the Program Committee of the 14th NAM of The Catalysis Society in Snowbird, Utah in 1995. John co-organized two symposia, on Solid Superacids and Heteropoly Oxometalates, at the 1995 Honolulu, Hawaii Pacific Basin Conference. John served as Chairman and was instrumental in ensuring the success of The North American Catalysis Society Meeting held in Toronto, Canada in 2001 (Chapter 5).

## Brian R. James

The awarding of the 1990 Canadian Catalysis Award to Brian James recognized and honoured his strong contributions to the understanding and applications of molecular catalysis.

Brian James was born in England and obtained his degrees, including a doctorate, at Oxford University. He then spent two years at UBC as a postdoctoral with Jack Halpern before returning to the U.K. to work as a Senior Scientific Officer at the Atomic Energy Authority, Harwell. The attraction for Vancouver was strong, however, and Brian returned to UBC in 1964 as an Assistant Professor, becoming Professor in 1974. Professor James has established a research program of international repute in homogeneous catalysis; over 50 Ph.D. and M.Sc. students have graduated from his group in projects focused mainly on the binding and activation of small molecules at transition metal centres. Research activity has led to about 300 publications and patents. Brian has received recognition through major awards [Noranda Award, 1975; Guggenheim Fellowship, 1983; Jacob Biely Award, 1986 (UBC's top research prize); Canadian Catalysis Award, 1990; Canada Council Killam Fellowship, 1993-95], and about a dozen other lectureships and fellowships, both Canadian and international.

Professor James has frequently been sought after as a lecturer at national and international meetings. He was elected a Fellow of the Royal Society of Canada in 1982, and served as Rapporteur and Convenor of Academy III. Professor James was appointed a Faculty Associate within the Pulp and Paper Centre at UBC. The extent of professional services rendered at other local, national and international committees included work with NSERC, IUPAC, NATO, and Canadian Award committees. Professor James contributed strongly through organizing conferences (local, Canadian and international), including being "permanent" secretary of the International Symposia on Homogeneous Catalysis since 1980. Refereeing duties have been associated with journals (including service on 8 editorial boards), granting agencies, and promotion/tenure decisions associated with nearly all Canadian Universities. Of note, Professor James was the "Inorganic" editor of the Canadian Journal of Chemistry from 1978 to 1988.

Professor James' NSERC funding included operating, strategic, network (Wood-Pulps), and collaborative awards, and several contract grants were received from Canadian companies and research institutions, including the Department of Defence.

Professor James has been strongly and widely influential on the Canadian chemistry scene via teaching courses from 1st year through to graduate level [including early development of courses in bioinorganic (1973) and aqueous environmental chemistry (1984)], and also significantly through contributions from past members of his research group - these are scattered throughout the world, and include about 24 graduate and undergraduates, and 15 postdoctorals, currently employed throughout Canada at universities, industrial companies, research agencies, community colleges and high schools. The number of postdoctorals and visiting scientists that have been associated with Professor James' laboratory approaches 100, and active collaborations were established with groups in Hungary, Poland, Japan, Italy, Brazil and Germany, as well as more local collaborative research with colleagues in chemistry, chemical engineering and PAPRICAN.

Brian James' research interests focused on the binding and activation of small molecules at transition metal centres, with the aim of understanding the mechanisms of homogeneous catalysis in order to develop new and improved catalysts (and processes) generally for the conversion of organics; the systems usually operate under mild conditions required for highly regio-, stereo-, and enantioselective processes. Studies have concentrated on platinum metal

complexes (especially Ru and Rh), and with some excursions into the first-row metals (Fe, Co, and Ni), and their interactions with H<sub>2</sub> (for catalytic hydrogenation of organics), CO (carbonylation and decarbonylation), O<sub>2</sub> (for oxidations), C<sub>2</sub>H<sub>4</sub> (Wacker-type oxidation to acetaldehyde), H<sub>2</sub>O (hydration of olefins and acetylenes), and H<sub>2</sub>S (for conversion to H<sub>2</sub> and sulfur).

The hydrogenation work has elucidated key elements of reduction of olefins, ketones, imines and nitriles, including systems with water-soluble, and chiral ligands (phosphines, amino acids, and sulfoxides) for asymmetric hydrogenation. Molecular hydrogen complexes were shown to play a role in some olefin hydrogenations. The 1973 book "Homogeneous Hydrogenation" (525 pages) became the classic text in this area. Competing reactions such as catalytic dehydrogenation and dealkylation of amines have also been discovered for some Ru complexes.

Reductive carbonylation chemistry demonstrated with Rh species was later used as the initial chemical step in Monsanto's process for carbonylation of methanol to acetic acid. New catalysts for amine carbonylation, aldehyde decarbonylation, and intramolecular hydroacylation of unsaturated aldehydes (to give chiral 2-substituted pentanones) were discovered.

Professor James was one of the first to recognize the potential for O<sub>2</sub> activation by Rh<sup>I</sup>, Ir<sup>I</sup>, and Ru<sup>II</sup> systems, and this led to the remarkable, first reported use of O<sub>2</sub>/H<sub>2</sub> mixtures for selective O-atom transfer chemistry via reductive activation of O<sub>2</sub>, and also led to the catalytic conversion of such a gas mixture to H<sub>2</sub>O<sub>2</sub>. The interest in O<sub>2</sub> activation led to interests in Fe- and Ru-porphyrin and -phthalocyanine chemistry in attempts to mimic Fe-based enzymatic systems. Catalyzed O<sub>2</sub>-oxidations (or -dehydrogenations) of unsaturated and saturated hydrocarbons, aromatics, thioethers, alcohols, and amines have been effected via mono- and dioxygenase model systems, and insight gained into the P450 enzyme system. Complementary studies with this enzyme and the natural O<sub>2</sub> carrier myoglobin (in conjunction with David Dolphin) has led to increased understanding of the binding and activation of O<sub>2</sub>. The interests in Ru-porphyrin chemistry have led to major developments in organometallic chemistry at such centres, and the possibility of novel, free-radical type catalysis involving hydrocarbons.

Knowledge of the H<sub>2</sub> hydrogenations and O<sub>2</sub> oxidations is currently being applied to conversion of lignin in pulp.

Professor James first reported the quantitative abstraction of H<sub>2</sub> from H<sub>2</sub>S using a transition metal complex (a dinuclear Pd<sub>2</sub> species) in solution, and the catalytic conversion of H<sub>2</sub>S to H<sub>2</sub> and an organosulfur compound; a current aim is to effect catalytic conversion to H<sub>2</sub> and elemental sulfur.

## Bohdan W. Wojciechowski

Professor Bohdan W. Wojciechowski was born in Poland (1935), obtained primary education also in Scotland, and completed both the Scottish and Polish high school curricula (1953). He then received academic degrees in chemical engineering from the University of Toronto (BASc (Hon), 1957, MASc, 1958). Bohdan obtained his doctorate in chemistry at Ottawa University (1960), with Professor K.J. Laidler, for research in which he applied kinetic principles to interpret the action of inhibitors in gas-phase pyrolysis. A number of long-standing controversies were resolved in connection with gas-phase chain reaction mechanisms. This work, which he continued as a postdoctoral fellow at NRC, was the beginning of his life-long research interest in kinetics and reaction mechanisms. Subsequently, Professor Wojciechowski began his work on catalytic reaction during three years at the Research and Development Department of Mobil Oil. His research covered subjects including both pure hydrocarbon systems and multicomponent mixtures in the presence of decaying catalysts.

Professor Wojciechowski then joined the Department of Chemical Engineering, Queen's University (1965), and was appointed full professor in 1972. An important contribution to the body of work in catalysis was the development of the Time on Stream (TOS) theory of catalyst decay, which significantly enhanced understanding of commercially important reactions such as catalytic cracking. Professor Wojciechowski's group continued this work on catalytic cracking, extending the models to a kinetic analysis of selectivity patterns and introducing the concept of Optimum Performance Envelopes (OPEs). This allows extrapolation of experimental data to selectivity regions without catalyst decay, and uncovered previously unavailable information (using OPEs) on properties of active sites, the mechanism of the cracking reaction, and changes in kinetics and mechanism on active sites induced by reaction. With his colleagues, Professor Wojciechowski applied concepts he introduced (TOS, OPEs, refractoriness effect) to arrive at a rigorous "Chain-mechanism" description of the catalytic cracking process. Subsequently, models were developed for other catalytic reactions by introducing versatile adsorption isotherms for heterogeneous surfaces, and the kinetics of Fisher-Tropsch synthesis from carbon monoxide and hydrogen was more fully described. Here he advanced the methodology to account for product distribution of such reactions, a subject of two recent review articles.

Professor Wojciechowski has built a systematic body of knowledge on the formation and rearrangement of hydrocarbon molecules, work stemming from his postgraduate years. This he achieved through a long-term commitment to the solution of complex fundamental issues. His research achievements have not only been of importance to the scientific community but also to industry, and have had an impact on researchers in catalyst manufacturing, transportation fuels and petrochemicals dealing with product quality and environmental issues.

His latest scientific invention is a revolutionary one. It deals with extracting kinetic data under transient conditions. Together with a colleague who is a mathematician, he has developed the Temperature Scanning Methodology and system for kinetic data acquisition. In principle, this abandons conventional ways of studying reactions but allows the obtained data to be transferred to conventional results. He designed and commissioned the first Temperature Scanning Reactor (TSR). TSR has the extreme breakthrough potential of increasing the research productivity a thousand times. He presently continues his research work using this machine.

Professor Wojciechowski enjoys international recognition both for his research work and for his influence through various appointments. He has been one of the key players within The Catalysis Division of The Chemical Institute of Canada, and was one of the active proponents for

the creation of the Canadian Catalysis Foundation. He was instrumental in establishing The Catalysis Award, and is one of its recipients (1992). He represented Canada on the Executive Board of the International Congress on Catalysis.

In Canada, Bohdan Wojciechowski is known for his community and political work, being an outspoken commentator on government politics and policies. Recently he has combined his scientific and entrepreneurial skills to form a company for commercialization of the patented TSR and its associated software and algorithms. The unit was on display at the 14th North American Meeting of The Catalysis Society at Snowbird, Utah, 1995.

In summary, Professor Wojciechowski exemplifies excellence in research. He has become renowned as one of the pillars of the international catalytic community and is a credit to Canadian science.

### Ivo G. Dalla Lana

The 1994 Catalysis Medal of The Catalysis Division, Chemical Institute of Canada, was awarded to Dr. I.G. Dalla Lana, FCIC, professor emeritus of the University of Alberta, for his outstanding contribution to the knowledge of catalysis, particularly of catalytic reactions of sulphur compounds.

Ivo Dalla Lana was born on 5 July 1926 in Trail, B.C. He received his Bachelor of Applied Science degree from the University of British Columbia. During 1948-51 he worked as an engineer in the Research and Development Department of Cominco Ltd. In 1953 he received his Master of Science degree from the University of Alberta and in 1958 he received a Ph.D. degree from the University of Minnesota, with a major in chemical engineering and minor in physical chemistry. From 1958 until his retirement in 1992, Dr. Dalla Lana was a professor in the Department of Chemical Engineering at the University of Alberta. During that time he supervised graduate work on 20 M.Sc. and 7 Ph.D. theses and collaborated with 25 postdoctoral fellows who participated in research programs that he initiated. This work resulted in over 100 publications and research reports, and a number of patents and patent applications. Dr. Dalla Lana's retirement did not interrupt his research activities which continue with unweakened energy, valuable experience and knowledge. Since his retirement, he has supervised research projects supported by three NSERC strategic grants: one NSERC operating grant and two industrial grants concerning olefin polymerization. His research group is truly an international one and his collaboration in the field of catalytic research involves five catalytic groups in different European countries. He was a visiting professor at the University of Bath, England, at Fritz-Haber-Institut der Max-Planck-Gesellschaft in Berlin, Germany (twice), and at Atomic Energy of Canada in Chalk River, Ontario. He delivered a number of invited lectures both in Canada and abroad, and he was also a keynote speaker. The Association of Professional Engineers of Alberta nominated him as a life member and The Chemical Institute of Canada nominated him as a fellow. Over ten scientific periodicals, publishing papers in the field of catalysis and chemical engineering, have asked Dr. Dalla Lana to referee submitted manuscripts. The Natural Sciences and Engineering Research Council nominated him a member of various committees and the Ontario Council of Graduate Studies invited him as a consultant for appraisal of a Ph.D. program. Due to his comprehensive knowledge of catalysis, he served as a consultant with a number of companies in Canada, and as an expert witness in a court case involving patent litigation in the United States of America.

Dr. Dalla Lana devoted much time to professional societies such as: 1) the Canadian Society of Chemical Engineering serving as director and secretary on the national executive and chairman of the local executive, 2) The Chemical Institute of Canada serving as a regional counsellor for Alberta and Saskatchewan, 3) The Catalysis Division of The Chemical Institute of Canada serving as national chairman and a founding member of its executive, 4) the 9th International Congress on Catalysis serving as vice-chairman of the organizing committee, and 5) The North American Catalysis Society serving as Catalysis Division representative.

The main areas of Dr. Dalla Lana's research activities include: 1) utilizing infrared spectroscopy to study adsorption and surface reactions (since 1967; has been successfully applied to several industrial catalytic reaction systems), 2) sulphur recovery technology, primarily based on the modified Claus reaction, which made him an internationally recognized expert in this field, and 3) ethylene polymerization on supported chromium catalysts in slurry reactors and oligomerization of ethylene in a solution reactor (since the mid-1980s). The

scientific and industrial importance of his work ensures that Dr. Dalla Lana thoroughly enjoys the research that he approaches with great enthusiasm.

## Marten Ternan

The 1996 Catalysis Medal of The Catalysis Division, Chemical Institute of Canada, was awarded to Dr. Marten Ternan, FCIC, employed at CANMET Energy Diversification Research Laboratory, for his outstanding research into the catalytic conversion of hydrocarbons and environmentally friendly applications of catalysis.

Marten Ternan, FCIC, was born in Saskatoon, SK, and subsequently moved to Burnaby, BC, where he received his elementary and secondary education. He received a BAsC in chemical engineering from the University of British Columbia in 1964. After graduation he worked as a process design engineer in Sarnia, ON, in the engineering division of Imperial Oil (1964-67) before moving to Montréal, PQ, for graduate studies. He received a PhD degree in chemical engineering from McGill University in 1972. He was then employed at the Process Research Stations of International Nickel at Port Colborne, ON (1971-73) before becoming a research scientist at the federal government's CANMET Energy Research Laboratories at Bells Corners near Ottawa.

At CANMET/ERL Dr. Ternan was Head of Catalysis Research for seven years and Manager of the Hydrocarbon Processing Research Laboratory for four years. Over a period of more than 20 years (1973-95) his research involved the use of catalysts for the conversion of oil sands bitumen, heavy oil, petroleum residuum, coal, and natural gas to transportation fuels. He is one of the two inventors of the first patent filed for the CANMET Hydrocracking Process used to convert vacuum residue material into lower boiling distillate products. As Manager of Hydrocarbon Processing he supervised 6 research groups with a total staff of 45-55 people which included Catalysis, Natural Gas Conversion, Hydrocarbon Conversion and Coal Gasification. During this period a number of high quality catalysis researchers were recruited to the laboratory and major purchases of catalysis equipment were made. The federal government's emphasis on sharing research costs with industry gave him the opportunity to be involved with a number of companies in projects concerned with Upgrading Heavy Oil, Reduction of NO<sub>x</sub> in Diesel Exhaust, and Chemical Heat Pumps. He was also a member of the National Task Force on Oil Sands Strategies and in 1994 led an industrial research consortium which explored the application of methylcracking for upgrading oil sands bitumen. In 1995 Dr. Ternan transferred to the CANMET Energy Diversification Research Laboratory at Varennes, PQ. In 1998 Ternan joined H-Power in Montréal, a company specializing in research and development of fuel cells for commercial applications. He has also been an Adjunct Professor in Chemical Engineering at the University of Ottawa (1981-present).

Dr. Ternan is a past Chairman of the Catalysis Division of The Chemical Institute of Canada and a past Chairman of the Ottawa Local Section of the Society for Chemical Engineering. He represented Canada on the International Catalysis Council for four years. He has received the ERCO Award of the CSChE, the Sunshine Project Award from the National Chemical Laboratory for Industry, Tsukuba, Japan, and a federal government Public Service Merit Award (shared with 10 others) for the development and transfer to industry of the CANMET Hydrocracking Process. In 2001 he was co-chair of the 17<sup>th</sup> Meeting of the North American Catalysis Society, held in Toronto. He has seven patents and more than 60 publications.

Ternan's major research interests have focused on events that occur inside catalyst pores. Reactions for upgrading heavy hydrocarbon residues require the participation of both small hydrogen molecules in the gas phase and large carbonaceous molecules that originate in heavy oil. He developed an equation to describe the liquid phase diffusion of large carbonaceous

molecules within catalyst pores based on theoretical concepts. It is superior to other equations that have been proposed because it is the only equation that satisfies the two end point conditions. It predicts an effective pore diffusivity that is equal to the diffusivity in the bulk liquid when the diffusing molecules are small compared to the pore diameter. It predicts an effective diffusivity of zero when the diffusing molecules are larger than the pore diameter. The equation has been particularly useful in describing diffusion effects in the pores of catalysts used to hydrocrack the large molecules present in oil sands bitumen and heavy oil. The combination of these phenomena in an overall rate constant demonstrated that adding large macropores to a catalyst can decrease the length of the diffusion path in the smaller mesopores which contain the majority of the reaction sites. Insights such as these have contributed to the development of upgrading technology that can be used on a practical scale. He also proposed a mechanism for the dissociation of hydrogen molecules at electron holes on the catalyst surface. His work indicated that electron holes are the reaction sites for the dissociation of hydrogen molecules on the surfaces of Co-Mo-S hydroprocessing catalysts.

More recently Dr. Ternan has focused his research activities on fuel cells and the basic materials used for their operation. He has investigated fuel cell performance as a function of feedstock and examined applications of hydrogen, methanol, and fossil fuels. A comparison of these materials indicated that there are substantial theoretical advantages for using fossil fuels directly as a fuel cell feedstock. Life cycle calculations showed that fuel cell systems operating directly on fossil fuels are more efficient and that they emit less carbon dioxide to the atmosphere than other systems. Ternan has suggested that an alternative operation would involve feeding a natural gas or other hydrocarbon species directly to the fuel cell where the hydrocarbon would react directly in the electrochemical reaction. A significant advantage is that the hydrocarbon would not have to be converted outside the fuel cell and hence there would be no efficiency loss caused by steam reforming. A negative aspect that Ternan has noted is that the reaction rates in real direct hydrocarbon fuel cells are slow. Consequently their performances are significantly lower than those of hydrogen based fuel cells. Dr. Ternan has continued working with a team at the University of Ottawa on modeling direct hydrocarbon fuel cells using computational fluid dynamics.

In 2001 Dr. Ternan received the Canadian Catalysis Lectureship Award which is sponsored by the Canadian Catalysis Foundation. His lecture tour presented an overview of direct hydrocarbon fuel cells, and compared their potential and advantages with those of hydrogen based fuel cells.

## Serge Kaliaguine

Dr. Serge Kaliaguine, Professor of Chemical Engineering, Université Laval, Ste-Foy, Quebec was the recipient of the 1998 Catalysis Award from The Catalysis Division, Chemical Institute of Canada. He received the award for his outstanding research in the area of shape selective catalysis which includes work in zeolites, aluminophosphates and mesoporous materials.

Serge Kaliaguine was born in Sigoules, France and lived for several years in North Africa. He received his higher education in Toulouse, France, his B.Sc. from l'Institut du Génie Chimique de Toulouse (1964) and his Ph.D. from the University of Toulouse (1967). He has been teaching at Laval University since the fall of 1967.

Dr. Kaliaguine was the Chairman of the Catalysis Division of the CIC in 1975. In 1982 he created the GRASP at Laval University a research group focused on the applications of surface physico-chemistry, and in 1990 he was the founding director of a research centre on surface properties and catalysis. He was the main organizer of numerous conferences including the 9<sup>th</sup> Canadian Symposium on Catalysis (Québec 1984), a post-congress symposium (Québec 1988), the 35<sup>th</sup> Canadian Chemical Engineering Conference (1995), an International Zeolite Symposium (Québec 1995), the 15<sup>th</sup> Canadian Symposium on Catalysis (Québec 1998) the first and second International Symposia on Mesoporous Molecular Sieves (ISMMS) (Baltimore 1998, Québec 2000).

Kaliaguine is the author or co-author of more than 200 publications in scientific journals and he was the editor or co-editor of three volumes in Elsevier's series *Studies in Surface Science and Catalysis* (a fourth volume is in preparation). He was appointed to the editorial board of *Applied Catalysis B: Environmental* in 1998. Kaliaguine was plenary lecturer in several national and international meetings: the International Symposium on Catalysis (Kyoto 1988), the Brazilian Conference on Catalysis (Salvador 1992), the International Zeolite Association Summer School (Taejon 1996), the 5<sup>th</sup> Conference of the Romanian Catalysis Society (Bucharest 1997) and the International Symposium on Catalysis (Kyoto 1998).

Since 1967, Dr. Kaliaguine has supervised or co-supervised over 50 MSc and PhD theses. He currently supervises several students and post-doctoral researchers. Dr. Kaliaguine has received the Best Paper Award of *The Canadian Journal of Chemical Engineering* (1976), the Urgel-Archambault Award from ACFAS (1994) and the Summa-Research Award of the faculty of Science and Engineering from Laval University.

The research interests of Dr. Kaliaguine are essentially involved with industrial and environmental aspects of catalysis. His group is working on all aspects of design, preparation, characterization and testing of heterogeneous catalysis. He deals with zeolites, ALPO's, mesoporous molecular sieves, supported oxides and perovskites as solid catalysts. Chemical reactions among the ongoing work encompass selective catalytic reduction of nitrogen oxides, catalytic combustion of volatile organic compounds, and oxidations and epoxidations using hydrogen peroxide as the oxidant. His activities also include work on catalytic membranes both as catalysts and as proton conductors.

Dr. Kaliaguine has worked in collaboration with several industrial and government organizations including Natural Resources Canada, Biothermica International, Innovatech, Environair SIPA and Ballard Power Systems. Past sponsors include PetroCanada, Atomic Energy of Canada Ltd., Alcan, ESTAC, LRDE-Varennes, Venmar and others.

Serge Kaliaguine has taken a central organizational role in the International Mesostructured Materials Association (IMMA). The association grew out of the research community which

participated in the International Symposia on Mesoporous Molecular Sieves. The name of the conference was changed and the scope of the research field was broadened to include other mesostructured materials. At the Third International Mesostructured Materials Symposium held in Jeju, Korea in 2002, Dr. Kaliaguine was elected to the IMMA council for a period of four years. After the election the council members also appointed him President of the IMMA. Dr. Kaliaguine was a keynote lecturer at the Fourth International Mesostructured Materials Symposium to be held in Cape Town, South Africa in May 2004.

## Garry L. Rempel

The 2000 Catalysis Award was awarded by The Catalysis Division, Chemical Institute of Canada, to Dr. Garry L. Rempel, FCIC, Professor of Chemical Engineering at the University of Waterloo, for his outstanding contributions to the knowledge of catalysis, particularly related to homogeneous catalysis and post-polymerization catalytic processing of polymer materials.

Garry was born in Regina, Saskatchewan in 1944. He received his BSc (1965) and PhD (1968) degrees from the University of British Columbia, Vancouver, BC. After spending a year as a National Research Council of Canada Postdoctoral Fellow at the Imperial College of Science and technology in London, England, he joined the Department of Chemical Engineering at the University of Waterloo in 1969. He served as Chair of the Department from 1988 to 1996. Rempel is a Fellow of the Chemical Institute of Canada and a Fellow of the Royal Society of Canada, as well as being a member of several additional professional and service organizations. Notably, he served as President, Academy of Science, The Royal Society of Canada, November, 2001 – November, 2003. He has enjoyed Visiting Professor or Visiting Scientist status with major institutions in North America and abroad.

In 2004, Garry became one of the first three faculty members to receive the title of University Professor at the University of Waterloo. He is the only Engineering Professor at the University of Waterloo to hold this title at the present time. At present Garry holds the Bayer Inc./NSERC Industrial Research Chair in Advanced Rubber Technology at the University of Waterloo.

Garry served as the Director of the Applied Sciences Division of the Royal Society of Canada from 1995-98 and he currently is President of the Academy of Science of the Royal Society of Canada.

His research achievements and contributions to chemical engineering have been recognized by numerous awards: the Thomas W. Eadie Medal of the Royal Society of Canada, the Industrial Practice Award of the Canadian Society for Chemical Engineering, a Canadian Gold medal for Business Excellence (Invention Category), a University-Industry Research and Development Award sponsored by the Natural Sciences and Engineering Research Council of Canada and the Conference Board of Canada, the Macromolecular Science and Engineering Award of the Chemical Institute of Canada and the R.S. Jane Memorial Award. Rempel received a Century of Achievement Award for significant contributions in the field of chemical engineering at the 49<sup>th</sup> Canadian Society for Chemical Engineering Conference. In 2001 he received an Award for Excellence in Research from the University of Waterloo. In 2003 he received the prestigious Le Sueur Memorial Award from the Society of Chemical Industry for his development of technical excellence of benefit to Canada in a chemical based industry.

Garry Rempel's research interests are in the areas of applied catalysis, chemical modification of polymers, polymerization, polymer processing and separation science, including catalytic distillation. In particular, he is a recognized expert in kinetics and catalysis of both homogeneous and heterogeneous systems; polymer science and engineering, including polymerization, chemical modification of polymers, polymer processing and properties, metallocene polymerization and applications of functionalized polymers in catalysis and environmental separations; environmental chemistry and engineering, especially wastewater treatment and selective separations via ion exchange methods; ion and ligand exchange processes; catalytic properties of transition metals and their compounds, including organometallic catalyst systems.

Garry is internationally recognized in the area of chemical modification of polymers. His outstanding research in this area was instrumental in his inventions of novel catalytic processes for the selective hydrogenation of nitrile butadiene rubber (HNBR). This has led to the commercial production of HNBR.

Garry's current research is directed toward chemical modification of polymers via catalysis; kinetics, catalysis and reaction engineering of polymer hydrogenation processes; advanced metallocene catalysts for polyolefin production, from both process and polymer property aspects; novel gel-coated resins for selective metal removal from media; experimental development and modeling of catalytic distillation processes; polymer processing by extrusion and injection molding; reactive extrusion of polymers; emulsion polymerization; and nanoparticles.

A survey of Garry's published work, since his first paper in 1966, while a student with Brian James (Catalysis Award 1990), shows the depth and breadth of his catalysis skills. He has published over 200 refereed publications, and has 15 patents issued or pending. His continuing impact on development of Canadian catalysis talent is remarkable.

His expertise has been called upon in the resolution of legal issues concerning polymer technologies. His extensive capabilities and knowledge of catalysis have been called upon through service on editorial boards, as a member or chair of NSERC committees, and in support or review of research and applied technologies.

## Michael C. Baird

The 2002 Catalysis Award was presented by The Catalysis Division, Chemical Institute of Canada, to Michael C. Baird, FCIC, Professor of Chemistry at Queen's University, for his outstanding contributions to knowledge of the chemistry of homogeneous catalyst systems. He received a rhodium-plated silver medal and travel expenses to present the Award Lecture at the Canadian Symposium on Catalysis in Vancouver.

Professor Baird was born in Hamilton, Ontario but raised in nearby Dundas. He studied chemistry at McMaster University, but distinguished himself rather more as an athlete. In his sophomore year he won the OQAA 220 yards dash and both the 100 and the 220 yards dashes in the only CIAU outdoor track and field championship ever held. He was also a double winner in the OUAA 100 and 220 in 1961-62, his graduating year. Mike went on to graduate school at the University of Toronto and, while still involved in sports, became a bit more serious and earned an M.A and a Ph.D. within three years. After two formative and extremely productive postdoctoral years with the late Geoffrey Wilkinson, at Imperial College, London, Mike returned to Canada in 1967 to a position at Queen's University. Here he has remained except for six months in 1975 as a Humboldt Fellow in the laboratory of E. O. Fischer at the Technische Universität, München.

Mike is an outstanding scientist of international stature who has received considerable recognition and acclaim for the breadth and the depth of his interdisciplinary interests. He has worked in a number of quite different areas of chemistry, including fundamental and mechanistic organometallic chemistry, homogeneous catalysis, olefin polymerization by organometallic compounds, new anti-tumour drugs, metal-fullerene complexes and applications of computational methodologies to organometallic compounds. In the latter context, he was among the first to combine NMR and IR spectroscopic techniques with molecular mechanics calculations to determine structures of flexible organometallic compounds. He was also the first to prepare transition metal compounds containing coordinated thiocarbonyl, carbon disulfide, ylid and nitroxide ligands, and has for many years been one of the leading organometallic chemists carrying out research on mechanisms of organometallic chemistry. His work on fundamentally important processes such as CO and SO<sub>2</sub> insertion reactions, electrophilic metal-alkyl cleavage reactions, oxidative addition and  $\beta$ -elimination reactions, the direct transfer of hydride ions to coordinated olefins, and nucleophilic attack on coordinated CO and olefins is widely recognized, and aspects have appeared in text books. He has also been particularly prominent in developing a basis for the understanding of the structures and chemistry of once little known 17-electron, paramagnetic organometallic compounds (metal-centred radicals), showing that several widely accepted literature claims were invalid, and collaborating with a theoretician and an EPR spectroscopist to determine electronic structures of several unstable species.

On the applied side, Mike made has made numerous contributions to the field of homogeneous catalysis and was among the first to incorporate water-soluble ligands into otherwise water-insoluble metal compounds to provide new types of water-soluble homogeneous catalysts; some of these behave as very interesting biphasic catalysts for *e.g.* olefin hydrogenation. He has also ventured into the field of synthetic fuels, exploring methanol homologation to ethanol and the catalytic hydrogenation of carbon monoxide and dioxide to hydrocarbons, research of a type expected to make significant contributions to North American energy needs when petroleum stocks ultimately begin to dwindle.

More recently, he has explored the utilization of organometallic compounds as homogeneous catalysts/initiators for olefin polymerization. Indeed, his research group discovered a compound,  $[\{\eta^5\text{-C}_5\text{Me}_5\}\text{TiMe}_2][(\mu\text{-Me})\text{B}(\text{C}_6\text{F}_5)_3]$ , which exhibits unique, extraordinarily versatile properties in the field of olefin polymerization, acting as a Ziegler-Natta catalyst for the homo-, co- and terpolymerization of ethylene, propylene and  $\alpha$ -olefins, as a cyclopolymerization catalyst for 1,5-hexadiene and a ring opening metathesis polymerization catalyst for norbornene. It also behaves as a carbocationic initiator for the polymerization of vinyl ethers, N-vinylcarbazole and isobutylene. The novelty of the latter process has opened up a new field of research, and Mike has been credited by The Catalyst Group, an important American consulting firm, as “above all others, the person who really stimulated interest in the polymerization of isobutylene” by organometallic catalysts (The Metallocene Monitor, October 1999). They also refer to his first paper in this area as “a key event in generating enthusiasm” for what is becoming a very important field.

Mike’s success in the carbocationic polymerization of isobutylene and the copolymerization of isobutylene and isoprene has resulted in a very close collaboration with Bayer Inc., Sarnia, Ontario, in research directed to development of a commercial process for making tire rubber and other elastomers. The high molecular weights necessary in this industry currently require polymerization at temperatures as low as  $-100\text{ }^\circ\text{C}$ , a capital intensive, very expensive process, and use of the environmentally unfriendly solvent methyl chloride. His research has made it possible to carry out the necessary reactions at much more desirable higher temperatures and in environmentally more benign hydrocarbon solvents, and his group’s findings were tested at the pilot plant level. Successful development of a new industrial process based on the Baird group’s findings could have serious implications for the Canadian economy.

Mike’s research in organometallic chemistry has resulted in well over 225 publications and several patents, and in numerous invitations to contribute oral conference presentations, book chapters and review articles. He has worked with over 70 graduate students, some two dozen postdoctoral fellows and at least 200 undergraduate students, and he was awarded the Chemistry Department Student Council Prize for Excellence in Teaching in 1989, 1994, 2002 and 2003. He has been a member of the Editorial Boards of the *Canadian Journal of Chemistry* and of *Organometallics*, has acted as consultant for DuPont Canada and is currently a consultant with Bayer Inc.

He has been the recipient of the Alcan Lecture Award of the CIC (1986) and the Queen’s University Prize for Excellence in Research (1998), as well as the 2002 Catalysis Award of The Catalysis Division. He was elected a Fellow of the Chemical Institute of Canada in 1978, and a Fellow of the Royal Society of Canada in 2003.

### Colin A. Fyfe

The 2004 Catalysis Award was presented by The Catalysis Division, Chemical Institute of Canada, to Colin A. Fyfe, MCIC, Professor of Chemistry at the University of British Columbia, for his pioneering research into structured porous catalysts. He received a rhodium-plated silver medal and travel expenses to present the Award Lecture at the Canadian Symposium on Catalysis in Montreal.

Colin A. Fyfe was born in Edinburgh, Scotland. He received both his BSc (Hon) and PhD from St. Andrew's University in 1964 and 1967 respectively. He was a Killam Professor at the University of British Columbia from 1967 to 1969. After 18 years at the University of Guelph, he joined the Department of Chemistry at UBC in 1987. He has published over 300 papers and review articles, and authored the text "Solid State NMR for Chemists". He has presented many invited lectures at international conferences, including Gordon Research Conferences, three NATO Advanced Study Institutes, and an International Zeolite Association Summer School. Four of his publications on zeolites have been in the top 100 cited papers in their respective time periods. He was elected as a Fellow of the Royal Society of Canada.

The 2004 Award was made to Colin for his pioneering studies of zeolite catalysts using solid-state nuclear magnetic resonance spectroscopy (NMR). Since 1981, his research group has developed high-resolution  $^{29}\text{Si}$  solid-state NMR spectroscopy as a complementary technique to diffraction methods for the investigation of zeolite materials. In particular, they demonstrated that highly informative Si spectra of zeolites could be obtained by magic angle spinning (MAS) experiments on a commercial high resolution spectrometer. Fyfe has also pioneered the development of 2D solid-state NMR experiments to deduce the 3D Si-O-Si bonding connectivities within the zeolite lattice. This greatly extended the potential of solid-state NMR techniques for investigations of unknown zeolite structures. More recently, the Fyfe group has made substantial progress on two outstanding problems in zeolite catalysis and selectivity: the determination of sorbate/zeolite framework structures and the characterization of multiple aluminium sites in acid zeolite catalysts. The range and scope of his studies can be seen from the detailed abstract of his Catalysis Award lecture at Montreal:

"Zeolites are open framework silicates and aluminosilicates widely used in industry, particularly the petrochemical industry, as acidic catalysts and for gas separations. The analogous titanosilicates are oxidation catalysts. They contain well defined channels and cavities which are of molecular dimensions and these give the frameworks a size and shape selectivity towards medium sized organic molecules which is unique for heterogeneous catalysts. A complete understanding of this selectivity depends on the determination of the structures of the complexes of organic molecules and other intercalates with the frameworks. However, with a very few important exceptions, it is not possible to apply single crystal diffraction techniques because of the small dimensions (few microns) of these materials and powder techniques have insufficient data to properly define the complexes.

We will describe a general method for the determination of the structures of zeolite host / guest complexes by solid-state NMR spectroscopy alone which involves the assignment of the resonances of the  $^{29}\text{Si}$  MAS spectra to specific sites in the framework by homonuclear connectivity experiments such as COSY and INADEQUATE and the location of guest species by measurements of the distance dependent heteronuclear dipolar couplings between the  $^{29}\text{Si}$  nuclei in the framework and specific nuclei in the guests. For single atoms, eg  $^{19}\text{F}$ , exact distances can be measured by CP, REDOR. For organic guests, all possible locations and

orientations are tested for linear correlation between the  $T_{CP}$  values from Cross Polarization experiments and the calculated heteronuclear second moments. This has been automated and the final structure determined by machine calculation. The viability of the approach will be demonstrated for a known structure and by the prediction and subsequent verification of an unknown structure. Further examples will illustrate the robustness of the method, present a variety of predicted structures and describe possible complications from disordered structures.

Lastly, extensions of the method in the future to cases where diffraction techniques cannot be used and to mixtures of guests where NMR and different diffraction techniques can be used together will be outlined.”

Clearly, Colin remains very active, and is extending the applications of the techniques he is pioneering into wider applications for catalysis.

## **4 THE NORTH AMERICAN CATALYSIS SOCIETY**

The Catalysis Division of CIC is affiliated with The North American Catalysis Society. The society was previously known by its chosen name as The Catalysis Society, as there were no other organizations of similar name at the time it was founded, and is still referred to by that name. The Catalysis Society is comprised of affiliated clubs and societies throughout the United States, Mexico and Canada, and is in turn affiliated with the International Association of Catalysis Societies, who coordinates the organization of the biennial International Congress on Catalysis. Dr. R.J. Cvetanovic was invited to attend as an observer at the 1969 meeting of the Board of Directors of The Catalysis Society. In 1970-71 the fledgling Catalysis Division of CIC became a member club of The Catalysis Society, and Dr. Cvetanovic was the director representing the Division. Each member of The Catalysis Division is registered also as a member of The Catalysis Society, and receives the newsletter published regularly by the Society. Dues are paid by the Division.

The Catalysis Society holds a conference on catalysis in each odd-numbered year. Thus the meetings organized by the Division and the Society take place in alternating years. Each affiliated club or society also holds regular meetings, and subject groups organize symposia at the national meetings of the American Chemical Society and the Pacifichem series of international meetings. Consequently a wide range of pertinent meetings is available to catalysis professionals through the Division and its sister organizations within the Society.

Details of both past and future activities within The Catalysis Society are available through the internet. The address for the World Wide Web page for The Catalysis Society is *<http://www.nacatsoc.org>*

### **Awards**

The Catalysis Society is responsible for the administration of four key awards: the Paul Emmett Award, the Houdry Award, the Robert Burwell Lectureship in Catalysis and the Ciapetta Award and lecture tour. In each case any member of The Catalysis Society may nominate for the awards workers who have made meritorious contributions in the field of catalysis. The details of each award, and the nominating procedure, are available through the Society, and brief descriptions of the Houdry and Emmett awards and criteria are presented on the following page.

The Bylaws of The North American Catalysis Society are given in Appendix 3.

### **Eugene J. Houdry Award in Applied Catalysis**

The Eugene J. Houdry Award in Applied Catalysis is sponsored by Süd-Chemie, Inc. It is administered by The Catalysis Society and is awarded biennially in odd numbered years, generally at the North American meeting of The Catalysis Society. The award consists of a plaque and a prize of \$3,000. An additional \$500 is available for otherwise unreimbursed travel expenses.

The purpose of the Award is to recognize and encourage individual contributions in the field of catalysis with emphasis on the development of new and improved catalysts and processes representing outstanding advances in their useful application.

Selection of the Award winner will be made by a committee of renowned scientists and engineers appointed by the President of The North American Catalysis Society. Selection shall be made without regard for age, sex, nationality or affiliation. Posthumous awards will be made only when knowledge of the awardee's death is received after announcement of the Award Committee's decision. Nominations for the Award should be made before August 1, 2006 and should present the nominee's qualifications, accomplishments and biography. A critical evaluation of the significance of publications and patents should be made as well as a statement of the particular contribution(s) on which the nomination is based. Nomination documents should be submitted in six copies to the President of the Society along with no more than two seconding letters.

### **Paul H. Emmett Award in Fundamental Catalysis**

The Paul H. Emmett Award in Fundamental Catalysis is sponsored by the Davison Chemical Division of W.R. Grace and Company. It is administered by The Catalysis Society and is awarded biennially in odd numbered years, generally at the North American meeting of The Catalysis Society. The award consists of a plaque and a prize of \$3,000. An additional \$500 is available for otherwise unreimbursed travel expenses.

The purpose of the Award is to recognize and encourage individual contributions in the field of catalysis with emphasis on discovery and understanding of catalytic phenomena, proposal of catalytic reaction mechanisms and identification of and description of catalytic sites and species.

Selection of the Award winner will be made by a committee of renowned scientists and engineers appointed by the President of The North American Catalysis Society. Selection shall be made without regard for sex, nationality or affiliation. The award winner shall not have passed his/ her 45th birthday on April 1 of the award year, thus nomination documents should indicate the age and birthdate of the nominee. [The next award is the 2007 Award year for this Emmett Award (nominations due by November 30, 2006). Thus, nominees should not have passed their 45th birthday on April 1, 2007.] Posthumous awards will be made only when knowledge of the awardee's death is received after announcement of the Award Committee's decision. Nominations for the Award should present the nominee's qualifications, accomplishments, birthdate, and biography. A critical evaluation of the significance of publications and patents should be made as well as a statement of the particular contribution(s) on which the nomination is based. Nomination documents should be submitted in six copies to the President of the Society along with no more than two seconding letters.

### **The Robert Burwell Lectureship In Catalysis**

The Robert Burwell Lectureship in Catalysis is sponsored by Johnson Matthey Catalysts Division and administered by The North American Catalysis Society. It is to be awarded biennially in odd-numbered years. The award consists of a plaque and an honorarium of \$5,000. An additional \$4,500 is available to cover travelling expenses in North America.

The award is given in recognition of substantial contributions to one or more areas in the field of catalysis with emphasis on discovery and understanding of catalytic phenomena, catalytic reaction mechanisms and identification and description of catalytic sites and species. The Awardee will be selected on the basis of his/her contributions to the catalytic literature and the current timeliness of these research contributions. The recipient may be invited to (1) visit and lecture to each of the affiliated Clubs/Societies with which mutually satisfactory arrangements can be made and (2) prepare a review paper(s) for publication covering these lectures. Publication will be in an appropriate periodical.

Selection of the Award winner will be made by a committee of renowned scientists and engineers appointed by the President of The North American Catalysis Society. Selection shall be made without regard for age, sex, nationality or affiliation. Posthumous awards will be made only when knowledge of the awardee's death is received after announcement of the Award Committee's decision. Nomination packages should indicate the nominee's qualifications, accomplishments, a nominating letter, a seconding letter and a biography of the nominee. A critical evaluation of the significance of candidate's qualifications should be made as well as a statement of the particular contribution(s) on which the nomination is based. Nomination documents should be submitted in six copies to the President of the Society along with no more than two seconding letters.

### **The F. G. Ciapetta Lectureship in Catalysis**

The F.G. Ciapetta Lectureship in Catalysis is cosponsored by the Davison Chemical Division of W.R. Grace & Company and The North American Catalysis Society. The Society administers this Lectureship. It is to be awarded biennially in even numbered years. The Award consists of a plaque and an honorarium of \$5,000. An additional \$4,500 is available to cover travelling expenses. The honorarium is provided completely by Davison.

The Award is given in recognition of substantial contributions to one or more areas in the field of catalysis with emphasis on industrially significant catalysts and catalytic processes and the discovery of new catalytic reactions and systems of potential industrial importance. The awardee will be selected on the basis of his/her contributions to the catalytic literature and the current timeliness of these research contributions. The recipient may be invited to (1) visit and lecture to each of the affiliated Clubs/Societies with which mutually satisfactory arrangements can be made and (2) prepare a review paper(s) for publication covering these lectures. Publication will be in an appropriate periodical .

Nomination documents should be submitted in six copies to the President of the Society along with no more than two seconding letters. Selection of the awardee will be made without regard to age, sex, nationality, or affiliation. A critical evaluation of the significance of candidate's qualifications should be made as well as a statement of the particular contribution(s) on which the nomination is based.

### **Canadian Awarded 2004 Ciapetta Lectureship in Catalysis**

The 2004 Ciapetta Lectureship in Catalysis was awarded to Professor Douglas Stephan of the Department of Chemistry and Biochemistry, University of Windsor, Windsor, Ontario. Professor Stephan presented his award address to the Canadian Division at the 18<sup>th</sup> Canadian Catalysis Symposium in Montreal, in May 2004.

Dr. Stephan received his PhD in Inorganic Chemistry from the University of Western Ontario. He undertook a NATO Postdoctoral Fellowship at Harvard University before moving to the University of Windsor where he has spent his career doing research.

Doug Stephan's research group has been active for over 20 years in studying the fundamental organometallic chemistry of early transition metals. He has received many distinctions and honors for his accumulated accomplishments during the course of his studies, but it was his recent success in developing a novel set of catalysts for polymerizing ethylene that have earned Doug Stephan many accolades both in industrial circles and among his academic peers. This development is expected to have a major impact on the Canadian petrochemicals industry, which is a significant part of Canadian manufacturing capability.

Stephan's innovative approach to ancillary ligand design quickly led to dramatic findings of new patentable catalysts that were highly active under industrial conditions. NOVA Chemicals' goal of developing new single site catalyst technologies was significantly advanced with the discoveries of potential new catalyst compounds from the Stephan laboratories. In collaboration with a team of chemists and engineers at NOVA Chemicals, Stephan's team worked to explore and develop these new catalyst families towards commercialization. Stephan and his group have continued to study the structure-reactivity relationship of these single-site catalysts. In addition, his group has discovered and studied a number of unusual deactivation pathways that these new catalysts exhibit allowing optimization of process conditions.

More recently, Stephan's group has been studying modified systems that exhibit living catalyst behaviour and their use in the formation of co- and block polymers. His new efforts are focused on developing new co-catalysts as well as strategies to late transition metal catalysts.

## **5** The 17<sup>th</sup> Meeting of the North American Catalysis Society, Toronto, 2001

**Co-chairmen:** John B. Moffat and M. Ternan  
**Secretary:** Alan R. Sanger

Approximately four years prior to the opening of the 17<sup>th</sup> North American Meeting of the Catalysis Society (abbreviated as 17 NACS or NACS2001), a group of scientists and engineers was assembled from the Canadian catalysis community to start organizing this important meeting. Each agreed to serve on the organizing committee for NACS2001. The effort made by each member of the committee was enormous. The work was performed with skill and energy. The results were excellent. This report has been constructed from reports for each subject area provided by the committees responsible.

**Finances:** Graeme Norval

### Expenses

We focused on expense items first to allow the committee to determine what the registration fee must be. The Toronto meeting was set for a break-even at roughly 750 total registrants, based on a \$CDN at 70¢ US. In fact, the \$US surged in Q1 2001, which pushed our break-even number lower. Also, the conference received a significant amount of donations after the registration cost had been set. Consequently, the Toronto meeting had a significant surplus, even with the extra expenses that we included. We estimated registration first was to estimate the number of registrants in the various categories, and to vary the registration fees to balance the expenses. The total number of anticipated registrants was used to estimate the food cost on the expense side of the spreadsheet.

### Support

Industrial Support was a huge success.

The NACS provided \$10,000 US as support for Kokes students. In addition The NSF and NIST provided support to cover student travel to the conference. The total student subsidy was roughly \$90,000 CDN, with \$45,000 CDN provided by NACS and NSF/NIST, and the balance provided by the conference.

The hotel contract provided a room credit to the conference of 1 room night per 50 room-nights sold. The low registration scenario had students staying at the hotel in order to fill the block, and avoid the penalty. Once the room block was cleared, it became clear that the students should stay at the University.

### Cash Flow

The largest concern for the Toronto meeting was cash flow. The Canadian Division did not have much money to seed the conference. As a consequence, several actions were initiated.

- 1) The first was the donation of services by NCUT – which donated the website and web service costs. All of these costs would have been payable prior to registrations arriving. This donation helped enormously.
- 2) Donations were solicited in advance, and donations were received in 1998, 1999 and 2000.

### Surplus

The meeting turned a surplus that was substantially greater than expected. One year before the conference, the breakeven registration was 800. Two months prior to the conference, using 900 delegates, the estimated surplus was \$85,000. The final accounting surplus was \$230,000. This surplus is equivalent to ~100 USD per registrant which is a significant over estimate of the registration fees.

### **Fund Raising:           Andrzej Krzywicki**

The Financial Committee was established in 1997. The Committee established a target of \$ 100,000CAD in donations. The Committee developed a list of target companies in Canada and the US. After the meeting in Toronto both lists were shared with the organizing Committees of 18<sup>th</sup> NACS and ICC meetings.

Due to the general economic situation, and M&A activities in the chemical industry the meeting timing was inconvenient, and the list of the target companies changed very quickly. Organizational changes, internal moves, lay-offs and early retirements characterized the soliciting period for the 17<sup>th</sup> NACS meeting. Several key contact people from industry changed their jobs or duties causing cancellations of earlier promised support. The exploration of Mexican sources by F.Beltran ended without any success.

### **Publications and Publicity:           Craig Fairbridge**

Originally, we included publications, publicity and exhibits together but we quickly decided to keep exhibits separate since it would be a lot of work on its own (see below). By December 1998, we started to make some plans for email address, website, logo, circulars and letterhead. A decision was taken to keep the publications and website similar to the previous NACS meetings.

One NACS2001 email address was chosen in 1998 so that any and all electronic communications went through this one address with an individual from our committee responsible for checking the email on a regular basis.

The first circular was designed and printed in the second quarter of 1999 and approximately 2,200 were mailed out in the third quarter. The second circular (call for papers) was designed and printed in the first quarter of 2000 and approximately 3,900 were mailed in the second quarter. We printed 3,000 first circulars and 4,500 second circulars. This second circular was also designed in French and Spanish. Although we had 3,700 names in our database, we had only about 500 email addresses. The third circular was the registration package. It was designed and mailed out in the first quarter of 2001. There were costs associated with the printing and mailing of this registration package.

The website was initiated in the second quarter of 1999. We chose to build and maintain our website rather than contract to a website design company. The site was simple and continuously updated. We tried to give Official Sponsors some prominence by placing their company logos and links on our homepage. We also listed Exhibitors on the site with links to their websites. Our meeting management company offered an electronic registration site so that we simply provided a link from our website. Our preliminary program schedule was placed on the website in March/April 2001 with links to each abstract.

Our printer required material for the book of abstracts by mid-April to guarantee June 1 delivery. The Program Schedule was difficult to design. There were usually 10 presentations per day for each of 7 sessions so we compromised on two pages for each day and we included author names only in the plenary and keynote presentations. We added a brief description of each exhibitor to this Program Schedule.

**Program: Kevin Smith**

#### Theme

The theme of the 17<sup>th</sup> North American Catalysis Society Meeting is 2001: Horizons of Catalysis. This theme focuses attention on catalysis research that is clearly linked to the needs of the 21<sup>st</sup> century. Each day begins with a plenary presentation. The Houdry Award Lecture was given by Leo E. Manzer on Monday and the Emmett Award Lecture was given by Donna G. Blackmond on Wednesday.

#### Session organizers:

The success of a conference is in large measure attributable to the quality of the technical sessions. In turn, the quality of the technical program is a direct consequence of a large and diligent effort by the organizers of the sessions.

#### Number of parallel sessions:

It was recognized early in the organization of the program that there would be a large number of submissions. A decision was made, after intense review of all options, to increase the number of parallel oral sessions when compared with earlier NACS meetings. Inevitably, this led to some conflicts when attendees found themselves choosing between two concurrent sessions. However, the incidence of such conflicts was relatively small, because great care was taken in scheduling sessions that would be likely to attract a similar group of attendees.

Having seven parallel oral sessions and a non-conflicting set of poster sessions allowed allocation of the vast majority of papers to the type of session preferred by the presenter(s), and allowed considerable flexibility in scheduling.

#### Abstracts:

Abstracts for all oral and poster presentations were reviewed. Papers were then assigned to oral or poster components of the program, and sessions were designed to maximize interest, convenience and relevance to specific themes. The abstracts were then compiled into printed volumes for distribution to all attendees. Copies of the volumes were circulated with the registration packages, and additional copies were available for sale at the registration desk.

**Table 4. 17<sup>th</sup> Meeting of the North American Catalysis Society: Session Organizers**

<b>Environmental:</b>	<b>K. Chuang</b> , University of Alberta
<b>Preparation and Characterization:</b>	<b>A. Dalai</b> , University of Saskatchewan, and <b>J. Adjaye</b> , Syncrude Canada Ltd.
<b>Acid Catalysis and Zeolites:</b>	<b>A. Kuperman</b> , Chevron
<b>Catalyst Deactivation and Reaction Engineering:</b>	<b>E.M. (Ted) Calverley</b> , Dow Chemical
<b>Natural Gas Conversion:</b>	<b>J. Galuszka</b> , Natural Resources Canada, CETC, and <b>K. Smith</b> , University of British Columbia
<b>Heterogeneous Organic Synthesis and Fine Chemicals:</b>	<b>K. Smith</b> , University of British Columbia
<b>Hydroprocessing:</b>	<b>J. Kriz</b> , Ensyn Technologies Inc.
<b>Fundamentals:</b>	<b>C.A. Mims</b> , University of Toronto
<b>Homogeneous and Polymerization Catalysis:</b>	<b>C. Crudden</b> , University of New Brunswick
<b>Combinatorial Methods:</b>	<b>G. Koermer</b> , Engelhard, and <b>A. Moini</b> , Engelhard
<b>Innovations in Mo catalysis:</b>	<b>C. Hallada</b> , Climax Molybdenum, <b>A.W. Armour</b> , Climax Molybdenum, and <b>P.C.H. Mitchell</b> , University of Reading
<b>Fuel Cells:</b>	<b>B. Peppley</b> , Royal Military College
<b>Membranes:</b>	<b>J. Galuszka</b> , Natural Resources Canada, CETC
<b>Novel Catalytic Processes:</b>	<b>D. Laycock</b> , Dow Chemical Canada Inc. NA Polyurethanes Flexibles Group, and <b>J. Monnier</b> , Natural Resources Canada, CETC
<b>General:</b>	<b>K. Smith</b> , University of British Columbia
<b>Posters:</b>	<b>A. Dalai</b> , University of Saskatoon

<b>Local Events and Registration:</b>	<b>C.A. Mims, M.J. Phillips</b>
<b>Meeting Management:</b>	<b>R. Dewar (MMS)</b>
<b>Kokes Fund and Related Issues:</b>	<b>Elm Alyea</b>

#### Hiring a meeting management company

We hired Ron Dewar, Meeting Management Services of Burlington, Ontario, to help with registration and local arrangements. The involvement of a meeting management company was deemed essential to the Local Arrangements Committee. One factor in this decision was the limited number of "locals" in Toronto to mount the effort required. Resources such as donated secretarial help at universities have all but dried up and the local industrial base is small. The demands of everyone's "day job" leaves little extra time for such an endeavour. A more important reason, however, was the efficiency gained by bringing onto the committee experts who knows the business instead of training ourselves in skills never to be used again. In our situation, a group of amateurs would have required enormous amounts of time and yet produced a lower quality meeting for the delegates. The question of hiring a company and how they should be used was a substantial one, as it requires the firm commitment of cash at an early date.

It was most important to find a good quality company who understood the needs of your group. Ron Dewar and Meeting Management Services (MMS) was the first choice of the local arrangements committee.

#### Registration

##### *Fees:*

The registration fees were decided 1 year out. They were based on a conference budget that included the "final" version of the events program. The "breakeven" paid registration was set at 700. It is good to have the early registration deadline on the same day the conference delegate room block lapses at the hotel (1 month out in our case).

##### *Registration Process:*

MMS provided web-based registration. A printable registration form was also available on the conference web-site and was also circulated in preconference publicity mailings for fax or regular mail registration. 47% of the delegates registered over the internet for NACS2001.

It was important to ask on the registration form for all the useful information you can use. The registration process was the only time that contact with the delegate was guaranteed. The registration form had a connection to all the other tasks (local arrangements, program, etc.) and the design of the registration form should involve input from everyone.

MMS prepared envelopes with each pre-registered delegate's materials (badge, receipt, event tickets) were pre-prepared and combined with delegate bags that have been pre-stuffed with the technical program and other items on the Saturday before the conference. On-site registrations were handled at a separate line.

The final numbers exceeded our optimistic model and are summarized in the tables below.

**Table 5: 17<sup>th</sup> Meeting of the North American Catalysis Society: Registration Breakdown**  
**a. Registration by categories**

<b>Revenue-generating registrations</b>	
Full registrations	645
One - day registrations	27
Student (non-Kokes)	90
Retired	19
Companions	58
<b>Non-revenue registrations</b>	
Kokes Students	85
Exhibitors	80
<b>Total</b>	<b>1004</b>

**b. Breakdown of attendees by country (866 total, excludes companions, exhibitors).**

	<i>Percentages</i>	
<b>North America</b>	<b>74.4</b>	
USA		60.9
CANADA		8.5
MEXICO		5.0
<b>South America</b>	<b>2.1</b>	
ARGENTINA		0.3
BRAZIL		1.0
CHILE		0.2
COLOMBIA		0.1
VENEZUELA		0.5
<b>Europe + FSU</b>	<b>16.1</b>	
DENMARK		0.8
FINLAND		0.3
FRANCE		3.3
GERMANY		2.6
HUNGARY		0.4
IRELAND		0.1
ITALY		1.6
BELGIUM		0.3
NETHERLANDS		1.7
POLAND		0.7
PORTUGAL		0.2

RUSSIA		0.4
SPAIN		0.4
SWEDEN		0.5
SWITZERLAND		0.2
UK		2.1
UKRAINE		0.2
<b>Middle East - Africa</b>	<b>0.6</b>	
ISRAEL		0.1
KUWAIT		0.1
SAUDI ARABIA		0.2
TUNISIA		0.1
UNITED ARAB EMIRATES		0.1
<b>Asia</b>	<b>6.7</b>	
TAIWAN		0.3
CHINA		0.6
INDIA		0.2
JAPAN		3.0
KOREA		2.5
<b>Pacifica</b>	<b>0.1</b>	
NEW ZEALAND		0.1

**c. Breakdown of attendees by sector (866 total, excluding exhibitors, companions)**

<b>Registrants participating in technical program</b>	<b>%</b>
Academic (non-students)	28
Students	19
Industry (non-exhibits)	44
Government	9
Media	0.2

Hotel (Contract, Accommodations, Events)

The site was selected and the hotel contract negotiated in 1995 by Y. Amenomiya, J.Moffat and M. Ternan. The meeting space (except for a charge for exhibits) was provided free of charge if the room block was filled, and an increasing fraction of the meeting room rental costs were to be applied for increasing shortfalls in the room block. We filled the room block for all nights almost exactly on the day that the block reservation lapsed (2 May, 2001). A block of rooms at Victoria College at the University of Toronto was booked for students, primarily for Kokes awardees. The rate was \$45 CDN /night and included a hot breakfast, although taking advantage of the breakfast precluded attending the plenaries. This block was also sold out.

Events

*Dinner cruise:*

Two boats were booked over a year in advance. The meal contracts on the boat were signed 1 month out. The delegate numbers and stronger-than- anticipated subscription to the cruise made it necessary to add another boat and band at the last minute (Sunday). All three boats were full, and more crowded than the optimum.

*Banquet:*

Although 670 people attended the banquet, we ended up with a substantial number (60 or so) of unfilled places because of no-shows. Most meeting managers and events organizers have formulae to calculate numbers, but the tendency is to err on the high side, since even a handful of people with no place at dinner will make a greater impact than 50 empty seats.

*Companions Program:*

We decided to provide a companions room with food and beverages, a local phone line, and knowledgeable people, including Ms. Carolyn Box, to help the companions sort out their options and arrangements on an individual basis. We counted on the local tour machinery and their contact through the hotel to accommodate the companions wishes, without putting conference funds at risk by reserving buses, etc. This room was heavily used.

*Volunteers:*

"Volunteers" were recruited from University of Toronto students for help with registration (6 from Sunday noon through Monday morning), delegate bag stuffing at the hotel (8 for 3 hours Saturday before the meeting), and help during the technical program (7 or 8 per day). This staffing was adequate, except we should have had help more coverage with posters set-up at odd hours (evenings and early morning). One student was given overall responsibility as a "lieutenant" and monitor, and served in the speaker-ready room when not overseeing the operations. We decided to use local students, and give the Kokes students a break, because it allowed us to pre-train and pre-acquaint the volunteers with their tasks before the meeting started. The volunteers were paid an hourly wage of \$15 CDN /h and the room monitors given a lunch voucher.

**Exhibits: Peter Byrne**

No. of companies solicited:	Approximately 70, (depends on counting duplicates)
No. of companies who attended:	29
No. of sold booths:	31

NACS 2001 provided only space. The exhibitors purchased everything else directly from suppliers. Exhibitors want conference attendees to be in the exhibit space as often as possible. Ideally the exhibits should be as close to the meeting rooms as possible. Services like coffee should be located to facilitate traffic through the exhibit area. Locating exhibits remotely is particularly undesirable. Arranging of these services and poster presentations to enhance exhibit attendance is critical as it may affect attendance at the following conference.

**Table 6. Organizing Committee, 17<sup>th</sup> Meeting of the North American Catalysis Society, Toronto, 2001**

**Co-Chairs**

John Moffat  
University of Waterloo  
Waterloo, Ontario

Marten Ternan  
CANMAR Engineering Inc.  
Ottawa, Ontario

**Secretary**

Alan R. Sanger  
Alvesan enterprises inc.  
Edmonton, Alberta

**Treasurer**

Graeme Norval  
PCI Chemicals Canada Inc.  
Mississauga, Ontario

**Technical Program**

Kevin J. Smith  
University of British Columbia  
Vancouver, British Columbia

**Fund Raising**

Andrzej Krzywicki  
NOVA Research & Technology  
Calgary, Alberta

**Local Arrangements**

Charles A. Mims  
University of Toronto  
Toronto, Ontario

Jane Phillips  
University of Toronto  
Toronto, Ontario

Ron Dewar  
Meeting Management Services Inc.  
Burlington, Ontario

Elmer Alyea  
(also **Kokes Awards Chair**)  
University of Guelph  
Guelph, Ontario

**Publications and Publicity**

Craig Fairbridge  
National Centre for Upgrading Technology  
Devon, Alberta

**Exhibits**

Peter J. Byrne  
Snap-tite, Inc.  
Toronto, Ontario

**Advisor**

Bohdan Wojciechowski  
Naples, Florida 34110



# 6

## THE INTERNATIONAL CONGRESSES ON CATALYSIS

### (INTERNATIONAL ASSOCIATION OF CATALYSIS SOCIETIES)

Every four years since 1956 the international catalysis community has held an International Congress on Catalysis (ICC). At these meetings a large number of prominent established catalysis professionals and emerging talents from many nations meet. Papers on every facet of catalysis are presented, and several issues related to catalysis are discussed. For each meeting to date a diligent and hard-working organizing committee has created a program with outstanding invited speakers and contributed papers. The difficulty in designing the program has always been selection of the most appropriate papers for presentation, from the many quality submissions made. A number of papers submitted by Canadian authors have been selected for presentation at each Congress.

The Council of the ICC comprises members representing each fully accredited member nation, and observers from other participating nations [It is now called the International Association of Catalysis Societies (IACS)]. Canada is entitled to two members of the Council of ICC. The holders of this office are listed among the Executives of The Catalysis Division (Appendix 1). The Constitution of the International Association of Catalysis Societies is given in Appendix 4.

The selection of the site for an ICC is competitive. The Council receives submissions from representatives of the prospective host nations, and these are assessed on the basis of site, facilities, transportation and other logistical considerations, and the scientific and organizational strength of the host catalysis community. The sites selected are shown in Table 4.

In 1982 Calgary was selected by the Canadian catalysis community as the most appropriate venue for an ICC. At the ICC held in Berlin in 1984 Canada was selected to host the 9th ICC, in 1988. A description of that meeting is presented in Chapter 7.

The constitution is available at [http://www.iacs-icc.org/ConstitutIACS\\_04.pdf](http://www.iacs-icc.org/ConstitutIACS_04.pdf)

**Table 7. Locations for the International Congresses on Catalysis**

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<b>Number</b>	<b>Year</b>	<b>Location</b>
1st	1956	Philadelphia, USA
2nd	1960	Paris, France
3rd	1964	Amsterdam, The Netherlands
4th	1968	Moscow, USSR
5th	1972	Miami, USA
6th	1976	London, UK
7th	1980	Tokyo, Japan
8th	1984	Berlin, Germany
9th	1988	Calgary, Canada
10th	1992	Budapest, Hungary
11th	1996	Baltimore, USA
12th	2000	Granada, Spain
13th	2004	Paris, France

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## **7 THE NINTH INTERNATIONAL CONGRESS ON CATALYSIS, CALGARY, 1988**

When Canada was awarded the Ninth International Congress on Catalysis (9ICC), it fell to a group of hard-working, dedicated and very effective volunteers to organize this, the most prestigious of catalysis meetings. Bob Anderson and Harry Habgood were selected as Co-Chairs for the organizing committee. A strong team of local talents from Calgary undertook organization of components related to the site and events, and the national catalysis community created teams to address each of the other components. A superb job was performed by the organizing committee in enabling and arranging the technical and supporting components. The program committee undertook the arduous task of selecting and programming oral and poster presentations, selecting and organizing session chairs from the international community, and ensuring that the technical content of 9ICC was lively and worthwhile. The meeting was an outstanding success.

The quality of the work by the organizing committee is well characterized in the report to the Council of the International Congress on Catalysis by the Co-Chairman, Harry Habgood.

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### **Ninth International Congress on Catalysis Report from Chairman of the Organizing Committee**

The committee was originally established with two co-chairmen, Professor R.B. Anderson and Dr. H.W. Habgood. Unfortunately Dr. Anderson passed away a few months before the Congress; his loss was keenly felt but more in an emotional and psychological way than in any great amount of added work for the remaining co-chairman or other committee members.

On our appointment by the executive of The Catalysis Division of The Chemical Institute of Canada we were told that we would not have to assume any great share of the work of the committee. In fact, the two vice-chairmen, Dr. R.A. Ross and Professor I.G. Dalla Lana, were not given specific assignments initially so that they would be available to help out or take over from the chairmen if necessary. It turned out that the vice-chairmen took on some specific responsibilities and the co-chairmen participated fully. We both were able to attend most of the committee meetings but our duties were indeed light - largely because of the efficiency and dedication of the secretary, Professor J.B. Moffat. We had numerous consultations with him by telephone and he was very willing to poll members of the committee about particular points that came up between meetings.

There were a few letters that we felt should be written by one of the chairmen - *e.g.* the request to NSERC for funds for their invited plenary lecturers - but generally we encouraged the committee members to write their own letters to solicit funds, invite speakers, negotiate the details of events, etc.

At the meeting itself there were a number of formal duties for the committee chairman: presiding at the official opening which we scheduled during the Sunday evening reception; presiding at the first plenary lecture; presiding at the Symposium banquet; and, as chairman of one of the final sessions, formally closing the Symposium (vice-chairman Dalla Lana did the same thing for the other final session).

The life of the committee is of the order of six years. An important function of the chairman is to provide a continuing focus for the members and to encourage them to keep up their interest and commitment. Bob Anderson and I have attempted to do this - with the high calibre of the committee members, particularly the secretary, this has not been difficult.

*H.W. Habgood (April 4, 1989)*

The volunteers on the organizing committee, who deserved such high commendation, are listed in Table 5.

**Table 8. Organizing Committee, Ninth International Congress on Catalysis, Calgary, 1988**

**CHAIRMEN:**

Professor R.B. Anderson (McMaster University) (deceased October 24, 1987)

Dr. H.W. Habgood (Technical University of Nova Scotia)

**VICE-CHAIRMEN:**

Professor I.G. Dalla Lana (University of Alberta)

Dr. R.A. Ross (Domtar Inc.)

**Committee:**

Dr. A.R. Sanger (Alberta Research Council) - Post Congress Symposia

**Exhibition:**

Professor K.T. Chuang (University of Alberta)

Dr. P.D. Clark (University of Calgary)

Mr. R.A. Cullen (Southern Alberta Institute of Technology)

Dr. A.Z. Krzywicki (NOVA HUSKY Research Corporation Ltd.)

**PROGRAM:****Chairman:**

Dr. Y. Amenomiya (National Research Council of Canada and University of Ottawa)

**Committee:**

Dr. J.R. Brown (Energy, Mines and Resources Canada)

Professor I.G. Dalla Lana (University of Alberta)

Dr. C. Fairbridge (Energy, Mines and Resources Canada)

Dr. J. Galuszka (Energy, Mines and Resources Canada)

Dr. Z.M. George (Alberta Research Council)

Dr. J.F. Kriz (Energy, Mines and Resources Canada)

Professor B.A. Morrow (University of Ottawa)

Dr. K.W. Oliver (National Research Council Canada)

Dr. A.R. Sanger (Alberta Research Council)

Dr. B.M. Sankey (Esso Petroleum Canada)

**FINANCE:****Treasurer and Chairman:**

Professor B.W. Wojciechowski (Queen's University)

**Committee:**

Dr. F. Hanson (University of Utah - USA)

Mr. T.H.G. Michael (retired from The Chemical Institute of Canada)

Dr. R.A. Ross (Domtar Inc.)

Dr. E.C. Sanford (Syncrude Research)

**SECRETARY:**

Professor J.B. Moffat (University of Waterloo)

**Committee:**

Ms. Lisa Dowsett (University of Waterloo)

Ms. Gloria Rau (University of Waterloo)

**LOCAL ARRANGEMENTS:****Chairman:**

Professor E.L. Tollefson (University of Calgary)

**Committee:**

Dr. F.W. Bachelor (University of Calgary) - Social Events

Professor A. Badakhshan (University of Calgary) - Congress Site Arrangements

Dr. F. Berruti (University of Calgary)

Professor P.M. Boorman (University of Calgary) - Registration and Finance

Dr. P.D. Clark (University of Calgary) - Sports Tours and Equipment Exhibition

Mr. R.A. Cullen (Southern Alberta Institute of Technology) - Equipment Exhibition

Dr. E.S. Hall (University of Calgary) - Social Tours

Dr. M.A. Hastaoglu (University of Calgary) - Secretary

Dr. J.R. Hawkins (ESSO Resources) - Industrial Tours

Dr. A.Z. Krzywicki (NOVA HUSKY Research Corp. Ltd.) - Equipment Exhibition

Professor R.A. Kydd (University of Calgary) - Registration and Finance

Professor M.F. Mohtadi (University of Durham - South Africa) - Protocol

Dr. E.C. Sanford (Syncrude Research) - Industrial Tours

Professor T. Sorensen (University of Calgary) - Transportation

**PUBLICATIONS AND ADVERTISING:****Chairman:**

Dr. M. Ternan (Energy, Mines and Resources Canada)

**Committee:**

Dr. J. Monnier (Energy, Mines and Resources Canada) - Advertising

Professor B.A. Morrow (University of Ottawa) - Graphics

Dr. M.J. Phillips (University of Toronto) - Publications

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Appended to the Co-Chairman's report were reports from the Secretary, John Moffat, and the Chairman of the Program Subcommittee, Yoshi Amenomiya. The following descriptions have been abstracted from these reports.

**Program*****Responsibilities***

The responsibilities of the Program Subcommittee were to:

1. Establish a form of paper presentation.
2. Establish a method for selecting papers and implement the selection.
3. Select the fields and topics for plenary lectures and recommend a list of lecturers to the Organizing Committee.
4. Select Co-Chairpersons and Assistant Chairpersons for the oral sessions.
5. Arrange a program for technical sessions.
6. Make arrangements for session rooms at the conference site and run the sessions.

In order to carry out the above responsibilities in conjunction with the schedules set up by the Organizing Committee, a timetable was set as internal milestones for the Subcommittee.

***Summary***

The initial selection of the contributed papers was based on an extended 2-page abstract. A total of 657 abstracts from 43 countries was received. Each abstract was vigorously reviewed and evaluated by at least two reviewers from a panel of 63 international catalysis experts. The reviewers were asked to rate the abstracts in two categories: the scientific quality of the research and the merit of the paper for presentation at the International Congress. Finally, a special meeting of the Program Subcommittee, including Bob Anderson, one of the Co-Chairmen, was held, and a total of 264 abstracts was selected based on the reviewers' evaluation.

After a long discussion at the meetings of the Organizing Committee, a total of five plenary lecturers was selected.

The Program Subcommittee selected a total of 36 prominent catalysis workers from the world as Co-Chairpersons of the oral sessions. Also a total of 18 Canadian scientists and engineers were asked to serve as Assistant Chairpersons. Finally, the Subcommittee selected five Chairpersons to chair the plenary lectures.

After receiving the full manuscripts of the selected papers, the Subcommittees of Publications and Advertising and of Program accepted a total of 255 papers for presentation.

These papers were contributed from 32 countries. The finalized program of technical sessions consisted of:

1. 5 plenary lectures.
2. 90 oral papers presented in 18 sessions.
3. 165 poster papers presented in 4 poster sessions.

The acceptance rate (No. of papers accepted / No. of abstracts submitted) at recent Congresses was 37% at Tokyo (1980), 45% at Berlin (1984) and 40% at Calgary (1988).

The proceedings of the 9ICC were published as five volumes. In the first four volumes the oral and poster presentations were grouped by category, as follows:

***Catalysis: Theory to Practice:***

***Proceedings of the 9th International Congress on Catalysis***

ed. M.J. Phillips and M. Ternan, The Chemical Institute of Canada, Ottawa (1988).

**Volume 1.** Hydroprocessing, Zeolites and Catalytic Processes

**Volume 2.** C1 Chemistry

**Volume 3.** Characterization and Metal Catalysts

**Volume 4.** Oxide Catalysts and Catalyst Development

It was decided to encourage the participants to presubmit questions and comments using a discussion form. A copy of each submitted form was delivered to the speakers at the Speakers' Breakfast. Although this formula was also used for the poster sessions, it was particularly useful to save the limited time of discussion at the oral sessions. The questions and the written replies were published in "**Volume 5.** Plenary Lectures and Discussion" in the above series of proceedings.

The scientific program was very good, and the sessions were run smoothly without any serious incidents. The catalysis community owes this to all people who cooperated, namely the reviewers, the Co-Chairpersons, the Assistant Chairpersons, and the Program Subcommittee members. The organizers were particularly thankful to the local members for their devotion in arranging and running sessions.

The 9ICC attendees truly represented the international catalysis community, both in terms of nations represented (Table 6) and the nature of the laboratories and plants in which work is conducted (Table 7).

***Post-Congress Symposium***

An additional effort was made by the Québec members of the Canadian catalysis community. A post-congress symposium was organized by P. McBreen, P.C. Roberge, and S. Kaliaguine. Over 80 attendees were attracted to the meeting on use of organometallic complexes in heterogeneous catalysis.

**Table 9. Ninth International Congress on Catalysis, Calgary, 1988: Breakdown of Registrations by Nation**

<b>Country</b>	<b>Total Regular Participants</b>	<b>Total Students</b>	<b>Total Participants</b>
Algeria	1		1
Argentina	3		3
Australia	15		15
Austria	2		2
Belgium	8		8
Bulgaria	3		3
Canada	73	6	79
Czechoslovakia	1		1
Denmark	4		4
Fed. Rep. Germany	31	2	33
German Dem. Rep.	4		4
Finland	6	2	8
France	45	2	47
Hungary	7		7
India	4		4
Ireland	2		2
Italy	38		38
Japan	97	6	103
Korea	2		2
Kuwait	2		2
Mexico, D.F.	1		1
Netherlands	37	8	45
New Zealand	1		1
Norway	8		8
Poland	2		2
Portugal	2		2
P.R. China	14	1	15
R.O. China	8		8
Romania	3		3
Scotland	2		2
South Africa	3	1	4
Spain	5		5
Sweden	8		8
Switzerland	13	1	14
United Kingdom	23	2	25
USSR	19		19
USA	293	16	309
Venezuela	3		3
Yugoslavia	1		1
Blanks include cancellations & those without addresses	18	3	21
<b>TOTALS</b>	<b>814</b>	<b>52</b>	<b>866</b>

**Table 10. Ninth International Congress on Catalysis, Calgary, 1988:  
Breakdown of Registrations by Employment Sector**

<b>Employment Sector</b>	<b>Number of Registrants</b>
Government	41
Industry	388
Universities	419
Cancellations & unspecified affiliations	18
<b>TOTAL</b>	<b>866</b>



## 8 THE CANADIAN CATALYSIS FOUNDATION

The seed money raised by the Canadian catalysis community enabled Canada to organize and host the 9th International Congress on Catalysis (9ICC) in Calgary, 1988. The seed money was provided through the efforts of The Catalysis Division and its individual and corporate friends. The meeting was extremely successful. Following 9ICC a decision was made to use the funds recovered from the event to establish a not-for-profit foundation with the intent of fostering and developing catalysis in Canada. Extensive discussions and planning during 1988 to 1990 led to a proposal to establish the Canadian Catalysis Foundation.

The objects and by-laws governing the body were registered in 1990 (Appendix 5), and the Foundation was incorporated by Letters Patent issued by Consumer and Corporate Affairs Canada, on March 19, 1990. At the inaugural general meeting, June 29, 1990, H.W. Habgood (q.v.) was confirmed as President, with the support of a vigorous and pro-active group of catalysis professionals as officers and members of the Board of Directors. The officers and members of the Board of Directors since that date are listed in Appendix 6.

### Objectives

The purposes for which the CCF was established each address the advancement and knowledge of catalysis in Canada. These objects were specified in the letters patent, and include:

- sponsoring catalysis lectures and lecture tours within Canada
- giving prizes and awards in recognition of Canadian catalysis achievements
- holding and supporting lectures, symposia, exhibitions, meetings, classes and conferences on catalysis
- related issues concerning funding

The objectives are addressed through the sponsorship of the Canadian Catalysis Lectureship Award, the Cross-Canada Lecture Tour, awards to students to travel to catalysis meetings, seed money or direct support of catalysis meetings, and similar events. It is not an objective of the CCF to sponsor catalysis research or applications, and no funds are made available for such purposes. Grants are made by the Board of Directors of CCF.

### Membership

The intention at the creation of the CCF was that the membership would be relatively small, and would comprise senior and experienced people in the catalysis community. The majority of the members are persons who have served as directors of CCF, or as Chairs of the Catalysis Division of CIC. It is recognized that new directors of CCF may be appointed from outside the membership of CCF.

Members who have served on the Board of Directors of CCF, or who served as Chair of the Catalysis Division of CIC before 1990, automatically become life members of CCF.

### The Canadian Catalysis Lectureship Award

The CCF created and sponsors the Canadian Catalysis Lectureship. The lectureship is restricted to Canadians who are currently working in Canada in the area of catalysis. It is intended to provide experience of Canadian scientists/engineers. The lecture tour is to be held annually, and to include 4 to 6 Canadian cities. It will be offered to a limited number of locations in the USA as well, the sites to be determined through The (North American) Catalysis Society, of which The Catalysis Division of CIC is a member. The recipient will be chosen by a committee appointed by The Catalysis Division, and could be either a researcher recognized as a leader in a particular field of research, or someone who has just completed a new and interesting or controversial piece of work but who is not yet widely recognized.

The inaugural lectureship award was made in 1994, and Yoshimitsu Amenomiya was selected as the first recipient.

**Table 11. Holders of the Canadian Catalysis Lectureship Award**

1994	Yoshimitsu Amenomiya, University of Ottawa, Ottawa
1995	Jerry F. Kriz, CANMET, Natural Resources Canada, Ottawa
1996	John B. Moffat, University of Waterloo, Waterloo
1997	Karl T. Chuang, University of Alberta, Edmonton
1998	Serge Kaliaguine, Université Laval, Ste-Foy
1999	Brian R. James, University of British Columbia, Vancouver
2000	Tom Ziegler, University of Calgary, Calgary
2001	Marten Ternan, CANMAR Engineering Inc., Ottawa
2002	Warren E. Piers, University of Calgary, Calgary
2003	Charles A. (Chuck) Mims, University of Toronto, Toronto
2004	Phillip Jessop, Queen's University, Kingston
2005	Peter D. Clark, University of Calgary, Calgary

### Canadian Catalysis Lectureship Award Winners

*(The following articles for each of the Canadian Catalysis Lectureship Award are reproduced or adapted, with permission, from Canadian Chemical News and The Catalysis Division Newsletter published by The Catalysis Division of The Chemical Institute of Canada.)*

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**1994** **Yoshimitsu Amenomiya**, FCIC, received the 1994 Canadian Catalysis Lectureship Award and gave a series of lectures to enthusiastic audiences in six Canadian cities in the Spring of 1995. Amenomiya's lectures titled 'Dynamic Study of Surface during Catalytic Reaction' and 'Acid and Base Centers as Observed by TPD' were presented in Fredericton (University of New Brunswick), Québec City (Laval University), Kingston (Joint CSciE/CSC Meeting), Saskatoon (University of Saskatchewan), Calgary (University of Calgary) and Vancouver (University of British Columbia).

The Canadian Catalysis Lectureship Award, sponsored by the Canadian Catalysis Foundation, is presented to a Canadian scientist who has made an outstanding contribution to the understanding of catalysis and catalysis reactions. Amenomiya, a native of Tokyo, Japan, received his BEng from the Tokyo Institute of Technology and his DSci in the field of heterogeneous catalysis from Hokkaido University in 1959. He joined the Chemistry Division of the National Research Council of Canada as a Postdoctoral Fellow in 1959 where he held the positions of Associate Research Officer and Senior Research Officer until his retirement from NRC in 1987. Amenomiya is presently an Honorary Visiting Professor at University of Ottawa, and in 1990 he was an Invited Professor at the International Cooperation Center, Tokyo Institute of Technology. Elected a Fellow of the CIC in 1973, Amenomiya pioneered the technique of temperature-programmed desorption for characterizing the acid-base properties of heterogeneous catalysts, and was jointly awarded the first Catalysis Award of The Chemical Institute of Canada in 1977 with R.J. Cvetanovic. Amenomiya's research interests include heterogeneous catalysis, chemical properties of solid surfaces and catalytic activation of methane.

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**1995** **Jerry Kriz**, FCIC, received the 1995 Canadian Catalysis Lectureship Award and gave a series of lectures in six Canadian cities in the Spring of 1996. Kriz's lecture titled 'Processing and Environmental Catalysis' was presented in Québec City (Laval University), Sarnia (Joint CSE/CSC Meeting), Edmonton (University of Alberta), Calgary (University of Calgary), Vancouver (University of British Columbia), and Whistler (14<sup>th</sup> Canadian Symposium on Catalysis).

Dr. Kriz received his Dipl. Eng. in Chemical Engineering from the Institute of Chemical Technology (Prague) in 1968 and his PhD in Physical Chemistry from Dalhousie University (Halifax) in 1973. He held the positions of Research Fellow in the Department of Chemical Engineering, University of Western Ontario, and NRC Postdoctoral Fellow in the Department of Chemistry at Simon Fraser University. In 1976, Kriz joined the Energy Research Laboratories of CANMET (now part of CANMET Energy Technology Centre) located in Ottawa. In his twenty year career as a research scientist with CANMET, Kriz has conducted R&D in various applications of heterogeneous catalysis to hydrocarbon processing: catalyst deactivation and coking propensity in heavy oil upgrading, aromatics saturation in synthetic crude distillates, catalytic processing of waste-derived oil, catalytic isomerization of gasoline range paraffins and benzene removal from gasoline. Kriz was head of the Catalytic Hydroprocessing Section between 1980 and 1991.

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**1996** **John B. Moffat**, FCIC, has been selected to receive the Canadian Catalysis Lectureship Award for 1996. Moffat received the Catalysis Award of The Chemical Institute of Canada in 1988 for his distinguished contribution to the field of catalysis.

Moffat served on the executive of the Catalysis Division successively as Secretary-Treasurer, Vice-Chairman, Chairman and past Chairman during 1980-1986, was a director of the CSC during the period from 1987 to 1990 and is a

founding Director of the Canadian Catalysis Foundation of which he was President from 1991 to 1995. He has served on the Editorial Boards of the *Journal of Molecular Catalysis*, and *Applied Catalysis*, and continues on *Catalysis Letters* and on the organizing committees of a number of conferences related to catalysis. He was Secretary for the International Congress on Catalysis held in Calgary in 1988 and continues to serve on the International Scientific Committee for the International Natural Gas Conversion Symposia held in New Zealand, Norway, Australia and South Africa, the latter in 1995. He co-chaired a symposium on Solid Superacids in Hawaii in December 1995, and will co-chair a conference on Chemistry, Energy and the Environment in Portugal in 1997 and most recently was named as the Chairman for the North American Catalysis Society Meeting to be held in Canada for the first time in 30 years in 2001.

Moffat has published over 240 publications in heterogeneous catalysis, surface chemistry and quantum chemical studies of bonding and molecular structure and is Editor of *Theoretical Aspects of Heterogeneous Catalysis*. His current research is concerned with the surface and catalytic properties of stoichiometric and nonstoichiometric phosphates, metal-oxygen cluster compounds, hydroxyapatites and a variety of oxides and studies of the nature of the active sites of heterogeneous catalysts, the mechanism of catalytic processes and the development of new catalysts for chemical processes. He continues to engage in collaborative research with other laboratories in Canada, France, Germany, Japan and the United States. Most recently, his research work has been expanded to include studies on the application of heterogeneous catalysis to the solution of environmental problems.

Moffat recently retired from the University of Waterloo after 35 years, but continues to be active in research and related activities.

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**1997** **Karl T. Chuang**, FCIC, has been selected to receive the Canadian Catalysis Lectureship Award for 1997. Chuang received his BSc degree in chemical engineering from Cheng-Kung University, Taiwan in 1963, his MSc degree in chemistry from St. Francis Xavier University, NS in 1968, and his PhD degree in chemical engineering from the University of Alberta in 1971. His professional experience includes a tenure in industry as section head of chemical engineering at Chalk River Nuclear Labs of the Atomic Energy of Canada Ltd. (AECL) during the period 1972 to 1986. From 1982 to 1986, he was also an adjunct professor of chemical engineering at the University of Ottawa. He returned to full-time teaching and research in 1986 by joining the Department of Chemical Engineering at the University of Alberta as a full professor.

At AECL, Chuang directed an R&D program to develop a model for design of improved sieve tray and packed towers at Canadian heavy water plants. Revamping of the towers has resulted in increased heavy water production worth millions of dollars per year. He was a member of the Technical Advisory Committee at Fractionation Research, Inc. (USA) for eleven years and contributed a great deal in setting the FRI program for distillation and absorption research. In recognition of his

innovative contributions towards the development of new separation processes, he was awarded the AECL Discovery Award in 1985 and again in 1986.

One of Chuang's main research interests, since joining the University of Alberta, is in the area of environmental cleanup involving such processes as removal of  $\text{NO}_x$ ,  $\text{H}_2\text{S}$  in waste streams, catalytic wet air oxidation for eliminating organic compounds in industrial waste streams, and removal of volatile organic compounds in waste water or polluted air. A second major area deals with separation processes involving membrane separation, distillation and absorption, novel high capacity and high efficiency gas-liquid contactors. He has fifteen patents based on his novel ideas. Several of the processes developed by him are being used in industry worldwide.

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**1998** **Serge Kaliaguine**, MCIC, a Professor at the Université Laval, Ste-Foy, QC, is this year's winner of the Catalysis Award. Kaliaguine began his lecture tour by speaking at the CANMET Energy Technology Centre in Nepean, ON on October 9 and at the University of Ottawa, Ottawa, ON on October 23. The lectureship will continue in 1999 with talks at the University of Toronto, Toronto, ON on March 3; the University of Waterloo on March 4; and, during the period April 7 through 12, he will speak at the University of Calgary, Calgary, AB; the University of Alberta, Edmonton, AB; the National Centre for Upgrading Technology, Devon, AB; and the University of British Columbia, Vancouver, BC.

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**1999** Professor **Brian James**, University of British Columbia, was awarded the Canadian Catalysis Lectureship Award in 1999. As part of this award, Professor James will be traveling to Victoria (2 March 2000, University of Victoria), London (13 March 2000, U. of Western Ontario), Toronto (14 March 2000, York U.), Kingston (16 March 2000, Queen's U.), Montreal (22 March 2000, McGill U.) and Halifax (24 March 2000, Dalhousie U.) to present the results of some of his catalysis research. After receiving a D.Phil. from Oxford, Brian completed postdoctoral fellowships with the UK Atomic Energy Authority and the University of British Columbia before joining UBC in 1964. His research has focused on the chemistry of the platinum metals for applications in homogeneous catalysis and chemotherapy. Sixty students have completed graduate degrees with Dr. James and he has generated 310 publications, 4 patents and a book entitled "Homogeneous Hydrogenation". Dr. James also received the Catalysis Award in 1990.

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**2000** The 2000 winner of the Canadian Catalysis Lectureship Award is **Tom Ziegler**, FCIC, a world leader in the development of Density Functional Theory (DFT), which has changed the role of theoretical chemistry by making accurate calculations on large molecules possible for the first time. DFT permits the accurate calculation of bond energies, molecular structures, transition states and reaction paths, and its

implications for understanding catalytic processes – and predicting new catalysts, particularly for reactions conducted in homogeneous solution with organometallic catalysts – are immense. During the past decade, he has conducted an extensive investigation into single-site olefin polymerization catalysts with NOVA Chemicals. His software package for the theoretical study of structure and reactions is now used by more than 300 academic and industrial research centers worldwide; he is one of the top 1% of chemists quoted in the world's chemical literature.

Tom graduated with a B.Sc. in chemistry from the University of Copenhagen, Denmark, and then received an M.Sc. in theoretical chemistry, University of Copenhagen, followed by a PhD in inorganic/theoretical chemistry, from the University of Calgary, AB. Tom had postdoctoral fellowships at the Free University in Amsterdam and McMaster University in Hamilton, ON. He was an NSERC University Research Fellow at the University of Calgary from 1981 to 1986, and then became an assistant professor, and has been a full professor since 1993. Tom is a Fellow of the Royal Society of Canada, the Royal Danish Academy of Sciences and Letters, has received two national awards from the Canadian Society for Chemistry, and has been welcomed as a visiting professor in Japan, Switzerland, and the Netherlands. He is a member of the chemistry department of the University of Calgary.

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**2001** **Marten Ternan**, FCIC, was the winner of the 2001 Canadian Catalysis Lectureship Award. Dr. Ternan spoke at 20 locations on “Fuel cell performance as a function of feedstock: hydrogen, methanol, or fossil fuels.” The talk addressed climate change, urban smog, acid rain, and loss of species which are environmental phenomena whose effects are known to be negative. One of the reasons hydrogen fuel cells have become popular, is the perception that they could have a minimum impact on the environment. In principle hydrogen for fuel cells can be manufactured by water electrolysis using either solar or wind energy. In practice it is less expensive to manufacture either hydrogen or methanol from fossil fuels than by any other route. A comparison of the three feedstocks, hydrogen, methanol, and fossil fuels indicates that there are substantial theoretical advantages for using fossil fuels directly as a fuel cell feedstock. Life cycle calculations show that fuel cell systems operating directly on fossil fuels are more efficient and that they emit less carbon dioxide to the atmosphere than the other systems. The reason that fossil fuel feedstocks are not currently used in low temperature fuel cells is that their performance is generally an order of magnitude worse than that of a fuel cell operating on hydrogen. Experimental fuel cell data using the three different feedstocks will be compared. Emphasis was placed on fossil fuel fed fuel cells. The phenomena discussed included: the diffusion of gaseous reactants (hydrocarbons, air), the structure of the porous electrodes, formation of protons and their diffusion through the electrolyte, the pressure profile through the cell, and the net flow of oxygen atoms. Of particular interest are the conventional platinum electrocatalyst and the potential of alternative electrocatalysts. Phenomena at the catalytic surfaces of the oxygen cathode and the hydrocarbon anode were discussed.

Ternan has contributed extensively to the catalytic processing of hydrocarbons. One of Ternan's principal research interests is low temperature fuel cell technology using hydrocarbons directly for an electrochemical reaction, without any conversion to hydrogen. Methylcracking petroleum residue is another of his interests. His Canadian Catalysis Lecture will present an overview of direct hydrocarbon fuel cells, and compare their great potential and advantages with the poor performance that they have often achieved. He is currently working with a team at the University of Ottawa (Bourgault, Conway, and Psfogiannakis) on modeling direct hydrocarbon fuel cells using computational fluid dynamics.

Ternan has degrees in chemical engineering from the University of British Columbia and McGill University. He has worked for a number of organizations (Imperial Oil, INCO, the federal government's CANMET laboratories, H-Power) on a variety of projects, such as process design, pilot plant operation, fossil fuel conversion, environmental catalysis, ammonia reactions in chemical heat pumps, and hydrogen synthesis for fuel cells.

Ternan has also held part-time appointments at the University of Ottawa (adjunct professor) and at Université du Québec (professeur associé). He has 7 patents and 62 publications. Ternan has been given the Catalysis Award from the Canadian Catalysis Foundation and the ERCO Award (now the Syncrude Award) from the Canadian Society for Chemical Engineering. He has been active at the local and national levels of the Catalysis Division of the Chemical Institute of Canada and the Canadian Society for Chemical Engineering. In 2001, Ternan was the co-chair of the 17<sup>th</sup> Meeting of the North American Catalysis Society, held in Toronto.

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**2002** The 2002 Canadian Catalysis Lectureship award winner was Dr. **Warren E. Piers**, S. Robert Blair Professor of Polymerization Catalysis, Department of Chemistry, University of Calgary. Warren Piers is a synthetic organometallic chemist, whose research interests include the development of new olefin polymerization catalysts and co-catalysts, and the development of new catalytic processes using early transition metal organometallic compounds - in this latter area, methods for chiral synthesis using new borane-based catalysts are being investigated. Much of his work is theoretically highly significant, and it has broad implications for Lewis catalyzed reactions in general. His work has aroused great interest in industry (particularly the polymer industry), and among organic chemists as well as pharmaceutical, agricultural, and materials scientists.

Dr. Piers was named to the S. Robert Blair Chair in Polymerization Catalysis and Polymer Synthesis at the University of Calgary in 2000. This chair was established with support from Nova Chemicals. In 2001, Dr. Piers received an E.W.R. Steacie Memorial Fellowship from NSERC. A Steacie Fellowship is the most prestigious award NSERC makes to outstanding young scientists, and Dr. Piers was the only chemist so honoured in 2001.

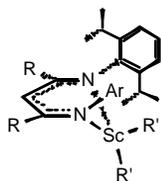
He was also named as the winner of the 2001 Rutherford Memorial Medal for Chemistry from the Royal Society of Canada. This award is named in memory of Lord Rutherford of Nelson, an outstanding scientist who spent some of his early years

in Canada. The fact that only one such award is given in Canada each year, and scientists in any area of Chemistry are eligible, highlights once again the outstanding quality of his research, and the national (indeed international) reputation that his work has achieved.

Dr. Piers obtained his Ph.D. from the University of British Columbia in 1988, and then spent a post-doctoral period at Cal Tech working with John Bercaw. He was a faculty member at the University of Guelph before joining the University of Calgary in 1995. Dr. Piers is currently a member of the Editorial Advisory Board of both the ACS journal *Organometallics* and the Canadian Journal of Chemistry.

His presentation topic was "Cationic Organoscandium and Organoyttrium Olefin Polymerization Catalysts." Single site olefin polymerization catalysts based on well-defined organometallic compounds are revolutionizing the polyolefins industry. While most of the commercially important catalysts are based on group 4 metals such as titanium and zirconium, catalysts based on other metals are growing in prominence.

For several years, we have been interested in group 3 metal-based catalysts. While the organometallic chemistry of scandium and yttrium has been dominated by the *bis*-cyclopentadienyl ligand set, this ancillary suite has limitations with respect to polymerization catalyst development, in that cationic alkyls are not accessible. The talk discussed these limitations, introduced general challenges in organogroup 3 chemistry, and presented catalyst design strategies for overcoming these challenges. The evolution of a new family of highly active cationic organoscandium catalysts stabilized by bulky beta-diketiminato ("nacnac") ligands was described. This versatile ligand system displays features that minimize commonly encountered problems with group 3 and lanthanide organometallic compounds. The chemistry of this family of organoscandium compounds relevant to olefin polymerization processes was discussed, along with new developments in the further evolution of "nacnac" ligand design and extension to organoyttrium catalysts, which have more commercial potential.



Professor Piers presented his talks at UPEI, Mt. Allison, Acadia University, Dalhousie University, University of Victoria, University of British Columbia, Simon Fraser University and The King's University College, Edmonton.

## 2003

The winner of the 2003 Canadian Catalysis Lectureship Award was Professor **Charles A. (Chuck) Mims** of the University of Toronto. Professor Mims has contributed significantly on the use of isotopic labelling for the investigation of reaction mechanisms of catalytic reactions. This work is of interest to many researchers in the field of catalysis. Fundamental understanding of reaction mechanisms will lead to improved catalyst selection for process development. Chuck also contributes to the activities of the Catalysis Division of the CIC and the North American Catalysis Society. His recent book, "Introduction to Chemical Reaction Engineering and Kinetics" co-authored by RW. Misen, CA Mims and B.A. Saville,

published by John Wiley and Sons in 1999, is a very useful textbook in the area of reaction engineering and mechanisms of reactions.

Since receiving his PhD from Berkeley in 1972, Dr. Mims worked for Exxon Research & Engineering and at Massachusetts Institute of Technology before joining the University of Toronto in 1990 as Professor, Chemical Engineering and Applied Chemistry. He is also Director, Surface Interfaces Ontario. His research addresses the fundamental properties of catalytic and electrocatalytic materials in energy conversion applications. These include natural gas and coal conversion, membrane catalysis, oxide fuel cell electrodes and oxygen activation. Professor Mims has contributed to dynamic isotope tracing of important catalytic reactions for approximately fifteen years. This procedure allows an inventory of surface intermediates involved in catalytic reactions to be measured without disturbing the reaction steady state. This method was applied to the Fischer-Tropsch reaction and to ethylene epoxidation. Professor Mims has also applied in-situ surface science spectroscopy to surface redox processes and isotope exchange-depth profiling to studies of oxygen activation and mobility in complex oxides.

Professor Mims is Chair, Catalysis Division of the CIC, a member of the Canadian Catalysis Foundation Board of Directors, and on the Editorial Board of Journal of Molecular Catalysis and Applied Catalysis A.

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**2004** The winner of the 2004 Canadian Catalysis Lectureship Award was Professor **Phillip Jessop** of Queen's University, and is the holder of an NSERC Canada Research Chair in Green Chemistry. He received his B.Sc. in Chemistry from the University of Waterloo and Ph.D. from the University of British Columbia, where he studied the synthesis and reactivity of phosphine ruthenium complexes under the direction of Dr. Brian James. Dr. Jessop carried out postdoctoral research at the University of Toronto with Dr. Robert Morris before taking a position in the Research Development Corporation of Japan in a project headed by 2001 Nobel Prize winner, Professor Ryoji Noyori, investigating hydrogenation in supercritical CO<sub>2</sub>. From 1996 to 2003 he served as an Assistant Professor at the University of California-Davis, and in 2003 he took up his current position at Queen's University. His research interests include homogeneous catalysis in unusual solvents (supercritical fluids, ionic liquids, and gas-expanded liquids) and the catalytic conversion of CO<sub>2</sub> to useful products.

Dr. Jessop has published over 50 papers and book chapters, including papers focused on novel aspects of homogeneous catalysis in neoteric solvents. In addition, he is an inventor on five patents, has organized conference symposia on green chemistry, and co-edited a book entitled "Chemical Synthesis using Supercritical Fluids".

Dr. Jessop gave a seminar on "The Utility of Carbon Dioxide in Homogeneous Catalysis" at the Universities of Saskatchewan, Alberta, Calgary, New Brunswick, Prince Edward Island, St. Mary's, Dalhousie, Western Ontario and Toronto during early 2005. While CO<sub>2</sub> fixation is obviously of great interest as a reagent, CO<sub>2</sub> has increasing utility even in reactions which do not result in its fixation. The talk

described studies of homogeneous catalysis in which CO<sub>2</sub> serves as a reagent, a solvent, an accelerant, a trigger for catalyst changes or a trigger for switchable solvents.

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**2005** Dr. **Peter D. Clark** was the 2005 winner of the Canadian Catalysis Lectureship Award. He holds the appointments of Professor in the Department of Chemistry at University of Calgary and Technical Manager of Alberta Sulphur Research Ltd. (ASRL). The research interests of Dr. Clark focus on the recovery of sulphur from fossil fuels and the chemistry relating to the use of sulphur in industry. He has contributed to the understanding of the mechanism and kinetics of the Claus reaction and demonstrated that sulphur is formed over alumina through a series of reactions involving sulphite, thiosulphate and polythionates. Research at ASRL showed that formation of sulphur from polythionates resulted in regeneration of thiosulphate, which is the actual reactive intermediate. This work also provided evidence that sulphate is part of the catalytic cycle leading to sulphur, rather than acting as a poison as previously thought. These studies have led to the investigation of short contact time catalytic oxidation of H<sub>2</sub>S to simplify sulphur recovery technology. Dr. Clark has also studied natural and synthetic clay catalysts for the synthesis of organosulphur compounds and for the removal of sulphur from petroleum and its products. Recent work investigated partial oxidation of ethane, propane and butane in the presence of hydrogen sulphide as a means improving industrial scale olefin manufacture and limiting emissions associated with conventional steam cracking methods. Dr. Clark received his B.Sc. and Ph.D. from the University of Hull, United Kingdom. Dr. Clark has over 120 publications in refereed journals and 130 reports prepared for government and industrial clients.

The title of Dr. Clark's lecture during his tour across Canada was "Investigations into the Catalysis of Sulfur Recovery by the Claus Process: Opening the Door to New Technology for the Canadian Refining and Petrochemical Industry".

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### **The Cross-Canada Lecture Tour**

The directors of the CCF recognized the necessary interaction of the Canadian catalysis community with the other members of the international community. To help foster such interactions the CCF has established and sponsors a biennial tour in which an internationally prominent catalysis worker lectures at several sites across Canada.

The tour is sponsored by the Canadian Catalysis Foundation. The intent of this award is to choose a speaker to present lectures at 4-6 locations across Canada. The speaker will be someone active in the field of catalysis, who is recognized as a leader in the field, without regard for nationality or location at which the research was carried out. The selection of the speaker is made by a committee appointed by The Catalysis Division. The tour will be held every two years, in alternate years to the Burwell Lectureship.

**Table 12. Holders of the Cross-Canada Lecture Tour**

1993	Mark Barteau, University of Delaware
1994	Lanny D. Schmidt, University of Minnesota
1996	Mark Davis, California Institute of Technology
1998	Leo E. Manzer, DuPont de Nemours, Delaware
2000	Robert J. (Bob) Farrauto, Englehard, New Jersey
2002	Harold Kung, Northwestern University
2004	James Dumesic, University of Wisconsin-Madison

### **Canadian Catalysis Foundation Cross-Canada Lectureship Holders**

The inaugural award (1993) was made to Professor **Mark Barteau**, Professor of Chemistry and Chemical Engineering and Director of the Center for Catalytic Science and technology, University of Delaware. Professor Barteau spoke in Québec City, Montréal, Ottawa, Toronto, Calgary, and Vancouver. A one-day symposium was held on the occasion of his visit to Ottawa. Professor Barteau gave an enlightening account of his work on the characters and applications of surface science, and their relationship to investigations of surfaces and species thereon for catalysts and catalyst deactivation phenomena.

The second award (1994) was made to Professor **Lanny D. Schmidt**, of the Department of Chemical Engineering and Materials Science, University of Minnesota. Professor Schmidt spoke on “Partial Oxidation of Alkanes on Pt and Rh at Millisecond Contact Times”. Lectures were presented in Ottawa, Québec City, Calgary, Edmonton, and Vancouver. In the lecture Professor Schmidt described his innovative work on the conversion of methane and ethane to synthesis gas by partial oxidation using metal catalysts. The lectures discussed kinetics, the role of surfaces, and several practical aspects of performing such experiments in the laboratory. The design of practical reactors, and potential impacts on applications to existing industrial processes, were emphasized.

**Mark Davis**, Warren and Katherine Schlinger Professor of Chemical Engineering at the California Institute of Technology held the 1996 award. His talk on “Zeolite Catalysis: Past Present, Future” covered a range of applications: He showed that zeolites have found widespread use as catalysts and their applications to environmentally friendly, selective conversions continue to burgeon. Active sites in zeolites can be due to framework constituents or from occluded matter. A transition is occurring, from traditional zeolite catalysts involving framework acid sites and occluded metal particles to framework redox centers and occluded metal oxide clusters. The implications from these changes were discussed. Future directions for both catalytic applications and materials compositions were enumerated.

The 1998 award was made to **Leo E. Manzer**, DuPont de Nemours. The title of Dr. Manzer’s address was “Environmental Catalysis: Challenging New Opportunities.” In the abstract he expressed his concern over the environment, which is becoming a major issue for all responsible citizens. Dr Manzer stressed that cleaning up past problems and developing green processes for the future present exciting new opportunities for catalytic science and technology. This talk gave some specific examples from DuPont to show how catalysis can address many environmental problems. The examples included: (1) development of a new catalyst for

phosgene production that essentially eliminates byproducts by increasing the yield to 99.99%; (2) a novel inductively-heated reactor for destruction of waste from a paraxylene oxidation plant; (3) a new electrochemical process for production of anhydrous HCl; and (4) process improvements for selective catalytic oxidations.

In 2000, the award was made to Dr. **Robert J. (Bob) Farrauto**, Englehard, New Jersey. Dr. Farrauto is a Research Fellow at the Corporate Research Laboratories of Engelhard in Iselin, New Jersey, USA. He presented his lectures in Edmonton, Vancouver, Calgary, Waterloo, Toronto, Quebec City, and Ottawa. He has worked extensively in the development of catalysts for the environmental, chemical and petroleum industries. His major responsibilities have included the development of advanced automobile emission control catalysts for passenger cars. He was technical leader of the Engelhard team that developed diesel oxidation catalysts now commercialized in the U.S. and Europe for trucks and passenger cars. Currently he is engaged in developing new technologies for bonding homogeneous catalysts to support the production of bulk and pharmaceutical chemicals. He is also managing a research team investigating hydrogen production for fuel cells to be used for stationary and vehicular applications. Dr. Farrauto has co-authored a book entitled "Catalytic Air Pollution Control: Commercial Technology" published in 1995 by Van Nostrand Reinhold, NY and is the co-author of a second book entitled "Fundamentals of Industrial Catalytic Processes" published by Chapman and Hall, London, 1997. In 1995 he received an outstanding teaching award from the New Jersey Institute of Technology where he is an Adjunct Professor of Chemical Engineering and teaches graduate courses in industrial catalysis.

Professor **Harold Kung** was the recipient of the 2002 Cross-Canada Lecture Award. He is a professor at the Department of Chemical Engineering, Northwestern University and also the Editor of Applied Catalysis A. He is a world recognized expert in the area of selective oxidation of light alkanes and NO<sub>x</sub> reduction in an oxidizing atmosphere, and has contributed significantly in the area of supported Au catalysis and hydrocarbon cracking over acidic zeolites. In each of these areas, he has advanced the fundamental understanding of the nature of the active sites and the reaction mechanisms which provide very valuable information for designing better catalysts and processes. His work also has been recognized by his peers with the 1991 Paul H. Emmett Award, the 1999 Robert L. Burwell Jr. Lecturership of the North American Catalysis Society, and the 1999 Herman Pines award of the Chicago Catalysis Club. He gave lectures in Ottawa, Toronto, Waterloo, and other Canadian universities.

Professor **James Dumesic** was the winner of the 2004 Cross-Canada Lecture Award. Dr. Dumesic is the Steenbock Professor of Chemical Engineering at the University of Wisconsin in Madison. He is well known for his leading-edge work in kinetic modeling of heterogeneous catalyzed reactions and is considered one of the worldwide leaders in this field. Dumesic is the author of more than 270 publications in the field of catalysis. He is the recipient of the Colburn Award - AIChE, the Emmett Award - North American Catalysis Society, and the Wilhelm Award - AIChE. He received the Parravano Award from the Michigan Catalysis Society, the Byron Bird Award for Excellence in Research at the University of Wisconsin, the Herman Pines Award from the Chicago Catalysis Club, and he was recognized in the Scientific American Top 50 Technology Leaders of 2003. He was elected to the National Academy of Engineering in 1998. Dr. Dumesic received a B.S. in Chemical Engineering from the University of Wisconsin and a Ph.D. from Stanford University.

Dr. Dumesic and his group have illustrated how microkinetic analysis can be applied to a test problem with excellent predictive results. His textbook on microkinetics has become a classic and is widely considered the definitive reference on microkinetic modeling. Dumesic has

led the whole field of catalysis to many successes. Most notably, he developed microcalorimetry methods which led to new depths of understanding of many catalytic reaction mechanisms, developed a chemical process that uses metal catalysts to generate hydrogen from sugar and other carbohydrates. An inexpensive nickel-tin combination catalyst is used that generates hydrogen at least as well as platinum in their process. Nickel-only catalysts generate polluting methane along with hydrogen, but the addition of tin staves off methane formation. He has shown that polyoxometalate (POM) compounds can be used to oxidize CO in liquid water at room temperature over gold catalysts. The compound not only removes CO from gas streams for fuel cells, but also converts the energy content of CO into a liquid that subsequently can be used to power a fuel cell. This process can be used for producing electrical energy from renewable biomass-derived oxygenated hydrocarbons, because these fuels generate H<sub>2</sub> and CO in nearly equal amounts during catalytic decomposition.

Dr. Dumesic visited the University of Toronto, CANMET Energy Technology Centre - Ottawa, Queen's University and the University of Calgary in March and April of 2005.

# **Appendix 1**

**Executives**  
**of**  
**The Catalysis Division**  
**of**  
**The Chemical Institute of Canada**

**Executives of The Catalysis Division of The Chemical Institute of Canada - (Page 1)**

<b>Year</b>	<b>Chairman</b>	<b>Vice-Chairman</b>	<b>Secretary-Treasurer</b>	<b>Representatives, International Congress on Catalysis</b>	<b>Director, The Catalysis Society</b>	<b>Representative, Chemistry in Canada</b>	<b>CIC Councilor</b>	<b>Members at Large</b>
1971-72	R.B. Anderson	E.L. Tollefson	J.R. Boocock	R.J. Cvetanovic	R.J. Cvetanovic			B.E. Conway I.G. Dalla Lana N.J. Gaspar K.E. Hayes S. Kaliaguine D.M. Ruthven
1972-73	E.L. Tollefson	C.H. Amberg	J.R. Boocock	C.H. Amberg R.J. Cvetanovic	H.W. Habgood	B.E. Conway	R.J. Cvetanovic	I.G. Dalla Lana O.M. Fuller N.J. Gaspar K.E. Hayes S. Kaliaguine P.L. Silveston
1973-74	C.H. Amberg	S. Kaliaguine	J.R. Boocock	R.B. Anderson H.W. Habgood	H.W. Habgood	B.E. Conway	R.J. Cvetanovic	Y. Amenomiya I.G. Dalla Lana O.M. Fuller K.E. Hayes A. Lawson P.L. Silveston
1974-75	S. Kaliaguine	J.R. Boocock	I.G. Dalla Lana	R.B. Anderson H.W. Habgood	H.W. Habgood	B.E. Conway	E.L. Tollefson	Y. Amenomiya O.M. Fuller A. Lawson B.I. Parsons D.M. Ruthven P.L. Silveston

**Executives of The Catalysis Division of The Chemical Institute of Canada - (Page 2)**

<b>Year</b>	<b>Chairman</b>	<b>Vice-Chairman</b>	<b>Secretary-Treasurer</b>	<b>Representatives, International Congress on Catalysis</b>	<b>Director, The Catalysis Society</b>	<b>Representative, Chemistry in Canada</b>	<b>CIC Councilor</b>	<b>Members at Large</b>
1975-76	J.R. Boocock	I.G. Dalla Lana	Y. Amenomiya	R.B. Anderson H.W. Habgood	H.W. Habgood	B.E. Conway	E.L. Tollefson	R.R. Hudgins A. Lawson P. Norton B.I. Parsons D.M. Ruthven F.R. Smith
1976-77	I.G. Dalla Lana	A. Lawson	Y. Amenomiya	R.B. Anderson H.W. Habgood	C.H. Amberg	B.E. Conway	E.L. Tollefson	E. Chornet R.R. Hudgins B.I. Parsons R.A. Ross D.M. Ruthven F.R. Smith
1977-78	A. Lawson	Y. Amenomiya	M. Ternan	R.B. Anderson H.W. Habgood	C.H. Amberg	S.E. Wanke	J.R. Boocock	E. Chornet P.C. Flynn R.R. Hudgins R.A. Ross N.H. Sagert F.R. Smith
1978-79	Y. Amenomiya	B.W. Wojciechowski	M. Ternan	R.B. Anderson H.W. Habgood	C.H. Amberg	S.E. Wanke	J.R. Boocock	E. Chornet P.C. Flynn K.E. Hayes A.E. Pope R.A. Ross N.H. Sagert

**Executives of The Catalysis Division of The Chemical Institute of Canada - (Page 3)**

<b>Year</b>	<b>Chairman</b>	<b>Vice-Chairman</b>	<b>Secretary-Treasurer</b>	<b>Representatives, International Congress on Catalysis</b>	<b>Director, The Catalysis Society</b>	<b>Representative, Chemistry in Canada</b>	<b>CIC Councilor</b>	<b>Members at Large</b>
1979-80	B.W. Wojciechowski	R.A. Ross	M. Ternan	R.B. Anderson Y. Amenomiya	C.H. Amberg	S.E. Wanke	J.R. Boocock	P.C. Flynn K.E. Hayes M.J. Phillips A.E. Pope N.H. Sagert F.R. Smith
1980-81	R.A. Ross	M. Ternan	J.B. Moffat	R.B. Anderson Y. Amenomiya	I.G. Dalla Lana	S. Kaliaguine	A. Harrison	K.E. Hayes B.R. James M.J. Phillips A.E. Pope F.R. Smith S.E. Wanke
1981-82	M. Ternan	E. Chornet	J.B. Moffat	Y. Amenomiya B.W. Wojciechowski	I.G. Dalla Lana	S. Kaliaguine	R.A. Ross	O.M. Fuller B.R. James M.J. Phillips A.R. Sanger F.R. Smith S.E. Wanke
1982-83	E. Chornet	M.J. Phillips	J.B. Moffat	Y. Amenomiya B.W. Wojciechowski	I.G. Dalla Lana	S. Kaliaguine	R.A. Ross	R.B. Anderson O.M. Fuller Z.M. George B.R. James R.F. Mann A.R. Sanger S.E. Wanke

**Executives of The Catalysis Division of The Chemical Institute of Canada - (Page 4)**

<b>Year</b>	<b>Chairman</b>	<b>Vice-Chair</b>	<b>Secretary-Treasurer</b>	<b>Representatives, International Congress on Catalysis</b>	<b>Director, The Catalysis Society</b>	<b>Division Councilor</b>	<b>Members at Large</b>	<b>Canadian Chemical News</b>	
1983-84	M.J. Phillips	J.B. Moffat	J.F. Kriz	Y. Amenomiya B.W. Wojciechowski	I.G. Dalla Lana	R.A. Ross	R.B. Anderson O.M. Fuller Z.M. George B.R. James R.F. Mann J.H. Rolston A.R. Sanger	S. Kaliaguine	
1984-86	J.B. Moffat	B.R. James	J.F. Kriz	Y. Amenomiya B.W. Wojciechowski	I.G. Dalla Lana	K.A.R. Mitchell	N.N. Bakhshi J. Feimer Z.M. George D.E. Laycock R.F. Mann J.H. Rolston A.R. Sanger	S. Kaliaguine	
<b>Year</b>	<b>Chairman</b>	<b>Vice-Chair</b>	<b>Secretary-Treasurer</b>	<b>Representatives, International Congress on Catalysis</b>	<b>Director, The Catalysis Society</b>	<b>Representative, CSC Board</b>	<b>Representative, CSChE Board</b>	<b>Members at Large</b>	<b>Canadian Chemical News</b>
1986-88	J.F. Kriz	A.R. Sanger	D.E. Laycock	Y. Amenomiya B.W. Wojciechowski	A.R. Sanger	K.A.R. Mitchell	S. Kaliaguine	N.N. Bakhshi J.R. Brown J. Feimer J.H. Rolston E.C. Sanford	S. Kaliaguine
1988-90	A.R. Sanger	D.E. Laycock	M. Goddard	M. Ternan B.W. Wojciechowski	D.E. Laycock	J.B. Moffat	S. Kaliaguine	P.M. Boorman J.R. Brown M. Goddard A. Krzywicki J.H. Rolston E.C. Sanford	S. Kaliaguine

**Executives of The Catalysis Division of The Chemical Institute of Canada - (Page 5)**

<b>Year</b>	<b>Chairman</b>	<b>Vice-Chair</b>	<b>Secretary-Treasurer</b>	<b>Representatives, International Congress on Catalysis</b>	<b>Director, The Catalysis Society</b>	<b>Representative, CSC Board</b>	<b>Representative, CSCChE Board</b>	<b>Members at Large</b>	<b>Canadian Chemical News</b>
1990-92	D.E. Laycock	M. Goddard	E.C. Sanford	M. Ternan B.W. Wojciechowski	M. Goddard	J. Davies	V. Galatone	P.M. Boorman J.R. Brown A. Krzywicki A. Sayari K.J. Smith	D. Laycock <sup>1</sup>
1992-94	M. Goddard	E.C. Sanford	M.F. Wilson	M. Ternan B.W. Wojciechowski	E.C. Sanford	J. Davies	V. Galatone	U. Achia J.R. Brown A. Krzywicki R.A. McFarlane J. Monnier A. Sayari	K.J. Smith <sup>1</sup>
1994-96	E.C. Sanford	M.F. Wilson	K.J. Smith	J.B. Moffat B.W. Wojciechowski	M.F. Wilson	A.L. Arduini	M. Goddard	J.R. Brown A. Krzywicki R.A. McFarlane C.A. Mims J. Monnier G. Norval	A. Sayari <sup>1</sup>
1996-98	M.F. Wilson	K.J. Smith	G. Norval	J.B. Moffat B.W. Wojciechowski	K.J. Smith	K. Griffiths	J. Lundy	R. Kydd A.L. Arduini R.A. McFarlane J. Monnier C.A. Mims	A. Sayari <sup>1</sup> J. Monnier <sup>1</sup>

**Executives of The Catalysis Division of The Chemical Institute of Canada - (Page 6)**

<b>Year</b>	<b>Chairman</b>	<b>Vice-Chair</b>	<b>Secretary-Treasurer</b>	<b>Representatives, International Congress on Catalysis<sup>2</sup></b>	<b>Director, The North American Catalysis Society</b>	<b>Representative, CSC Board</b>	<b>Representative, CSCChE Board</b>	<b>Members at Large</b>	<b>Canadian Chemical News</b>
1998-2000	K.J. Smith	G. Norval	A. Sayari	J.B. Moffat B.W. Wojciechowski	G. Norval	K. Griffiths	J. Lundy	R. Kydd F.T.T. Ng C. Fairbridge A.J. Dalai C.A. Mims	J. Monnier <sup>1,3</sup>
2000-02	G. Norval	C.A. Mims	J. Monnier	J.B. Moffat B.W. Wojciechowski	C. Mims	C. Crudden	J. Lundy	R. Kydd F.T.T. Ng C. Fairbridge K.T. Chuang B. McGarvey	A.K. Dalai <sup>1,3</sup>
2002-04	C.A. Mims	J. Monnier	M. Poirier	K.J. Smith B.W. Wojciechowski	J. Monnier	C. Crudden	J. Lundy	K.T. Chuang C. Fairbridge B. McGarvey F.T.T. Ng J.Kirchnerova B. Peppley	A.K. Dalai <sup>1,3</sup>
2004-06	J. Monnier	B. McGarvey	F.T.T. Ng	<i>Representatives to IACS:</i> J. Monnier F.T.T. Ng	J. Monnier	C. Crudden	J. Lundy	K.T. Chuang J.Kirchnerova F. Larachi J. Hill B. Peppley R. Ranganathan	A.K. Dalai <sup>1,3</sup>

<sup>1</sup> Also Editor, Catalysis Division Newsletter.

<sup>2</sup> International Association of Catalysis Societies (IACS) since 1996

<sup>3</sup> Since 1998, Allan Palmer, Associate Editor of the Catalysis Division Newsletter, prepared the *Bulletin de la Division de Catalyse* (French version)

## **Appendix 2**

**Constitution and By-Laws**  
**of**  
**The Catalysis Division**  
**of**  
**The Chemical Institute of Canada**

## DIVISION OF CATALYSIS

### CONSTITUTION

(Contains amendments approved at three annual general business meetings: August 20, 1979 in Ottawa; October 6, 1981 in Montréal; and June 27, 1988 in Calgary)

#### **Article I - Name**

The name of this Division is “The Catalysis Division”, hereinafter called the “Division”.

#### **Article II - Object**

The object of the Division is the advancement of the knowledge and application of both heterogeneous and homogeneous chemical catalysis in Canada by encouragement of appropriate research and development in science and engineering. This object shall be carried out in accordance with the objectives of the two constituent societies of The Chemical Institute of Canada (hereinafter called The Institute), the Canadian Society for Chemistry and the Canadian Society for Chemical Engineering (hereinafter called the Societies).

#### **Article III - Terms of Reference**

The functions of the Division shall include, among others, the following:

- a) To arrange through its Executive Committee, meetings of the Division at the time of the annual conferences of either or each of the Societies, and at other times as shall be decided.
- b) To maintain liaison with The Catalysis Society [of North America] and, subject to an agreement with The Catalysis Society, to elect one of its members as a representative to the Board of The Catalysis Society.
- c) Through the Executive Committee to make recommendations for Canadian representative(s) to the International Congress on Catalysis.
- d) Subject to the approval of the Board of Directors of the Society(ies) to undertake any other activities that its Executive Committee consider to be consistent with the objects of the Division. If a conflict of administration associated with the two Societies arises, such conflict shall be resolved at a meeting of the Society Councilors of The Institute.

#### **Article IV - Membership**

The membership of the Division shall consist of all members of The Institute, who have duly signified their interest in the Division. **(Membership in another Division of The Institute shall be no bar to membership in the Division.)**

### BY-LAWS

#### **Article I - Preamble**

##### ***Section I - Restrictions***

The Division is constituted under the By-Laws of the Societies, and no portion of the Constitution or By-Laws of the Division may be interpreted or applied in any way contrary to the Charter of By-Laws of the Societies.

## **Article II - Officers and Executive Committee**

### ***Section I - Officers***

The Officers of the Division shall be elected from the members of the Division and shall consist of Chairperson, Vice-Chairperson, Secretary-Treasurer, and the Immediate Past Chairperson.

### ***Section IA - Election and Term of Office of Officers***

- a) The Chairperson shall be elected for a two-year term at an Annual Business Meeting of the Division. The Vice-Chairperson from the preceding term is expected to offer himself for Chairperson. The outgoing Chairperson may not be elected to a second consecutive term as Chairperson but may be re-elected after the lapse of two years following the Annual Business Meeting the member ceased to be Chairperson.
- b) The Vice-Chairperson shall be elected for a two-year term at an Annual Business Meeting of the Division; he/she shall be expected to stand for election as Chairperson for the term following the Annual Business Meeting at which he/she was elected Vice-Chairperson.
- c) The Secretary-Treasurer shall be elected for a two-year term at an Annual Business Meeting of the Division: he/she shall be expected to stand for election as Vice-Chairperson for the term following the Annual Business Meeting at which he/she was elected Secretary-Treasurer.

### ***Section II - Executive Committee***

The Division will be represented on the Boards of Directors of the Societies. The officers, the two representatives to the Societies, the Division's representative on "Canadian Chemical News", the Canadian representatives to the International Congress on Catalysis and six Executive Members-at-Large shall constitute the Executive Committee of the Division.

### ***Section IIA - Election and Term of Office of Executive Committee***

- a) The election and term of office of the Officers are described in Section I-A of this article.
- b) The election and term of office of representatives to the Societies shall be as provided in the By-Laws of the Societies.
- c) The Division's Contributing Editor to "Canadian Chemical News" shall be nominated by the Chairperson of the Division with the approval of the Executive Committee. The term of the appointment, and the approval of the nomination, shall be in accord with the policy of the Editorial Board of "Canadian Chemical News".
- d) Executive members-at-large shall be elected at the Annual Business Meeting of the Division and each shall hold office for two years. Two executive members-at-large shall retire each two years.
- e) The Canadian representatives to the International Congress on Catalysis are appointed by the Executive Committee and then installed in accordance with the regulations of the International Congress on Catalysis. The nominees may already be members of the Executive Committee.
- f) The Executive Committee members shall be installed and normally take office at the Annual Business Meeting at which they are elected.

### **Article III - Duties**

#### ***Section I - The Executive Committee***

Subject to the Constitution and By-Laws of the Division, the Executive Committee shall have power to manage, operate and direct the affairs of the Division between Annual Business Meetings of the Division.

#### ***Section II - Chairperson***

The Chairperson shall preside at all meetings of the Division, and shall act as Chairperson of the Executive Committee. The Chairperson shall be a member *ex officio* of all committees of the Division.

#### ***Section III - Vice-Chairperson***

In the absence of the Chairperson, the Vice-Chairperson shall perform the functions of the Chairperson. If the Chairperson shall, for any reason, be unable to complete his term of office, the Vice-Chairperson shall serve as Chairperson for the unexpired term. The Vice-Chairperson shall be the Division's representative to the Board of The Catalysis Society [of North America].

#### ***Section IV - Immediate Past Chairperson***

In the absence of both the Chairperson and Vice-Chairperson, the Immediate Past Chairperson shall assume their duties and responsibilities. The Immediate Past Chairperson shall also be the Chairperson of the Nominating Committee.

#### ***Section V - Secretary-Treasurer***

The Secretary-Treasurer shall keep a record of the proceedings of the Annual Business Meeting of the Division and of the meetings of the Executive Committee, and of all other matters concerning the Division, and shall attend to all correspondence of the Division, and pay all bills when they have been certified as correct by another officer of the Executive Committee. The Secretary-Treasurer shall make a financial report at the Annual Business Meeting and shall issue minutes of the Annual Business Meeting within one month, sending a copy of these to the National Office of The Institute. The Secretary- Treasurer shall also report to the Executive Committee at such other times as it may require.

### **Article IV - Nominations and Elections**

#### ***Section I - Nominating Committee***

The Nominating Committee shall consist of three members including the Immediate Past Chairperson. The Nominating Committee shall prepare a slate of officers and Executive Committee members and, having ascertained their willingness to serve, shall arrange through the Secretary-Treasurer for the publication of the slate in "Canadian Chemical News" at least two months prior to the Annual Business Meeting, with an invitation for further nominations. Such further nominations shall bear the signatures of at least two members of the Division and shall be accompanied by the written consent of the nominee to serve, and shall be mailed to the Chairperson of the Nominating Committee not later than two weeks prior to the Annual Business Meeting.

#### ***Section II - Elections***

If no further nominations are received, the slate shall be presented at the Annual Business Meeting for adoption. If further nominations are received, the vote shall be by secret ballot at the Annual Business Meeting.

## **Article V - Vacancies**

Any vacancy occurring in the Executive Committee for any reason may be filled by appointment by the Executive Committee, the appointee to serve until the next Annual Business Meeting.

## **Article VI - Meetings**

### ***Section I - Annual Business Meeting***

The Annual Business Meeting of the Division shall be held at an Annual Conference of one of the Societies, or when this shall not be practical, at an appropriate technical meeting of the Division. The time between successive Annual Business Meetings shall not exceed 30 months. Ten members of the Division shall constitute a quorum for the transaction of business.

The agenda shall include provisions for:

- 1) Minutes of the preceding Annual Business Meeting.
- 2) Financial Report.
- 3) Report by Chairperson of Nominating Committee.
- 4) Election.
- 5) New Business.

### ***Section II - Meetings of the Executive Committee***

There shall be a meeting of the Executive Committee as soon as feasible after the Annual Business Meeting. The Chairperson or Vice-Chairperson and four other members of the Executive Committee shall constitute a quorum for the transaction of business.

## **Article VII - Finances**

The Division shall operate its own treasury. The budget of the Division and the most recent audited Financial Statement shall be submitted to the National Office of The Institute by December 31st, of each year. The operation of the Division shall be financed by:

- a) Revenues from meetings of the Division.
- b) Grants from the Societies.
- c) Grants and donations from other sources.

## **Article VIII - Limits of Authority**

Notwithstanding anything in the foregoing, all activities of the Division are subject to approval of the Boards of Directors of the Societies.

## **Article IX - Amendment**

Either the Constitution or the By-Laws of the Division may be amended at an Annual Business Meeting of the Division by a two-thirds affirmative vote of the members present provided a quorum is present and a notice of motion has been received by the Secretary-Treasurer at least two months in advance of such meeting. A notice of such amendment shall appear in "Canadian Chemical News" in the issue of the month prior to that in which the Annual Business Meeting is held. Such amendments shall not be effective until approved by the Boards of Directors of the Societies.

## **Article X - Dissolution**

In the event of the dissolution of the Division any funds and property remaining are to be used to further Catalysis activities in Canada. In the event that this is impractical, these will

revert to all constituent Societies in proportion to the number of division members in each society.

*June, 1988*

*January 14, 1989*

*Approved by the Board of Directors of the Canadian Society for Chemistry*

*March 5, 1989*

*Approved by the Board of Directors of the Canadian Society for Chemical Engineering*

## **Appendix 3**

### **Bylaws of The North American Catalysis Society**

# BYLAWS OF THE NORTH AMERICAN CATALYSIS SOCIETY

Version of 2 June 2003 Approved by the membership

We, the members hereof, associate ourselves for these purposes: to promote and encourage the growth and development of the science of catalysis and those scientific disciplines ancillary thereto; to organize and participate in professional meetings of scientists; to report, discuss and exchange information and viewpoints in the field of catalysis; to serve as a central exchange for the several catalysis club(s)/society(ies) (hereafter referred to as societies) concerning information on their activities; and to provide liaison with foreign catalysis societies, with the International Association of Catalysis Societies, and with other scientific organizations and individuals

## ARTICLE I

### Name

Section 1. The name of this corporation shall be: The North American Catalysis Society,(NACS).

## ARTICLE II

### Membership

Section 1. Any person from North America associated, directly or indirectly, with the fields of endeavor referred to in the purpose clause of these Bylaws, shall be eligible for full membership.

Section 2. All members of any affiliated North American catalysis society(ies) shall become individual members of the NACS in the event of an appropriate resolution of affiliation enacted by the Executive Board of similar governing body of such catalysis society(ies), as hereinafter provided.

Section 3. Any North American catalysis society(ies) in existence at the time of the adoption of these Bylaws may thereafter affiliate with the NACS by resolution of its Executive board or similar governing body.

Section 4. Any North American catalysis society(ies) founded after the adoption of these Bylaws may affiliate with the NACS by resolution of its Executive Board or similar governing body, but only after being invited to do so by the Board of Directors of the NACS.

Section 5. Nothing herein shall preclude members of any catalysis society(ies) from becoming individual members of the NACS, notwithstanding that such catalysis society(ies) may not have been invited to affiliate with the NACS.

Section 6. Persons from outside North America may indicate their interests in joining NACS as Associate Members. As Associate Members they do not have to pay dues, and they are not eligible to vote on elections and other matters pertaining to the NACS.

Section 7. The local clubs shall be entities that are separate from the NACS.

ARTICLE III  
Dues, Finances and Compensation

Section 1. Membership fees shall be paid in such amounts and for such periods as shall be determined by the Board of Directors.

Section 2. The fiscal year of the NACS shall end on December 31.

Section 3. No compensation shall be paid to any officers or directors for their services rendered to the NACS in such capacities; provided, however, that this shall not preclude such officers and directors from being reimbursed for expenses incurred by them in the conduct of their activities in such capacities, at the discretion of the Board of Directors.

ARTICLE IV  
Location

Section 1. The registered office of the NACS shall be located within the Commonwealth of Pennsylvania, at such place as shall be determined by the Board of Directors. The principal office of the NACS shall be located at such place as shall be determined by the Board of Directors without restriction as to jurisdiction.

ARTICLE V  
Officers

Section 1. The officers of the NACS shall consist of a President, Vice-President, Secretary, Treasurer and Foreign Secretary.

Section 2. No one person shall be entitled to hold the office of President and Secretary at any one time.

Section 3. Only members of the NACS shall be eligible for election to office.

ARTICLE VI  
Duties of Officers

Section 1. The President shall be the chief executive officer of the NACS and shall preside at all meetings of the membership and/or the directors; he/she shall call all meetings of the directors; he/she shall have general and active management of the business of the NACS and shall, either directly or by delegation, see that all orders and resolutions of the Board of Directors and that all duties of the officers are properly performed; he/she shall submit interim reports of the operation of the NACS to the membership as and when meetings of the

membership shall be held and to the Board of Directors at their various meetings as hereinafter provided; he/she shall appoint all committees except as herein otherwise provided, and he/she shall be an ex-officio member of all committees so appointed; he/she may delegate the performance of any of the foregoing; he/she shall execute any and all contracts and other documents in behalf of the NACS pursuant to authority delegated to him/her for such purposes by resolution duly adopted by the Board of Directors, and he/she shall perform such other duties as may be prescribed by the Board of Directors from time to time.

Section 2. The Vice-President shall perform all duties of the office of President in the latter's absence, incapacity or arbitrary refusal to act, and, when so acting, shall have all powers of and be subject to all restrictions upon the office of President. Further, he/she shall perform such other duties as may be prescribed by the Board of Directors or by the President, from time to time.

Section 3. The Secretary shall attend all meetings of the Board of Directors and of the membership and shall perform the following various duties: he/she shall maintain a list of the membership and their addresses; he/she shall record minutes of all meetings in a book to be maintained for that purpose and, when required, shall perform a similar service for all standing committees; he/she shall send to the Board of Directors and/or to the membership all notices as to the business of the NACS and as to the time, date and place of all meetings to be held of the Board of Directors and/or of the membership, respectively; he/she shall engage in, and maintain records of, all correspondence as required by the business of the NACS; he/she shall be the custodian of the corporate seal and of all books and records of the NACS, except as herein otherwise provided; he/she shall attest any and all contracts and other documents, and shall affix the corporate seal as necessary, in behalf of the NACS pursuant to authority delegated to him/her for such purposes by resolution duly adopted by the Board of Directors or by the President, from time to time. In the event of the Secretary's absence, incapacity or arbitrary refusal to act, his/her duties shall be performed by a Secretary Pro Tem appointed by the Board of Directors or by the President.

Section 4. The Treasurer shall be the custodian of all funds as well as financial books and records of the NACS and shall deposit all such funds in the name of the NACS in such depository or depositories as shall be designated by the Board of Directors; he/she shall collect and receive all fees, contributions and grants paid to the NACS; he/she shall pay all vouchers and obligations pursuant to authority duly granted to him/her by the President and Secretary or by resolution of the Board of Directors; he/she shall prepare and submit complete and accurate interim financial reports of the finances of the NACS as and when meetings may be held, as well as to the Board of Directors at any time upon request therefrom, and he/she shall perform such other duties as may be prescribed by the Board of Directors or by the President, from time to time.

Section 5. The Foreign Secretary shall attend all meetings of the Board of Directors and perform the following duties: maintain contact with other catalysis societies outside North America and maintain records of correspondence with these societies, distribute the NACS Newsletter to other catalysis societies and serve those functions of the Secretary with foreign members, serve as one of the two NACS representatives to the Council of the

International Association of Catalysis Societies, and perform such other duties as may be prescribed by the Board of Directors or by the President, from time to time.

## ARTICLE VII

### Bonds

Section 1. The Board of Directors may require any of the officers to be bonded at such times and for such amounts as it shall deem necessary.

Section 2. The Board of Directors may require the administrators (trustees) of the Keith Hall Educational Fund and any outside professional who assumes an active role in administering the proceeds of the Fund to be bonded.

## ARTICLE VIII

### Board of Directors

Section 1. The Board of Directors shall consist of members elected by the affiliated catalysis society(ies), one from each, 4 members elected from the members elected at large by the membership of the NACS, and any officers (elected by the Board) who are not already members of the Board.

Section 2. Only members of the NACS shall be eligible for election to the Board of Directors.

## ARTICLE IX

### Duties and Powers of the Board of Directors

Section 1. The property and business of the NACS shall be managed by the Board of Directors.

Section 2. In addition to the general powers of the Board of Directors existing by virtue of their office, the powers and authority expressly given by law, by the terms of the Articles of Incorporation of the NACS, and elsewhere in these Bylaws, the following specific powers are expressly conferred on the Board of Directors.

To appoint and/or remove any and all agents, servants or employees of the NACS, other than the members of the Board of Directors and the officers, and to determine their duties and salaries, as well as to delegate such powers to an officer of the NACS; to authorize the negotiating and executing of all contracts, documents and instruments appropriate for the proper operation of the NACS; to delegate any powers of the Board of Directors to any committee of Board members, not less than two (2) in number, for so long and under such terms as the Board may determine; to establish policies of the NACS and to direct the execution of the same, pursuant to the purposes of the NACS, and generally to do all lawful acts and things as are not herein otherwise delegated or directed to be done by the membership or officers of the NACS.

ARTICLE X  
Meetings of the Board of Directors

Section 1. The Board of Directors shall meet at least annually at the call of the President. In addition, the Board of Directors shall meet intermittently at such times and places as may be set by resolution duly adopted at duly convened meetings of the Board of Directors.

Section 2. Special meetings of the Board of Directors shall be called by the President and/or Secretary as and when they or either of them shall deem it necessary, or upon the signed written request of any three (3) members of the Board of Directors, the times and places of such special meetings to be determined by the officer calling the same.

Section 3. The Secretary shall send to each member of the Board of Directors, at least one (1) week's prior written notice of any special meeting and at least ten (10) days prior written notice of any annual or intermittent meeting.

Section 4. Notwithstanding Article 20, the Provisions of the ARTICLE may be amended at any regular duly convened meeting by a majority vote of the members of the Board of Directors present and voting at such meeting.

ARTICLE XI  
Meetings of the Membership

Section 1. Meetings of the membership in general shall be held at such times and places as shall be determined by the Board of Directors.

Section 2. Notices of the meetings of the membership in general shall be given to each member at least thirty (30) days in advance of the date of such meeting, provided that the payment of such member's membership fee is not then in default.

Section 3. Location of national biennial technical meetings of the NACS shall rotate around the membership clubs. For this purpose these meetings shall be operated by the local society. For these meetings the NACS shall be responsible for the selection of the meeting organizers. For this meeting, the operating local society has an "agency" (as defined by the US IRS in 2000) relationship with the NACS for the organization and operation of the meeting.

ARTICLE XII  
Notices

Section 1. Notices of all meetings of the membership and of the Board of Directors shall be mailed to each member of the NACS or of the Board of Directors, addressed to such members or directors latest addresses, as recorded in the books of the NACS.

Section 2. Attendance by a member or by a Director at any meeting shall constitute a waiver of notice of such meeting, except where attendance at such meeting is for the express purpose of objecting to the transaction of business because said meeting was allegedly

not lawfully or duly called or convened, and where such objection is made immediately following the convening of such meeting.

Section 3. Any notice may be waived in writing, signed by the person or persons entitled thereto, either before or after the time and date stated therein, and such waiver shall be entered into the minutes of the meeting held pursuant to such waiver of notice.

Section 4. Neither the business to be transacted at, nor the purpose of any membership meeting, or any annual or intermittent meeting of the Board of Directors, need be stated in any notice or waiver of notice of such meeting unless otherwise specifically required by law or by these Bylaws. Notice of any special meeting of the Board of Directors shall contain the purpose of, and a brief description of the business to be transacted by such meeting.

### ARTICLE XIII Nominations, Elections and Terms of Office

Section 1. The members of the Board of Directors to be elected by the membership at large shall be elected from a slate of not fewer than seven (7) nominees selected by the Nominations Committee, appointed by the President. Election shall be by mail ballot of the membership of the NACS. Any member of the NACS shall be added to the slate upon receipt by the President of the NACS, no more than one-half of whom shall be members of any one affiliated catalysis society(ies), provided that the petition shall be received by the President prior to the first of January of the year in which new members of the Board of Directors are to be elected. Election shall be by plurality vote. The elected at-large members of the Board of Directors will be seated at the next meeting of the Board of Directors and will be the at-large members who vote for the election of new officers.

Section 2. The one (1) member of the Board of Directors from each affiliated catalysis society(ies) shall be elected by the respective catalysis society(ies) in accordance with its internal procedures.

Section 3. Nominations for the officers shall be made at a Board meeting and elected by the Board of Directors at a meeting of such Board convened with reasonable dispatch after the election of such Board. The officers shall take office on July 1, 2001, and every four years thereafter.

Section 4. The term of office for all officers and members of the Board of Directors shall be four (4) years. All officers and members of the Board of Directors shall continue in their respective capacities until their successors are elected.

Section 5. Any vacancies in the Board of Directors or among the officers arising by reason of death or resignation, shall be filled for the unexpired term by a majority vote of the remaining members of the Board of Directors present and voting at the first meeting held after such death or resignation. In the event that the President is no longer able to serve (for reasons of death or resignation), the Vice-President shall assume his/her duties until a meeting of the Board of Directors within 2 months of the loss of the elected President. In the event that neither

the President nor the Vice President is able to serve, the Executive Committee shall elect one of its members to serve as the operating officer (by majority voting) until an emergency meeting of the Board of Directors can be convened (within 2 months of the vacancies).

Section 6. Election of officers and of members of the Board of Directors shall be by closed, written ballot, whether submitted at a meeting or by mail.

Section 7. Any member who shall have paid his/her dues shall be eligible to hold office in the NACS, whether as an officer or as a member of the Board of Directors.

#### ARTICLE XIV Quorum

Section 1. A quorum for the purpose of holding a meeting of the membership generally shall consist of such members as shall be in attendance at the time and place when such meeting is to convene.

Section 2. A quorum for the purpose of holding any meeting of the Board of Directors shall consist of a majority of all of the members of the Board, exclusive of any member who may have resigned or died. If a quorum is unavailable for any meeting of the Board of Directors, that meeting shall be adjourned to a new time and place, due notice of which shall be given to the members of the Board of Directors, in which event a quorum, for purposes of the said adjourned meeting, shall consist of such members of the Board of Directors as shall be in attendance at the time and place when such adjourned meeting is to convene.

#### ARTICLE XV Voting

Section 1. All matters to be voted upon by the general membership, other than election to the Board of Directors, shall be determined by majority vote of the members voting.

Section 2: The act of the majority of the members of the Board of Directors present at a meeting of the directors at which a quorum is present shall be the act of the Board. Members of the Board of Directors may participate in a meeting of the Board by means of conference telephone or similar communications equipment whereby all persons participating in the meeting can hear each other, and participation in a meeting in this manner shall constitute presence in person at the meeting. In the absence of a meeting by a majority of the members of the Board, resolutions can be enacted by unanimous written consent of all the members of the Board.

Section 3. Each member of the Board of Directors shall be entitled to one (1) vote in such capacity at the meeting of the Board, and each member of the NACS shall be entitled to one (1) vote in such capacity.

Section 4. Proxy voting at membership shall be permitted, provided that such proxy is executed in writing by the individual entitled to cast such vote and provided such proxy specifies the meeting at, or the duration for which, such proxy shall be effective.

Section 5. Mail balloting at membership meetings shall be permitted, provided that such mail ballot is signed by the member entitled to cast such vote. If the matter being voted upon is to be the subject of a membership meeting, such mail ballot shall be valid only if received no later than the convening of such meeting. If the matter being voted upon is the subject of a general mail ballot only, such mail ballot shall be valid only if received no later than the date specified for such purpose in the material promulgating to the membership the subject to be voted upon.

#### ARTICLE XVI Inspection of Books, Accounts and Records

Section 1. The books, accounts and records of the NACS shall be open for inspection at any time by any officer or member of the Board of Directors.

Section 2. The books, accounts and records of the NACS shall be open for inspection by any member of the NACS at such reasonable times and places as may be designated by resolution duly adopted by the Board of Directors; provided, however, that the Board of Directors shall designate a time and place for the examination of such books, accounts and records by the membership immediately prior to, during, or immediately following any membership meeting which may be held.

#### ARTICLE XVII Committees

Section 1. The President shall appoint the Nominations Committee to suggest candidates for officers of the NACS; at the time of elections of the officers, additional nominations may be received from those attending the Board meeting.

Section 2. In addition to such committees as the President may appoint pursuant to these Bylaws, the Board of Directors may establish and appoint, from time to time, such additional standing and/or special committees as it may deem appropriate.

Section 3. The Executive Committee shall be comprised of elected officers and key functional positions within the NACS. Members of the Executive Committee shall be designated by the President, but should include: the President, Vice-President, Secretary, Treasurer, Foreign Secretary, Lead Trustee of the Keith Hall Educational Fund, and the past President.

Section 4. The President may call a meeting of the Executive Committee to seek its advice.

Section 5. An Awards Committee shall be appointed by the President and led by the Vice President, for the purpose of soliciting suggestions for nominations for the professional award. This committee should be selected in a manner to avoid conflict of interests in the award process.

ARTICLE XVIII

Corporate Seal

Section 1. The Secretary shall hold the Corporate Seal

ARTICLE XIX

Amendments to Bylaws

Section 1. These Bylaws may be amended by a majority vote of the members voting either (a) in person, by proxy or by mail ballot receive at a duly convened membership meeting of the NACS, or (b) by mail ballot circulated at the instance of the Board of Directors, provided that notice of the proposed amendment shall be contained in the notice of such duly convened meeting or in such mail ballot so circulated.

ARTICLE XX

Adoption of Bylaws

Section 1. These Bylaws shall be adopted by a majority vote of the general membership as herein provided, and shall become effective immediately thereafter.

ARTICLE XXI

Procedural Requirements

Section 1. All meetings of the Board of Directors and all meetings of the membership of the NACS shall be conducted pursuant to Roberts' Rules of Order, these Bylaws, and to any additional rules adopted by such meetings not inconsistent with either of the foregoing.

ARTICLE XXII

Professional Awards

Section 1. The NACS has established a series of professional awards for distinction in catalysis. The President is responsible for the selection of a jury for each award, which shall be made up of established technologists in catalysis without having any conflicts of interest in the nominations or award process. Each jury shall be made up of at least 3 persons appointed by the President. Their decisions shall be confidential and reported only to the President, who then tallies the voting, and notifies the winner.

ARTICLE XXIII  
Keith Hall Educational Fund

Section 1. Within NACS shall be the Keith Hall Educational Fund (Fund), disbursements from only the net income of which shall be made for the support and maintenance of the tax-exempt activities of NACS, including but not limited to national lectureships, seminars and symposia, assistance for attendance at national meetings of NACS for graduate students or post-doctoral fellows, and award recognizing contributions to the furtherance of the field of catalysis. Although the Fund shall be subject to the ultimate administration of the Board of Directors of NACS, it may be administered on a day-to-day basis by “trustees,” who shall be appointed by the President of NACS for staggered 6 year terms, with the concurrence of the Executive Committee of NACS. One of these trustees shall be designated by the President as the Lead Trustee, who shall be responsible for reporting the status of the Fund on a quarterly basis to the President and to the Board on an annual basis. These trustees shall receive, hold, invest, and reinvest the assets of the Fund.

ARTICLE XXIV  
Restrictions and Interpretation.

Section 1. No part of the net earnings of NACS shall inure to the benefit of, or be distributable to, its members, directors, officers, or other private persons, except that NACS shall be authorized and empowered to pay out of pocket expenses for services rendered and to make payments and distributions in furtherance of the purposes of NACS. Approval of the President is required for such expenses, which are to be reported to the Board at its annual meeting.

Section 2. No substantial part of the activities of NACS shall be the carrying on of propaganda, or otherwise attempting to influence legislation. NACS shall be empowered to make the election provided by IRC § 501(h). NACS shall not participate in, or intervene in (including the publishing or distribution of statements) any political campaign on behalf of or in opposition to any candidate for public office.

Section 3. Notwithstanding any other provisions of these Bylaws or the Articles of Incorporation, NACS shall not carry on any activities not permitted to be carried on (i) by a corporation exempt from federal income tax under IRC § 501(a) by reason of description in IRC §501(c)(3), or (ii) by a corporation, contributions to which are deductible under IRC § 170(c)(2).

ARTICLE XXV  
Dissolution

Section 1. Upon the dissolution of NACS, the Board of Directors shall, after paying or making provisions for the payment of all of the liabilities of NACS, dispose of all of the assets of NACS exclusively for one or more of the purposes of NACS which may include

distribution to an organization or organizations organized and operated exclusively for one or more of such purposes, or shall distribute all of the assets of NACS to the federal government, or to a state or local government, for a public purpose. Any assets not so disposed of shall be disposed of by the Circuit Court of the county in which the principal office of NACS is then located, exclusively for such purposes or to such organization or organizations, as said court shall determine, which are organized and operated exclusively for one or more of the purposes of NACS.

## **Appendix 4**

### **Constitution of the International Association of Catalysis Societies**

## CONSTITUTION OF THE INTERNATIONAL ASSOCIATION OF CATALYSIS SOCIETIES

*Version adopted by the IACS Council at the 13th ICC, Paris, July 11, 2004*

WHEREAS, the International Congress on Catalysis, Inc., a corporation of Pennsylvania, USA, organised the first International Congress in Philadelphia in 1956 and participated in the planning of subsequent Congresses in Paris in 1960 and Amsterdam in 1964, with the objective of furthering the science and technology of catalysis.

AND WHEREAS, such Congresses have provided:

Means for open exchange of information and knowledge on catalysis and related science and technology;

Opportunities for scientists and engineers of participating countries to make personal contacts.

THEREFORE, in view of the continuing and growing interest in catalysis, it has been agreed to establish an international organisation to further the above objectives. The new organisation was originally called International Congress on Catalysis, but its name has been changed in 1996 to International Association of Catalysis Societies. It has further been agreed that this organization seeks continued affiliation with the International Union of Pure and Applied Chemistry (IUPAC). In order to assure regularity in all actions and perpetuity thereof, the following Constitution of the International Association of Catalysis Societies has been agreed and approved.

### Article 1. General

The name of the organisation shall be International Association of Catalysis Societies. Its objectives shall be generally to promote scientific and technological progress in the field of catalytic chemistry, and specifically to provide a forum for formal and informal discussions amongst scientists and engineers from time to time by promoting the organisation of International Congresses on Catalysis, hereafter referred to as ICC. Attendance at an ICC shall be open to all interested scientists and engineers. The operation of the International Association of Catalysis Societies shall be carried on by a Council and an Executive Committee whose purpose and method of operation are hereinafter described. The International Association of Catalysis Societies represented by its Executive Committee controls the use of its name and that of the International Congress on Catalysis.

### Article 2. Objectives of the Council

Objectives of the Council shall be:

(a) To coordinate an effective network of relationships between the main associations of catalysis world-wide and in particular:

- to coordinate and make more effective meetings on catalysis, avoiding unnecessary duplication and stimulating discussion in new areas of catalysis science
- to strengthen international relationships and scientific collaboration world-wide and as a reference organisation to stimulate funding agencies to adopt a wide perspective
- to initiate joint actions for more effective integration of research world-wide
- to be a forum for the discussion of common problems within the catalysis community
- to promote the visibility of catalysis outside the catalysis community and emphasise its relevance to society and environment
- to promote educational aspects of catalysis and to assist young researchers by the effective diffusion of knowledge and by facilitating their mobility within the catalysis community
- to create an efficient communication network by whatever means appropriate for the noncommercial distribution of information regarding meetings, appointments, and general information.

(b) To promote discussions of the science and technology of catalysis and related subjects from time to time by inviting appropriate groups in various countries to organise and hold International Congresses on Catalysis at a convenient interval of years, and also to decide upon the dates for holding these ICCs.

(c) To ensure that each ICC shall contribute its full share toward the object (b) above, and to maintain continuity, the Council looks after all matters concerning International Congresses on Catalysis.

### Article 3. Membership of the Council

(a) The Council shall be composed of duly accredited delegates of member countries or groups of countries. Each member country or member group of countries shall have two delegates. The Council decides by secret ballot on the admission of new member countries or groups of countries, and the removal of the names of countries that either no longer exist as states represented in IUPAC or no longer fulfil the conditions for admission. A minimum condition for membership is that scientists working in that country, or group of countries, have contributed several papers to recent International Congresses on Catalysis. Admission or removal of a member requires a three-fourths (3/4) majority vote of the Council. Membership of a group of countries excludes each country of that group from direct membership, unless the Council decides on a new definition of the remaining group. Before each Council meeting, the Secretary provides all Council members with a list of the countries and groups of countries that are members of the Council; this list also states explicitly which countries form part of a member group and which countries, if any, have changed their official names since the previous Council meeting. After approval by the Council, this list will be attached to the minutes of the Council meeting.

(b) Appointment of delegates will be made by a national or multinational organisation, competent in the field of catalysis. Problems concerning the appointment of delegates to the Council or the selection of the organisations that make these appointments will be submitted to IUPAC for resolution.

(c) The normal term of office of delegates shall be from the beginning of one ICC to the beginning of the next. If new appointments are made by a national or multinational organisation, competent in the field of catalysis, between two ICCs, the term of office ends with the beginning of the next IACS Council.

(d) A member should not normally serve more than two consecutive terms unless elected to the office of Vice-President.

(e) Officers of the Council shall hold office from the end of each Congress until the end of the next. If any Officer of the Council is not being appointed a delegate for a further period, the new delegate to replace him/her shall be permitted to attend the Council meeting, but without the right to vote.

(f) When a delegate is unable to attend a meeting of the Council, an alternate may serve in his/her stead. Accredited delegates unable to attend such a meeting may each nominate one leading representative of the catalysis community from their country to represent them; such nomination must be received in writing by the Secretary at least one week before the meeting, to ensure circulation of papers.

#### Article 4. Officers of the Council

The Council at each ICC shall elect by secret ballot a Vice-President, Secretary, Treasurer and a representative chosen from the delegates of the Council. The Vice-President becomes President after the next ICC. On the event of loss of both the President and Vice-President, the Executive Committee shall designate a temporary executive officer until the meeting of the next Council meeting. No more than two of these five Officers may be from the same nation. Election of Officers is by majority vote of the Council.

#### Article 5. Executive Committee

The Officers of the Council constitute the Executive Committee. The main functions of the Executive Committee are as follows:

(a) The Executive Committee cooperates with the Congress Committee organising the next ICC to ensure that the standard of scientific papers and organisation of the meeting is in line with the tradition of the ICCs.

(b) If unforeseen circumstances force a Congress Committee to relinquish its task, the Executive Committee will take the steps necessary to obtain a decision of the Council in agreement with its Objectives described in Article 2.

(c) The Executive Committee arranges to supply to the press and other news media information concerning activities of the ICC.

(d) The Executive Committee arranges for the financing of the Council and itself.

(e) The Executive Committee is authorised to appoint a Deputy Treasurer who will act in the case of an emergency or if the Treasurer is incapacitated.

#### Article 6. Officers

(a) The President of the Council, who shall also be Chairperson of the Executive Committee, shall supervise the work of the Council and its Executive Committee, preside at their meetings, and be responsible for the executions of the decisions of these bodies. He or she shall represent the Council at ICCs and between ICCs.

(b) Should the President be absent for any reason, the Vice-President shall take his/her place. Should the President become permanently incapacitated, the Vice-President shall automatically become President and fulfil the President's unexpired term. If a member of the Executive Committee other than the President is permanently incapacitated, the President, after consultation with members of the Executive Committee, will invite a Council member to join the Executive Committee.

#### Article 7. Secretary

(a) The Secretary shall function for both the Council and the Executive Committee.

(b) The Secretary shall prepare minutes of meetings of the Council and the Executive Committee and distribute these to members of the respective bodies.

(c) The Secretary receives and distributes to members of the Council petitions for admission of new countries to the Council and for changes in bylaws.

(d) The Secretary notifies scientific bodies in countries represented in the Council, at least six months before an ICC, to review and certify their representation on the Council.

(e) The Secretary conducts election for Officers of the Council, unless he/she is a candidate, in which case the President shall appoint an alternate.

#### Article 8. Treasurer

(a) The Treasurer shall receive funds required for the operation of the Council and its Executive Committee by such means as shall be devised by the Executive Committee. He/she shall hold these funds and disburse them in accordance with the actions of the Executive Committee. He/she shall prepare a financial statement for presentation at the Meeting of the Council during each ICC.

(b) The Treasurer shall advise the Congress Committee on the income from registration fees at previous Congresses and the principal costs of operating them. For this purpose the Treasurer shall maintain a file of non-confidential information on the finances of previous ICCs and hand this file over to the next Treasurer.

#### Article 9. Meetings

(a) The Council shall meet at the time of each ICC. The business of the Council will be handled, as much as possible, by correspondence. The Executive Committee may call additional meetings of the Council, between two consecutive ICCs, at major international meetings on catalysis. The quorum at such additional meetings shall be not less than four-tens (4/10) of the accredited delegates. Accredited delegates unable to attend such a meeting may each nominate one leading representative of the catalysis community from their country to represent them; such nomination must be received in writing by the Secretary at least one week before the meeting, to ensure circulation of papers. Such nominated persons will enjoy all the responsibilities and privileges of nationally accredited delegates for the purpose and duration of the additional meeting of the Council only. Actions consequent upon resolutions and decisions made at an additional meeting of Council shall be the responsibility of nationally accredited delegates.

(b) The Executive Committee shall meet at least once at the time of each ICC and at such other times as may be deemed necessary by the Executive Committee. A special meeting of the Executive Committee shall be held at the earliest convenient time following the written request of not less than two-thirds (2/3) of the countries represented in the Committee or in the Council.

(c) At each ICC, the Council shall decide on the country in which the next ICC will be held. All invitations received from accredited Council delegates on behalf of their national or multinational scientific organisations will be considered, provided that they contain a written commitment of the inviting organisation that every reasonable effort will be made to distribute extended abstracts of all papers at least one month before the ICC. In addition, the ICC shall make every effort to publish the Plenary and Award lectures presented at the ICC in an archival publication organ, the choice of which shall be approved by the Executive Committee.

(d) Any delegate of the Council or member of the Executive Committee who is unable to attend a meeting may be represented by another delegate or non-member accredited for the purpose. This representative shall have the voting rights of the absentee delegate.

(e) The majority required for any vote or ballot in the Council and Executive Committee shall be a simple majority, except where otherwise stated in the Constitution.

(f) All Proceedings at the meetings of the Council and Executive Committee shall be conducted in English.

## Article 10. Finance

(a) Normal financing of the expenses of the Council and the Executive Committee will be on the basis of a percentage of registration fees.

(b) A set proportion of 10% of the sum of all registration fees is to be turned over to the Executive Committee as a levy to support the organisation.

(c) The financial obligations of the Council and its Executive Committee shall be limited to correspondence, and when required, to providing expenses in relation to the objectives set out in Art. 2a, to providing expenses for Council Meetings whenever called, to providing secretarial help to the Secretary and assistance to the President to ensure his/her attendance at an ICC. The amount of money for secretarial and other assistance shall be determined by the Executive Committee.

(d) The expenses of the Council should as far as possible be paid from funds at the disposal of the Executive Committee. If the need for additional funds arises, the Executive Committee has the power to raise funds by any means that it thinks fit. Each year the Treasurer shall submit to the members of the Executive Committee a financial statement. He/she shall also report on finances at the meeting of the Council during each ICC, including a projection of future income and expenses.

## Article 11. Congress Committee

(a) The appropriate scientific organisation(s) of the country hosting an ICC shall appoint a committee, known as the Congress Committee, which shall be subject to approval of the Executive Committee.

(b) The Congress Committee for each ICC, although enjoying every initiative and responsibility for carrying out the work it has undertaken, shall follow the general directions given by the Executive Committee to ensure that the permanent interests and objectives of the International Association of Catalysis Societies are maintained. To this end the Congress Committee shall keep the Executive Committee informed of the work undertaken for the preparation of the ICC. The Executive Committee shall cooperate with the Congress Committee in every possible way.

(c) The Congress Committee appoints a chairperson and such other officers as are required for handling local arrangements, financing, pre-printing, and publication of plenary and award lectures, etc.

(d) The Congress Committee has complete responsibility for all matters concerned with the ICC, with respect to the conduct and financing of the ICC, the final selection of papers on the programme and matters concerned with pre-printing of extended abstracts of papers and publication of Plenary and Award lectures.

(e) The Congress Committee may obtain funds for operating its ICC by registration fees, and by other means such as sponsorship by industry or government.

(f) The Executive Committee can assist in the financial arrangements for the next Congress. Upon written request by the Congress Committee organising the next Congress, the Executive Committee can provide a loan of up to a maximum of 30% of the sum received from the fee levy of the previous Congress. No interest is paid for the part of the loan which does not exceed 10% of the sum received from the fee levy of the previous Congress. The Executive Committee, advised by the Treasurer, decides on the interest to be paid by the Congress Committee for the part of the loan exceeding this amount. The loan must be repaid within twelve months of the end of the Congress.

(g) The Congress Committee shall provide the Treasurer with a confidential statement, summarizing the finances of the ICC, within twelve months of the end of the ICC. The Treasurer will destroy this statement and any copies of it after four years or when his/her term of office has finished.

#### Article 12.

Alterations of these Articles may be proposed by a member country at any meetings of the Council, but any such proposed alterations must also be seconded by another member country and submitted to the Secretary in writing not less than three months before the date on such a meeting. The proposed alterations shall be quoted in full on the agenda for that meeting and distributed in advance to the members of the Council. Any change in the Constitution shall result from a threefourths ( $3/4$ ) majority vote of those present at a meeting of the Council. These alterations are subject to approval by IUPAC.

In case of legal disputes, the law of the country where IUPAC has its permanent office will apply.

## **Appendix 5**

### **Objectives and By-Laws of the Canadian Catalysis Foundation**

## **CANADIAN CATALYSIS FOUNDATION**

### **BY-LAW NUMBER 1**

Being a General By-Law for regulating the administrative affairs of  
CANADIAN CATALYSIS FOUNDATION

BE IT ENACTED as a by-law of the Corporation as follows:

#### **DEFINITIONS**

1. In this by-law and all other by-laws of the Corporation, unless the context otherwise specifies or requires:

(a) "Act" means the Canada Corporations Act, Revised Statutes of Canada 1970, c.C-32, as from time to time amended, and every statute that may be substituted therefor and, in the case of such amendment or substitution, any references in the by-laws of the Corporation shall be read as referring to the amended or substituted provisions therefor;

(b) "Board" shall mean the Board of Directors of the Corporation;

(c) "by-law", "by-laws" means any by-laws of the Corporation from time to time in force and effect;

(d) "Catalysis Division" means a certain organization now known as The Catalysis Division of the Chemical Institute of Canada and composed of members of the Chemical Institute of Canada and its constituent societies, the Canadian Society for Chemistry, the Canadian Society for Chemical Engineering and the Canadian Society for Chemical Technology and includes any successor organization;

(e) All terms contained in the by-laws which are defined in the Act shall have the meanings given to such terms in the Act;

(f) Words importing the singular number only shall include the plural and vice versa; words importing the masculine gender shall include the feminine and neuter genders;

(g) The headings used in the by-laws are inserted for reference purposes only and are not to be considered or taken into account in construing the terms or provisions thereof or to be deemed in any way to clarify, modify or explain the effect of any such terms or provisions.

#### **HEAD OFFICE**

2. The directors may from time to time by resolution fix the location of the head office of the Corporation within the place in Canada designated as such by the Corporation's letters patent.

#### **SEAL**

3. The seal, an impression whereof is stamped in the margin hereof, shall be the seal of the Corporation.

#### **MEMBERSHIP**

## **ADMISSION TO MEMBERSHIP**

4. **QUALIFICATION.** Any individual whose address is known to the Corporation may be admitted as a member of the Corporation.
5. **HONORARY APPOINTMENTS.** The Board of Directors may from time to time by resolution appoint one or more Honorary Patrons, Honorary Officers and Honorary Members until a successor is appointed or for a term of one or more membership years, or for life, and in the absence of specification the term of such appointment shall be for one membership year. Persons receiving any such appointment shall be Honorary Members of the Corporation during the term thereof and, unless otherwise stated in the resolution of appointment, shall be entitled to the same rights as those of ordinary members. Honorary Members may attend, without the right to vote, at any regular meeting of the Board.
6. **DIRECTORS.** All persons who after the date of this by-law are or become directors of the Corporation shall be life members of the Corporation.
7. **EX OFFICIO MEMBERS.** All persons who, after the date of the by-law, are or become members of the Executive Committee of the Catalysis Division (defined in Section 1) shall, during the time they are members of such Executive Committee, ex officio, be members of the Corporation.
8. **ADMITTED.** Other members may be admitted from time to time to membership in the Corporation by resolution of the Board. The resolution admitting a member may provide membership shall be during a period of tenure of a particular office, or to be for a period of one or more years, or for life and if no period is indicated membership shall be for a term of one year.

Each membership for a period of one or more years shall, unless otherwise declared by resolution of the Board, commence at the beginning of the next following annual membership year.

9. **ANNUAL MEMBERSHIP YEAR.** The annual membership year of the Corporation shall commence on the termination of business of an Annual Meeting of Members of the Corporation and end upon the termination of business of the next following Annual Meeting of the Corporation. Membership in the Corporation for a term of one or more years shall lapse at the end of the respective number of annual membership years next following the date of admission to membership.
10. **LAPSE ON DEATH.** The interest of a member in the Corporation is not transferable and shall lapse and cease to exist upon death.
11. **DEEMED LAPSE OF MEMBERSHIP.** Upon receiving the report of the secretary that the present address of any member is not known the Board may by resolution declare such membership to have lapsed.
12. **MEMBERSHIP REGISTER.** The secretary shall keep as accurately as may reasonably be practical a register of the names and addresses of all members of the Corporation showing the date of admission. Changes of address shall be made in the register upon the request of the member but the secretary is not otherwise required to maintain current addresses of members. The secretary shall, upon satisfying himself that the interest of a member has terminated or lapsed for any reason, delete reference to such member from the current membership lists and enter the particulars so deleted in a separate terminated membership category of the register. Particulars of terminated memberships shall be retained at least ten years after termination. The secretary shall report annually to the Board upon the state of the membership register.
13. **REINSTATEMENT OF LAPSED MEMBERSHIP.** The secretary may replace in the current membership list of the register of members of the Corporation the name of any former member

whose membership is deemed to have lapsed upon being satisfied that but for such deemed lapse the former member is entitled to be recognized as a member of the Corporation and the secretary shall do so if such former member requests in writing and appears to be entitled.

14. RESIGNATION. Any member of the Corporation may resign from membership upon notice in writing to the Corporation and upon acceptance thereof by the Board.

### **MEETINGS OF MEMBERS**

15. ANNUAL MEETING. The annual meeting of the members required by section 102 of the Act shall be held at any place within Canada, on such day in each year and at such time as the directors may by resolution determine. At annual meetings there shall be presented a report of the directors of the affairs of the Corporation for the previous year, a financial statement of the Corporation and the auditor's report thereon as required by the Act, and such other information or reports relating to the Corporation's affairs as the directors may determine.
16. SPECIAL MEETINGS. Other meetings of the members whether special or general may be convened by order of the president of the Board at any time and any place within Canada and shall be convened from time to time upon written request therefor signed by five (5) members of the Corporation.
17. NOTICE. A printed, written or typewritten notice stating the day, hour and place of meeting and the general nature of the business to be transacted shall be served either personally or by sending such notice to each member entitled to notice of such meeting and, if required, to the auditor of the Corporation through the post in a prepaid wrapper or letter or by electronic facsimile at least fourteen (14) days (exclusive of the day of sending and of the day for which notice is given) before the date of every meeting directed to such address of each such member and of the auditor as appears on the books of the Corporation, or if no address is given therein, then to the last address of each such member or auditor known to the secretary; provided always that a meeting of members may be held for any purpose at any date and time and at any place within Canada without notice if all the members are present in person or represented by proxy at the meeting or if all the unrepresented absent members shall have signified their assent in writing to such meeting being held and such assent may be validly given either before or after the meeting to which such assent relates.
18. OMISSION OF NOTICE. Any accidental omission in the giving of notice of any meeting or the non-receipt of any notice by any member or members or the auditor shall not invalidate any resolution passed or any proceeding taken at any meeting.
19. PROOF OF SERVICE. A certificate of the secretary of the Corporation as to facts in relation to the giving of any notice to any member, shall be conclusive evidence thereof.
20. PERSONS ENTITLED TO THE PRESENT. The only persons entitled to attend a meeting of members shall be those entitled to vote thereat and the auditor of the Corporation. Any other person may be admitted only on the invitation of the chairman of the meeting or with the consent of the meeting.
21. QUORUM. Five members present in person or by proxy shall constitute a quorum for the transaction of all business at any Annual or Special Meeting of the Corporation. No business shall be transacted at any meeting unless the quorum requisite be present at the commencement of the business.

If within one-half hour from the time appointed for a meeting of the Corporation a quorum of members is not present, the meeting, if convened upon the request of members shall be dissolved.

- In any other case, it shall stand adjourned without further notice to the same day in the following week, at the same hour and place; and if at such adjourned meeting a quorum of members is not present, it shall be dissolved.
22. **CHAIRMAN.** In the absence of any director who is president or vice-president of the Board, the members present shall choose another director as chairman and if no director is present and willing to act, the members present shall choose one of their own number to be chairman.
23. **SCRUTINEERS.** At each meeting of members one or more scrutineers may be appointed by a resolution of the meeting or by the chairman with the consent of the meeting to serve at the meeting. Such scrutineers need not be members of the Corporation.
24. **VOTING.** Each member entitled to vote shall be entitled to one vote on each question arising at any meeting of members either in person or by proxy. Unless the Act or these by-laws otherwise provide, each question submitted to any meeting of members shall be decided in the first instance by a majority of votes given on a show of hands and in case of an equality of votes the chairman shall, both on a show of hands and at a poll, have a second or casting vote in addition to the vote to which he is entitled as a member. At any meeting, unless a poll is demanded, a declaration by the chairman that a resolution has been carried or carried unanimously or by a particular majority or lost or not carried by a particular majority shall be conclusive evidence of the fact without proof of the number or proportion of votes recorded in favour of or against the motion.
25. **PROXY.** Every member entitled to vote at a meeting of members may by means of proxy which may, but need not be in the form provided with the notice calling the meeting, appoint a proxyholder or one or more alternate proxyholders, who need not be a member, to attend and act at the meeting in the manner and to the extent authorized by the proxy and with the authority conferred by the proxy.
- An instrument appointing a proxy shall be in writing and executed by the member or his attorney authorized in writing and is valid only at the meeting in respect of which it is given or at any adjournment thereof.
26. **POLLS.** If a poll be required by the chairman of the meeting or be duly demanded by any member and the demand be not withdrawn, a poll upon the question shall be taken in such manner as the chairman of the meeting shall direct.
27. **ADJOURNMENT.** The chairman of the meeting may with the consent of any meeting, adjourn the same from time to time, and no notice of such adjournment need be given to the members. Any business may be brought before or dealt with at any adjourned meeting which might have been brought before or dealt with at the original meeting in accordance with the notice calling the same.
28. **WRITTEN RESOLUTIONS.** Subject to the Act, the letters patent and the by-laws, a resolution in writing signed by all the members entitled to vote on that resolution at a meeting of members is as valid as if it had been passed at a meeting of members.

### **DIRECTORS**

29. **NUMBER AND POWERS.** The affairs of the Corporation shall be managed by a board of directors consisting of not fewer than 3 directors and not more than 12; the number within such range may be changed from time to time by resolution of the Board of Directors of the Corporation; until changed the number of directors shall be 6.

The directors may exercise all such powers and do all such acts and things as may be exercised or done by the Corporation and are not by the by-laws of the Corporation or by statute expressly

directed or required to be done by the Corporation at a meeting of members.

30. HONORARY DIRECTORS. The members of the Corporation may elect not more than three Honorary Directors to hold office until the next annual meeting of the Corporation. Honorary Directors may attend, without the right to vote, at any regular meeting of the Board.
31. EX OFFICIO DIRECTORS. The holder from time to time of each of the following offices shall ex officio be a director of the Corporation:
  1. the Chairman of the Catalysis Division;
  2. the Vice-Chairman of the Catalysis Division.
32. ELECTION OF DIRECTORS. The whole Board (except ex officio directors) shall be elected annually by the members from among qualified individuals nominated at the meeting.
33. QUALIFICATIONS. No person who is bankrupt, incompetent or a convicted criminal, within the meaning of section 35 hereof shall be eligible to hold the office of director. Any other person shall be eligible to hold the office of director except the following who shall not be eligible for election or appointment as director but nevertheless may be directors ex officio and Honorary Directors:
  - (a) a person under twenty-one or over seventy-five years of age;
  - (b) a person who has held the office of director during any part of each of the eight consecutive whole annual terms immediately preceding the end of the meeting at which such election or appointment may be made.
34. TERM OF OFFICE. The first directors shall hold office until the first annual meeting of members of the Corporation. Thereafter a director's term of office shall be from the date of the meeting at which he is elected or appointed until the annual meeting next following or until his successor is elected or appointed.
35. VACATION OF OFFICE. The office of a director of the Corporation shall become vacated:
  - (a) if he becomes bankrupt or a receiving order is made against him or he makes an assignment under the Bankruptcy Act (Canada) or any statute that may be substituted therefor;
  - (b) if an order is made declaring him to be a mentally incompetent person or incapable of managing his own affairs; or
  - (c) if he is convicted of any criminal offence.
36. REMOVAL OF DIRECTORS. The members may, by resolution passed by at least 66 2/3 percent of the votes cast at a special general meeting of members of which notice specifying the intention to pass such resolution was given, remove any director before the expiration of his term of office, and may, by a majority of the votes cast at that meeting, elect any person in his stead for the remainder of his term.
37. RESIGNATION OF DIRECTORS. Any director may at any time resign his office as director by filling his written resignation with the secretary of the Corporation and such resignation shall taken effect immediately upon the filing thereof as aforesaid and shall not require the confirmation of the Board.
38. VACANCIES. Vacancies in the Board may be filled for the remainder of its term of office from

- among qualified persons, either by the members at a general meeting called for the purpose or, by the remaining directors if constituting a quorum; otherwise such vacancies shall be filled at the next meeting of the members at which directors for the ensuing year are elected. If the number of directors is increased a vacancy or vacancies in the Board of the number of the authorized increase shall thereby be deemed to have occurred which may be filled in the manner above provided.
39. **CALLING OF MEETINGS.** Meetings of the Board may be held at the head office of the Corporation or such other place in Canada as the president or the Board may determine. Directors' meetings may be called by the president or vice-president or may be called by the secretary upon the direction of the president or vice-president or the direction in writing of any two directors. Notice of such meetings shall be delivered, telephoned or by electronic facsimile to each director not less than one day before the meeting is to take place or shall be mailed to each director not less than fourteen days before the meeting is to take place. The time of giving notice shall be computed excluding the day notice is given and including the day for which notice is given. The certificate of the secretary or the officer calling the meeting that notice has been given pursuant to this by-law shall be sufficient and conclusive evidence of the giving of such notice. The directors may consider or transact any business, either special or general at any meeting of the Board.
40. **REGULAR MEETINGS.** The Board may appoint a day or days in any month or months for regular meetings at an hour to be named and of such regular meeting no notice need be sent.
41. **FIRST MEETING OF NEW BOARD.** A directors' meeting may be held without notice immediately following the annual meeting of the Corporation provided a quorum is present.
42. **ERRORS IN NOTICE.** No error or omission in giving notice for a meeting of directors shall invalidate such meeting or invalidate or make void any proceedings taken or had at such meeting and any director may at any time waive notice of any such meeting and may ratify and approve of any or all proceedings taken or had thereat.
43. **QUORUM AND VOTING.** A majority of the directors shall constitute a quorum for the transaction of business. Questions arising at any meeting of directors shall be decided by a majority of votes. In case of an equality of votes, the chairman of the meeting, in addition to his original vote, shall have a second or casting vote. All votes at any such meeting shall be taken by ballot if so demanded by any director present, but if no demand be made, the vote shall be taken in the usual way by assent or dissent. A declaration by the chairman that a resolution has been carried and an entry to that effect in the minutes shall be admissible in evidence as prima facie proof of the fact without proof of the number or proportion of the votes recorded in favour of or against such resolution.
44. **TELEPHONE PARTICIPATION.** Where all the directors of the Corporation consent thereto (either before or after the meeting), a director may participate in a meeting of directors or of any committee of directors by means of such telephone, electronic or other communications facilities as permit all persons participating in the meeting to hear each other simultaneously and instantaneously, and a director participating in a meeting by such means shall be deemed for the purposes of the Act to be present at that meeting.
45. **ACTION BY UNANIMOUS WRITTEN RESOLUTION.** Any action required or permitted to be taken at any meeting of the Board may be taken without a meeting by a resolution in writing signed by all the directors to indicate their consent and filed with the minutes of proceedings of the Board.
46. **INTEREST OF DIRECTORS IN CONTRACTS.** No contract or arrangement entered into by or on behalf of the Corporation with any director or in which any director is in any way interested shall be liable to be avoided nor shall any director so contracting or being so interested be liable to account to the Corporation for any profit realized by any such contract or arrangement by reason

of such director holding that office or of the fiduciary relationship thereby established.

47. **DECLARATION OF INTEREST.** It shall be the duty, however, of every director of the Corporation who is in any way, whether directly or indirectly, interested in a contract or arrangement or proposed contract or arrangement with the Corporation to declare such interest to the extent, in the manner and at the time required by the applicable provisions of the Act for and to refrain from voting in respect of the contract or arrangement or proposed contract or arrangement if and when prohibited by the Act.
48. **REMUNERATION OF DIRECTORS.** No director shall receive remuneration for acting as such provided that a director may be paid reasonable expenses incurred by him in the performance of his duties.

### **OFFICERS**

49. **ELECTED OFFICERS.** At the first meeting of the Board after each election of directors the Board shall elect a president from among its members. In default of election of the president the then incumbent, if a member of the Board, shall hold office until his successor is elected. A vacancy occurring from time to time in such office may be filled by the Board from among its members.
50. **APPOINTED OFFICERS.** From time to time the Board shall appoint a treasurer and a secretary and may appoint one or more vice-presidents and such other officers as the Board may determine including one or more assistants to any of the officers so appointed. The officers so appointed may, but need not be, directors. One person may hold more than one office.
51. **TERM OF OFFICE.** No director shall be elected or appointed president or vice-president who has held such respective office as well as the office of director during any part of each of the four (4) consecutive whole annual terms immediately preceding the end of the meeting at which such election or appointment may be made. In the absence of written agreement to the contrary of the Board may remove at its pleasure any officer of the Corporation.

### **DUTIES OF OFFICERS**

52. **RESPONSIBLE TO BOARD.** Each officer of the Corporation shall be responsible to the Board. He shall in addition to duties specifically indicated perform all duties incidental to his office and shall have such other powers and duties as may from time to time be assigned to him by the Board. The directors may fix the remuneration (if any) to be paid to officers of the Corporation. All officers in the absence of agreement to the contrary shall be subject to removal by resolution of the board of directors at any time with or without cause.
53. **PRESIDENT OF THE CORPORATION.** The president shall, when present, preside at the meetings of the Board and meetings of the members of the Corporation and shall, ex officio, be a member of all committees of the Board. The president shall be charged with the general supervision of the business and affairs of the Corporation.
54. **VICE-PRESIDENT OF THE CORPORATION.** The vice-president, or if there are more than one, the vice-presidents in order of seniority (as determined by the Board) may, during the absence or inability of the president, perform and exercise all the duties and powers of the president save that no vice-president shall preside at a meeting of the Board, or at a meeting of members who is not qualified to attend the meeting as a director, or as a member as the case may be. If a vice-president exercises any such duty or power, the absence or inability of the president shall be presumed with reference thereto. A vice-president shall also perform such duties and exercise such powers as the president may from time to time delegate to him, or the Board may prescribe.

55. **SECRETARY OF THE CORPORATION.** The secretary shall give, or cause to be given, all notices required to be given to members, directors, auditors and members of committees; he shall attend all meetings of the directors and of the members and shall enter or cause to be entered in the books kept for that purpose minutes of all proceedings at such meetings; he shall be the custodian of the stamp or mechanical device generally used for affixing the corporate seal of the Corporation and of all books, papers, records, documents, and other instruments belonging to the Corporation, and he shall maintain a membership register.
56. **TREASURER OF THE CORPORATION.** The treasurer shall keep or cause to be kept full and accurate books of account in which shall be recorded all receipts and disbursements of the Corporation; he shall be chairman of the Finance Committee and, under the direction of the Finance Committee and the Board, shall control the deposit of money, the safekeeping of securities and the disbursement of the funds of the Corporation and he shall render to the Board at the meetings thereof, or whenever required of him, an account of all his transactions as treasurer and of the financial position of the Corporation.
57. **OTHER OFFICERS.** The duties of all other officers of the Corporation shall be such as the terms of their engagement call for or the Board requires of them. Any of the powers and duties of an officer to whom as assistant has been appointed may be exercised and performed by such assistant, unless the Board otherwise directs.
58. **VARIATION OF DUTIES.** From time to time the Board may vary, add to or limit the powers and duties of any officer or officers.
59. **FIDELITY BONDS.** The Board may require such officers, employees and agents of the Corporation as the Board deems advisable to furnish bonds for the faithful discharge of their duties, in such form and with such surety as the Board may from time to time prescribe. The cost of any such bond may be paid by the Corporation.

### **COMMITTEES**

60. **STANDING COMMITTEES.** The Board shall appoint the Finance Committee and the Audit Committee annually at the first meeting of the Board after each election of directors.
61. **EXECUTIVE COMMITTEE.** The Board of Directors, whenever it consists of more than six may elect from its number an executive committee consisting of not less than three and shall have power to fix its quorum at not less than a majority of its members. Each matter arising at a meeting of the executive committee shall be determined by the majority of votes cast by the members present, each of whom shall be entitled to one vote.

The executive committee may exercise the full powers of the Board to deal with all matters which in its discretion it considers require attention prior to the next regular meeting of the Board and shall report every such action to the Board at its next meeting. The executive committee may at any time receive reports of other committees, authorize such studies and professional guidance as it considers advisable and make recommendations to the Board. The committee shall undertake other duties directed by the Board.

Notice of executive committee meeting stating the day, hour and place of the meeting shall be given to each member of the committee at least two days before the meeting is to take place, provided always that meetings of the executive committee may be held without notice if all committee members are present or those absent in writing waive notice or consent to the holding of the meeting in their absence.

62. OTHER COMMITTEES. The Board may from time to time as deemed necessary, appoint other committees and shall prescribe their duties.
63. COMMITTEE MEMBERS. Except the executive committee, each committee appointed by the Board shall be composed of not fewer than two directors and may include a committee member or members who are not directors. No committee shall have power to add to its number unless so authorized by resolution of the Board.
64. TERM OF OFFICE. Each member of a committee appointed by the Board shall hold office during the pleasure of the Board and shall cease to be a committee member upon acceptance by the Board of his resignation either as such committee member or as a director or upon appointment of his successor or his removal by resolution of the Board.
65. COMMITTEE CHAIRMAN. Each committee appointed by the Board shall have a chairman who shall be a director. The Board shall appoint such committee chairman except that the treasurer shall be chairman of the Finance Committee.

The chairman of a committee shall make or cause to be made a full and sufficient report to the Board without delay, and if practicable at the next following Board meeting, upon all decisions made by the committee and generally all matters considered by the committee in respect of which, in his opinion, the Board ought to be informed.

66. QUORUM. Subject to any regulations imposed from time to time by the Board, committees shall each have power to fix its quorum.
67. VACANCY. If and whenever a vacancy exists in any committee the remaining members of the committee may exercise all its powers. The Board may fill any vacancy in any committee from time to time.
68. PROCEDURE. Committee meetings may be held at the head office of the Corporation or at any other place in Canada. Each standing committee shall keep minutes of its meetings in which shall be recorded all actions taken by it. Other committees shall keep minutes if their terms of reference so provide. Questions arising at any meeting of a committee shall be decided by a majority of votes and in the case of an equality of votes the chairman shall have the second or casting vote. Subject to any regulations imposed from time to time by the Board, committees may otherwise meet for the transaction of business, adjourn and regulate their meetings as they think fit.
69. AUDIT COMMITTEE. The Audit Committee shall be composed of directors only, not fewer than two, none of whom shall be officers or employees of the Corporation.

The Corporation shall submit the financial statement to the Audit Committee for its review and the financial statement shall thereafter be submitted to the Board. The auditor has the right to appear before and be heard at any meeting of the Audit Committee and shall appear before the Audit Committee when required to do so by the committee. Upon the request of the auditor, the chairman of the Audit Committee shall convene a meeting of the committee to consider any matters the auditor believes should be brought to the attention of the directors or members.

70. FINANCE COMMITTEE. The Finance Committee shall be composed of directors only, not fewer than two, one of whom shall be the treasurer who shall be chairman of the committee. The Vice Chairman of the Catalysis Division shall ex officio be a member of the Finance Committee. The Finance Committee shall advise and assist the treasurer in the performance of his duties. The committee shall undertake other duties directed by the Board.

## **BANKING ARRANGEMENTS AND CONTRACTS**

71. **CHEQUES, DRAFTS AND NOTES.** All cheques, drafts or orders for the payment of money and all notes and acceptances and bills of exchange shall be signed by such officer or officers or person or persons, whether or not officers of the Corporation, and in such manner as the Board may from time to time designate.
72. **SECURITIES SAFEKEEPING.** The securities of the Corporation shall be deposited for safekeeping with one or more bankers, trust companies or other financial institutions to be selected by the Board. Any and all securities so deposited may be withdrawn, from time to time, only upon the written order of the Corporation signed by such officer or officers, agent or agents of the Corporation, and in such manner, as shall from time to time be determined by resolution of the Board and such authority may be general or confined to specific instances.
73. **BORROWING.** The Board may from time to time
- (a) borrow money on the credit of the Corporation; or
  - (b) charge, mortgage, hypothecate or pledge all or any of the real or personal property of the Corporation to secure any money borrowed, or other debt, or any other obligation or liability of the Corporation.

From time to time the Board may authorize any director, officer or employee of the Corporation or any other person to make arrangements with reference to the monies borrowed or to be borrowed as aforesaid and as to the terms and conditions of the loan thereof, and as to the securities to be given therefor, with power to vary or modify such arrangements, terms and conditions and to give such additional securities for any monies borrowed or remaining due by the Corporation as the Board may authorize, and generally to manage, transact and settle the borrowing of money by the Corporation.

74. **EXECUTION OF INSTRUMENTS.** Contracts, documents or any instruments in writing requiring the signature of the Corporation may be signed by one of the president or a vice-president together with the secretary or the treasurer and all contracts, documents and instruments in writing so signed shall be binding upon the Corporation without any further authorization or formality. The Board shall have the power from time to time by resolution to appoint any officer or officers or any person or persons on behalf of the Corporation either to sign contracts, documents and instruments in writing generally or to sign specific contracts, documents and instruments in writing.

The seal of the corporation may when required be affixed to contracts, documents and instruments in writing signed as aforesaid or by any officer or officers, person or persons, appointed as aforesaid by resolution of the Board.

The term “contracts, documents and instruments in writing” as used herein shall include deeds, mortgages, hypothecs, charges, conveyances, transfers and assignments of property real or personal, immovable or movable, agreements, releases, receipts and discharges for the payment of money or other obligations, conveyances, transfers and assignments of shares, stocks, bonds, debentures or other securities and all paper writings.

In particular without limiting the generality of the foregoing one of the president or a vice president together with the secretary or the treasurer shall have authority to sell, assign, transfer, exchange, convert or convey any and all shares, stocks, bonds, debentures, rights warrants or other securities owned by or registered in the name of the Corporation and to sign and execute (under the corporate seal of the Corporation or otherwise) all assignments, transfers, conveyances, powers of attorney and other instruments that may be necessary for the purpose of selling,

assigning, transferring, exchanging, converting or conveying any such shares, stocks, bonds, debentures, rights, warrants or other securities.

### **INVESTMENTS - GRANTS - AWARDS**

75. INVESTMENTS. Funds of the Corporation may be invested from time to time in such investments as are determined by the Board from among investments authorized under the laws of Canada.
76. GRANTS - AWARDS. The Board shall seek the advice of the Catalysis Division on proposals for grants and shall establish mechanisms for solicitation of proposals from the catalysis community. The Board may reserve funds for specific commitments and may make grants and awards within the purposes and objects of the Corporation out of the net income of the Corporation. A reservation of funds shall be authorized by resolution of the Board. No grant or award may be made out of capital. Any net income not spent or reserved in any fiscal year shall be added to and form part of the capital of the Corporation. Grants and awards may be made in honour of a specific person, persons or organization.

### **SUBMISSION OF CONTRACTS OR TRANSACTION TO MEMBERS FOR APPROVAL**

77. The Board in its discretion may submit any contract, act or transaction for approval or ratification at any meeting of the members called for the purpose of considering the same and any contract, act or transaction that shall be approved or ratified by a resolution passed by a majority of the votes cast at any such meeting (unless any different or additional requirement is imposed by the Act) shall be as valid and as binding upon the Corporation and upon all the members as if it had been approved or ratified by every member of the Corporation.

### **PROTECTION OF DIRECTORS, OFFICERS AND OTHERS**

78. INDEMNIFICATION. Each person who has been or is threatened to be made a party to any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative, by reason of the fact that he is or was a director, officer, employee or agent of the Corporation, or is serving or has served at the request of the Corporation as a director, officer, employee or agent of the Corporation, or is serving or has served at the request of the Corporation as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, shall be indemnified by the Corporation against expenses (including attorneys' fees), judgments, fines and amounts paid in settlement actually and reasonably incurred by him in connection with such action, suit or proceeding, and expenses incurred in connection therewith may be advanced by the Corporation, all to the full extent and in the manner permitted by the Act.

The indemnification provided by this section shall be deemed exclusive of any other rights to which those indemnified may be entitled under any by-law, agreement, vote of members or disinterested directors or otherwise, both as to action in his official capacity and as to action in another capacity while holding such office and shall continue as to a person who has ceased to be a director, officer, employee or agent and shall inure to the benefit of the heirs, executors and administrators of such a person.

79. INSURANCE. Subject to the limitations contained in the Act, the Corporation may purchase and maintain such liability insurance for the benefit of its directors and officers, as such, as the Board may from time to time determine.

80. **PROTECTION OF DIRECTORS.** No director or officer for the time being of the Corporation shall be liable for the acts, receipts, neglects or defaults of any other director or officer or employee or for joining in any receipt or act for conformity or for any loss, damage or expense suffered or incurred by the Corporation through the insufficiency or deficiency of title to any property acquired by the Corporation or for or on behalf of the Corporation or for the insufficiency or deficiency of any security in or upon which any of the monies of or belonging to the Corporation shall be placed out or invested or for any loss or damage arising from the bankruptcy, insolvency or tortious act of any person, firm or corporation, including any person, firm or corporation with whom or which any monies, securities or effects shall be lodged or deposited, or any loss, conversion, misapplication or misappropriation of or any damage resulting from any dealings with any monies, securities or other assets belonging to the Corporation or for any other loss, damage or misfortune whatever which may happen in the execution of the duties of his respective office or trust or in relation thereto unless the same shall happen by or through his own wrongful and wilful act or through his own wrongful and wilful neglect or default.

The directors for the time being of the Corporation shall not be under any duty or responsibility in respect of any contract, act or transaction whether or not made, done or entered into in the name or on behalf of the Corporation, except such as shall have been submitted to and authorized or approved by the Board of Directors. If any director or officer of the Corporation shall be employed by or shall perform services for the Corporation otherwise than as director or officer or shall be a member of a firm or a shareholder, director or officer of a company which is employed by or performs services for the Corporation the fact of his being a director or officer of the Corporation shall not disentitle such director or officer or such firm or company, as the case may be, from receiving proper remuneration for such services.

### **ENACTMENT AND AMENDMENT OF BY-LAWS**

81. By-Laws of the Corporation may be enacted, and such by-laws repealed or amended, by by-laws enacted by a majority of the directors at a meeting of the Board and sanctioned by an affirmative vote of at least  $66 \frac{2}{3}$  percent of the members present at a meeting of members duly called for the purpose of considering the said by-laws, provided that the repeal or amendment of by-laws not embodied in the letters patent of the Corporation shall not be enforced or acted upon until the approval of the Minister has been obtained.

### **FINANCIAL YEAR**

82. The financial year of the Corporation shall end on the 31st day of December in each year.

### **AUDITOR**

83. The members shall at each annual meeting appoint one or more persons licensed under the Public Accountancy Act as auditors to hold office until the next annual meeting, and if an appointment is not so made the auditor in office shall continue in office until a successor is appointed. The remuneration of an auditor appointed by the members shall be fixed by the Board unless otherwise directed by the members at the time of the auditor's appointment.

PASSED by the Board and sealed with the corporate seal this 29 day of June, 1990.

President

Secretary



## **Appendix 6**

### **Officers and Board of Directors of the Canadian Catalysis Foundation**

## Executive and Board of Directors of the Canadian Catalysis Foundation

Year	President	Vice President(s)	Treasurer	Secretary of the Corporation	Board Members
1990-91	H.W. Habgood <sup>7</sup>	J.B. Moffat <sup>4</sup> B.W. Wojciechowski <sup>3,5</sup>	B.W. Wojciechowski <sup>3,5</sup>	David E. Hill <sup>1</sup>	M. Goddard <sup>2,3,5</sup> D.E. Laycock <sup>2,4,6,7</sup> E.C. Sanford <sup>2</sup> A.R. Sanger <sup>2,6</sup>
1991-92	J.B. Moffat	A.R. Sanger <sup>4,6</sup> B.W. Wojciechowski <sup>3,5</sup>	B.W. Wojciechowski <sup>3,5</sup>	David E. Hill <sup>1</sup>	Y. Amenomiya <sup>6,7</sup> M. Goddard <sup>2,3</sup> D.E. Laycock <sup>2,4,7</sup> E.C. Sanford <sup>2</sup>
1992-93	J.B. Moffat <sup>5</sup>	A.R. Sanger <sup>4</sup> B.W. Wojciechowski <sup>3,5</sup>	B.W. Wojciechowski <sup>3,5</sup>	David E. Hill <sup>1</sup>	Y. Amenomiya <sup>6,7</sup> M. Goddard <sup>2,3,6</sup> D.E. Laycock E.C. Sanford <sup>2,4,7</sup>
1993-94	J.B. Moffat <sup>7</sup>	Y. Amenomiya A.R. Sanger <sup>4</sup> B.W. Wojciechowski <sup>3,5</sup>	B.W. Wojciechowski <sup>3,5</sup>	David E. Hill <sup>1</sup>	M. Goddard <sup>2,6</sup> D.E. Laycock <sup>3,5,7</sup> E.C. Sanford <sup>2,4,6</sup>
1994-95	J.B. Moffat	Y. Amenomiya A.R. Sanger <sup>4</sup> B.W. Wojciechowski <sup>3,5</sup>	B.W. Wojciechowski <sup>3,5</sup>	David E. Hill <sup>1</sup>	D.E. Laycock <sup>3,5,7</sup> E.C. Sanford <sup>2,4,6</sup> M.F. Wilson <sup>2,6</sup>
1995-96	Y. Amenomiya	A.R. Sanger <sup>4</sup>	B.W. Wojciechowski <sup>3,5</sup>	David E. Hill <sup>1</sup>	D.E. Laycock <sup>3,5</sup> J.B. Moffat <sup>4,7</sup> E.C. Sanford <sup>2</sup> M.F. Wilson <sup>2,6,7</sup>

<sup>1</sup> David E. Hill, Q.C., is a retired lawyer formerly with Holmsted and Sutton, Toronto,

<sup>2</sup> Ex-officio, on behalf of the Catalysis Division of CIC.

<sup>3</sup> Finance Committee.

<sup>4</sup> Grants Committee.

<sup>5</sup> Investment Committee.

<sup>6</sup> Audit Committee.

<sup>7</sup> Nominating Committee.

## Executive and Board of Directors of the Canadian Catalysis Foundation (Page 2)

<b>Year</b>	<b>President</b>	<b>Vice President(s)</b>	<b>Treasurer</b>	<b>Secretary of the Corporation</b>	<b>Board Members</b>
1996-97	Y. Amenomiya	D. E. Laycock <sup>3,5</sup>	B.W. Wojciekowski <sup>3,5</sup>	David E. Hill <sup>1</sup>	S. Kaliaguine <sup>4</sup> J. F. Kriz <sup>7</sup> J.B. Moffat <sup>4</sup> A. Sanger <sup>7</sup> K. J. Smith <sup>6,2</sup> M.F. Wilson <sup>4,2</sup>
1997-98	Y. Amenomiya	D. E. Laycock <sup>3,5</sup> M. F. Wilson <sup>4</sup>	D. E. Laycock <sup>3,5</sup>	David E. Hill <sup>1</sup>	S. Kaliaguine <sup>4</sup> J. F. Kriz <sup>7</sup> J.B. Moffat <sup>3,4,5</sup> A. Sanger <sup>7</sup> K. J. Smith <sup>6</sup> B.W. Wojciekowski <sup>6</sup>
1998-99	Y. Amenomiya	D. E. Laycock <sup>3,5</sup> J. F. Kriz <sup>7</sup>	D. E. Laycock <sup>3,5</sup>	David E. Hill <sup>1</sup>	S. Kaliaguine <sup>4,6</sup> J.B. Moffat <sup>3,5,7</sup> Graeme Norval <sup>2,4</sup> K. Smith <sup>2,6</sup> M. F. Wilson <sup>4</sup> B.W. Wojciekowski
1999- 2000	D. E. Laycock <sup>3,5,7</sup>	J. F. Kriz <sup>7</sup> M. F. Wilson <sup>4</sup>	D. E. Laycock <sup>3,5,7</sup>	David E. Hill <sup>1</sup>	S. Kaliaguine <sup>4,6</sup> K. J. Smith <sup>2,6</sup> Graeme Norval <sup>2,3,4,5</sup>
2000-01	D. E. Laycock <sup>3,5,7</sup>	J. F. Kriz <sup>7</sup> M. F. Wilson <sup>3,4,5</sup>	D. E. Laycock <sup>3,5,7</sup>	David E. Hill <sup>1</sup>	K. J. Smith <sup>4,6</sup> C. A. Mims <sup>2,6</sup> Graeme Norval <sup>2,4,6</sup>
2001-02	J. F. Kriz <sup>7</sup>	K. J. Smith <sup>4,7</sup>	M. F. Wilson <sup>3,5</sup>	David E. Hill <sup>1</sup>	C. A. Mims <sup>2,6</sup> Graeme Norval <sup>2,3,4,5,6</sup>

## Executive and Board of Directors of the Canadian Catalysis Foundation (Page 3)

<b>Year</b>	<b>President</b>	<b>Vice President(s)</b>	<b>Treasurer</b>	<b>Secretary of the Corporation</b>	<b>Board Members</b>
2002-03	K. J. Smith <sup>7</sup>	J. F. Kriz <sup>3,5,7</sup>	Graeme Norval <sup>3,4,5</sup>	David E. Hill <sup>1</sup>	C. A. Mims <sup>2,4,6</sup> J. Monnier <sup>2,6</sup>
2003-04	K. J. Smith <sup>7</sup>	J. F. Kriz <sup>3,5,7</sup>	G. Norval <sup>3,4,5,7</sup>	David E. Hill <sup>1</sup>	C. A. Mims <sup>2,4,6</sup> J. Monnier <sup>2,3,5,6</sup>
2004-05	C.A. Mims <sup>4</sup>	J. Monnier <sup>2,3,5,6,7</sup>	G. Norval <sup>3,4,5,7</sup>	David E. Hill <sup>1</sup>	B. McGarvey <sup>2,6</sup>
2005-06	C.A. Mims <sup>4,7</sup>	G. Norval <sup>3,5,6</sup>	J. Monnier <sup>2,3,5</sup>	David E. Hill <sup>1</sup>	B. McGarvey <sup>2,4,6,7</sup>

<sup>1</sup> David E. Hill, Q.C., is a retired lawyer formerly with Holmested and Sutton, Toronto,

<sup>2</sup> Ex-officio, on behalf of the Catalysis Division of CIC.

<sup>3</sup> Finance Committee.

<sup>4</sup> Grants Committee.

<sup>5</sup> Investment Committee.

<sup>6</sup> Audit Committee.

<sup>7</sup> Nominating Committee.