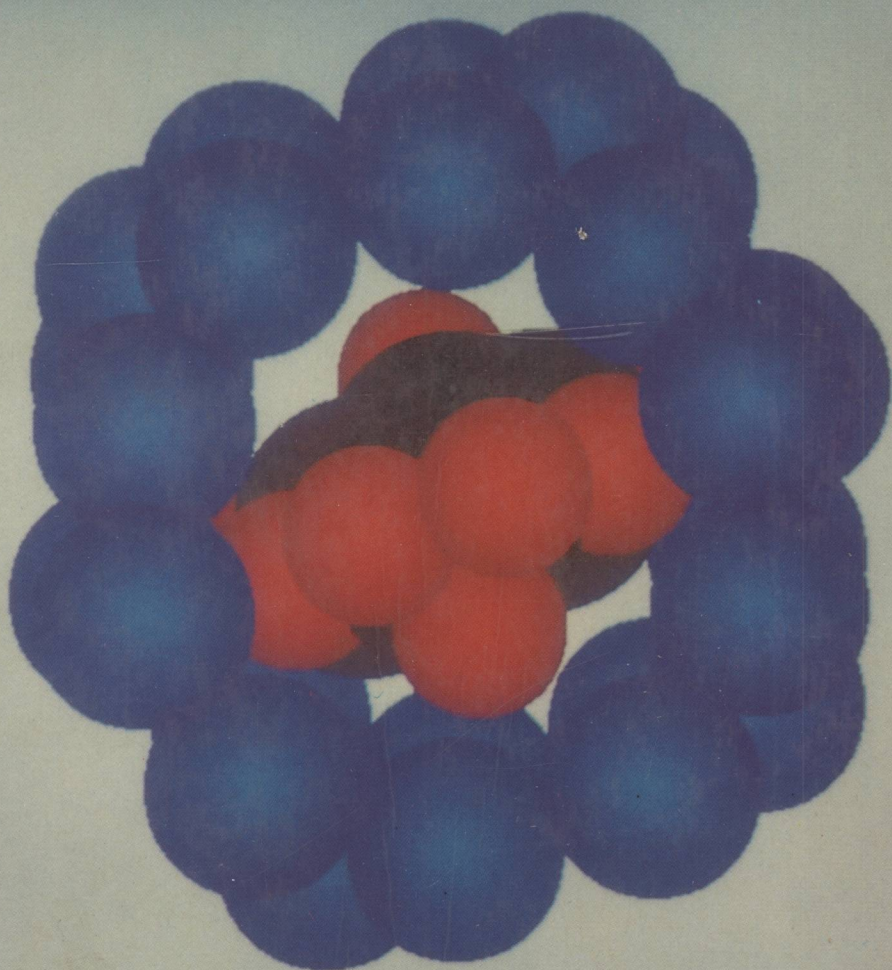


Proceedings of The Sixth International **ZEOLITE** Conference

Edited by David Olson and Attilio Bisio



P-XYLENE IN ZSM-5 TEN RING

Proceedings of The Sixth International ZEOLITE Conference

Reno, USA 10-15 July 1983

Edited by

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and

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**Proceedings of
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Conference**

PROCEEDINGS OF THE SIXTH IZC

PREFACE

Fifteen years ago, zeolite research was a rapidly maturing field, with most papers reporting studies which were largely extensions and refinements of earlier reported findings. Recent developments have created new excitement in the areas of synthesis, characterization, catalysis and technological applications.

The advent of high silica, medium pore sized zeolites has opened up a myriade of new opportunities in synthesis, characterization and catalysis. More than 15 new high silica zeolites have been reported and the number continues to grow. The medium pore zeolites, typified by ZSM-5 have given new meaning to the term "shape selectivity" as we see channel structure imposing steric and diffusional constraints on numerous reactions in ways not observed heretofore.

The discovery of synthesis routes to aluminum phosphate molecular sieves, AIPO's, has resulted in several new framework structures. These structures present materials having new surface properties to be explored. The significance of this discovery was recognized with the granting of the First Don Breck Memorial Award to Stephen Wilson, Brent Lok, Celeste Messina, Thomas Cannan and Edith Flanigen for their pioneering work.

MASNMR and HREM are powerful new tools finding multiple applications in the study of zeolite crystal chemistry. The former has confirmed many important crystal chemical properties deduced earlier using more classical methods of study and has added a great deal to our knowledge of crystal chemistry of aluminum and silicon in zeolites.

HREM has produced lattice images which show even the smaller zeolite channels or features and has given us an awareness of the prevalence of defects in structures. Both tools have great promise for the future.

A large fraction of the 87 papers contained in this Proceedings deal with these exciting new areas.

The Breck Memorial Symposium, which lead off the conference, was a grand and appropriate tribute to the late Donald Breck, who devoted his career to the understanding and commercial development of zeolite molecular sieves. His contributions to zeolite crystal chemistry will stand as a permanent memorial.

We are grateful to a large number of people for their contributions to this volume. First and foremost we thank the authors for their fine papers and their cooperation in the preparation of the manuscripts. The two Program Chairmen, David Vaughan and John Ward must be recognized for their fine efforts in putting together this highly successful conference. Section Chairpersons require a special thanks for their efforts in overseeing the refereeing and selection of papers and for editing the Discussion for their sections; they are Edith Flanigen - Don Breck Memorial Symposium, Douglas Ruthven - Adsorption and Diffusion, Thomas Hughes - Catalysis, Frederick Mumpton - Geology and Mineralogy, John Sherman - Ion Exchange, John Thomas - New Techniques, Water Meier - Structure, Harry Robson - Synthesis, and Howard Sherry - Zeolite Technology, and Guenter Kuehl - Zeolite Modification (combined with other sections).

We must also thank several typists whose efforts were essential to the publication of these Proceedings. They include Karen Maday of Exxon, and Jean Mannix and Claire Liberty of Mobil.

THE PRESIDENT'S MESSAGE

The Sixth International Zeolite Conference marked the climax and end of my term as President of the International Zeolite Association Incorporated (IZA). I wish to commend Dr. John Ward and Dr. David Vaughan, Co-Chairmen of the Conference Organizing Committee, and their committee members for an excellent scientific meeting and an enjoyable week.

The IZA moved forward significantly during the years 1980 to 1983. The Constitution and By-Laws were updated and distributed to each attendee at Reno. Under Dr. Edith Flanigen, the difficult task of updating the membership list was accomplished. The IZA was incorporated in the State of Delaware and has obtained a tax-exempt status from the United States Internal Revenue Service. These two achievements would not have been realized without the expert and devoted services of Dr. Cristobal Bonifaz. With the help of Dr. Lovat Rees, the IZA is now an Associated Organization of the International Union of Pure and Applied Chemistry.

In 1982, Prof. Riccardo Sersale, Chairman of the Organizing Committee of the 5th International Zeolite Conference, submitted a check for over twelve thousand dollars to IZA. We thank Prof. Sersale for his efforts in organizing this meeting in Naples, Italy.

A cordial and productive relationship has continued between the IZA and the International Committee on Natural Zeolites (ICNZ). This was exemplified by the zeolite field trip, prior to the Reno meeting, organized by Prof. Fred Mumpton, Chairman of the ICNZ.

Union Carbide Corporation very generously established the Donald W. Breck Memorial Award of one thousand dollars to be granted at each International Zeolite Conference. This award recognizes the authors of the most significant paper published in the three year period between successive IZA conferences and includes papers of the preceeding conference.

In 1982, Dr. W. J. Mortier published a "Compilation of Extra Framework Sites in Zeolites". This work was done on behalf of the Structure Commission of the IZA.

The members attending the Reno meeting elected seven new council members: D. Barthomeuf (France), J. Dwyer (England), G. Kokotailo (USA), D. Olson (USA), J. Sherman (USA), H. Tominaga (Japan), and D. Vaughan (USA), who will serve until 1989. Elected to Council for three years were H. Beyer (Hungary), F. Leach (Scotland) and H. Sherry (USA). The members also selected Tokyo, Japan, as the site for the Seventh International Zeolite Conference to be held sometime in 1986 with Professor M. Koizumi as the Chairman of the Organizing Committee.

At Reno, the new IZA Council elected D. E. W. Vaughan as President, W. Mortier as Vice President, E. M. Flanigen as Secretary, and L. Moscou as Treasurer. Their terms of office will expire in 1986.

I wish to thank my fellow officers of the 1980-1983 Council: Vice President H. Lechert, Secretary E. M. Flanigen, and Treasurer L. Moscou, for their help during my term of office. I am also deeply indebted to the other Council members for their support and counsel: R. Aiello, D. B. Hawkins, B. Imelik, L. V. C. Rees, L. B. Sand, J. V. Smith, and G. V. Tsitsishvili.

I am grateful for the opportunity to serve the IZA and I wish the new officers and Council members every success in the future. I cannot close without acknowledging the excellent assistance of my secretary Mr. J. Mannix, who spent many hours on IZA business.

George T. Kerr

CONTENTS

DON BRECK MEMORIAL SYMPOSIUM

1. The Word and Work of Don Breck. E. M. Flanigen	3
2. Zeolite Synthesis: Some Chemical Aspects. R. M. Barrer.	17
3. Adsorption in A, X and Y Zeolites: Thirty Years of Science and Technology. D. M. Ruthven.	31
4. Speculations on Molecular Sieve and Ionization Effects in Y Zeolite. J. A. Rabo.	41
5. Considerations on Some Effects of Cation Location in the Faujasite-Type Zeolites. J. B. Uytterhoeven.	49
6. New Vistas in Crystal Structures of Molecular Sieves and Some Personal Reminiscences of Donald W. Breck. J. V. Smith.	56
7. Zeolite Exploration: The Early Days. F. A. Mumpton.	68
8. Zeolite Chemistry V - Substitution for Aluminum in Zeolites via Reaction with Aqueous Ammonium Fluorosilicate. G. W. Skeels and D. W. Breck.	87
9. Synthesis of $AlPO_4$ Molecular Sieves. S. T. Wilson, B. M. Lok, C. A. Messina and E. M. Flanigen.	97
10. Studies on the Prediction of Multicomponent Ion-Exchange Equilibria Involving Natural and Synthetic Zeolites. R. P. Townsend, P. Fletcher and M. Loizidou.	110
11. Diffusional Transition in Zeolite NaX: 1. Single Crystal Gas Permeation Studies. D. L. Wernick and E. J. Osterhuber.	122
12. The Cation Distribution in Faujasites. M. J. Sanders and C. R. A. Catlow.	131
13. Statistical and Topological Approaches to Modelling Zeolite Acidity, Activity and Stability. W. A. Wachter.	141
14. Agglomeration Mechanism During the Preparation of Ni(0) and Fe(0) Zeolites. F. Schmidt, Th. Bein, U. Ohlerich and P. A. Jacobs.	151
Discussion	161

ADSORPTION - DIFFUSION

1. Experimental and Theoretical Analysis of the Adsorption of Methane in A Zeolites: Infrared and Neutron Spectroscopy Studies. E. Cohen De Lara and R. Kahn.	172
2. NMR Diffusion Studies in Zeolites. J. Karger, H. Pfeifer and W. Heink.	184
3. Investigations of Motion, Interaction and Oxidation of Carbon Monoxide in Alkali and Alkaline Earth Ion-Exchanged Zeolite A. H. Bose, H. Forster, W. Frede and M. Schumann.	201
4. Gas Chromatographic Sorption Studies of Hydrocarbons in Pentasils with Different Si/Al Ratios. H. Lechert and W. Schweitzer.	210
5. Direct Measurement of Diffusivity for Butane Across a Single Large Silicalite Crystal. A. Paravar and D. T. Hayhurst.	217
6. Experimental and Theoretical Investigations of the Adsorption of n-Paraffins, n-Olefins and Aromatics on Silicalite. H. Stach, H. Thamm, J. Jänchem, K. Fiedler and W. Schirmer.	225
7. Diffusional Transition in Zeolite NaX: 2. Polycrystalline Gravimetric Sorption Studies. O. H. Tezel, D. M. Ruthven and D. L. Wernick.	232
8. Diffusion of Benzene in NaX Zeolite. M. Bulow, W. Mietk, P. Struve, W. Schirmer and M. Kocirik and J. Karger	242
9. The Effect of Cation on Adsorption and Diffusion in ZSM-5. P. Wu and Y. H. Ma.	251
10. Temperature Programmed Water Desorption of Zeolites. 2. Alkali Metal and Alkaline Earth Cationic Forms of Zeolite X. W. A. McCann and L. V. C. Rees.	261
11. Adsorption of C ₈ Aromatics on NaY Zeolite. M. Goddard and D. M. Ruthven.	268
12. Zeolite RHO. Part III. Sorption of Inorganic Gases and Hydrocarbons. R. M. Barrer and M. A. Roseblat.	276
13. The Use of Isopiestic Vapour Pressure Measurements to Study Salt Imbibition by Zeolites. S. G. Fegan and B. M. Lowe.	288
Discussion	298

GENERAL ACID CATALYSIS

1. Dehydration of Cyclohexanol as a Test Reaction for Zeolite Acidity. .. H. G. Karge, H. Kusters, and Y. Wada.	308
2. Relation Between Acidic Properties and Catalytic Performance For Gasoline Synthesis from Methanol Over ZSM-5 Class Zeolites. T. Inui, H. Matsuda, and Y. Takegami.	316
3. Factors Influencing the Selectivity in the Ethylation of Toluene Over ZSM-5 Zeolites. K. H. Chandavar, S. G. Hegde S. B. Kulkarni, P. Ratnassamy, G. Chitlangia, A. Singh and A. V. Deo.	325
4. Isomerization-Disproportionation of M-Xylene Over Dealuminated Mordenites. N. Giordano, P. Vitarelli, S. Cavallaro, R. Ottana and R. Lembo.	331
5. Modified Mordenites for Catalytic Conversion of Methanol. J. Bandiera, C. Hamon, and C. Naccache.	337
Discussion	345

METAL CATALYSIS

1. Physical and Catalytic Properties of Noble Metals in Zeolites. P. Gallezot.	352
2. Structural and Catalytic Properties of Zeolite-Supported Cu-Pt, Cu-Ir, Cu-Rh, and Cu-Ru Bimetallic Clusters. I. Tebassi, A. M. Satarum, A. Ghorbel, M. Dufaux, Y. Ben Taarit.	368
3. Nickel Sulfides in X-Type Zeolite. D. Cornet, A. Ezzamarty, and J. F. Hemidy.	377
4. Mechanisms of Reduction and Metal Particle Growth in Ni^{2+} , Pd^{2+} , and Pt^{2+} Exchanged Faujasites. D. Exner, N. I. Jaeger, R. Nowak, G. Schulz-Ekloff and P. Ryder.	387
5. Characterization and Reactivity of Nickel Loaded Mordenite Towards the CO+NO Reaction. E. Garbowski, M. Primet and M. V. Mathieu.	396
6. Preparation and Characterization of Molybdenum Zeolites. Mark B. Ward and J. H. Lunsford.	405
7. Intrinsically Corrected XP Spectra of Zeolites at Elevated Temperatures: XPS Study of Ni Containing A, X, Y, and ZSM-5 Zeolites. F. Steinbach, J. Schutte, R. Krall, Chr. Minchev, V. Kanazirev, and V. Penchev	417
8. n-Alkane Transformation, Activity and Stability of Platinum-Zeolites. G. Perot, P. Hilaireau and M. Guisnet.	427

9.	Synthesis, Characterization and Catalytic Properties of Rhodium Carbonyl Cluster Compounds Within Y Zeolite Cages. F. Lefebvre, P. Gelin, C. Naccache and Y. Ben Taarit.	435
10.	Hydrosulfurization of the C=C Bond on Me^{2+} -Zeolites. D. Kallo, G. Onyestyak and J. Papp, Jr.	444
	Discussion	454

PENTASIL CATALYSIS

1.	Acid Catalysis With Medium Pore Zeolites. W. O. Haag.	466
2.	Correlation Between the Sorptive and Catalytic Properties of a Series of Pentasil Zeolites. I. D. Harrison, H. F. Leach and D. A. Whan.	479
3.	The Reaction Mechanism of the First C-C Bond Formation in the Methanol to Gasoline Process. J. H. C. van Hooff, J. P. van den Berg, J. P. Wolthuizen and A. Volmer.	489
4.	Shape Selectivity and Acidity of ZSM-5 and ZSM-11 Type Zeolites. J. C. Vedrine, A. Auroux, G. Coudurier, P. Engelhard, J. P. Gallez and G. Szabo.	497
5.	Shape Selectivity of Pentasil-Type Zeolites in the Bifunctional Conversion of Ethylbenzene and Propylbenzene. R. C. Sosa, M. Nitta, H. K. Beyer and P. A. Jacobs.	508
6.	Diffusion and Catalytic Reaction of 2, 2-Dimethylbutane in ZSM-5 Zeolite. M.F.M. Post, J. Van Amstel and H.W. Kouwenhoven	517
7.	Sorption and Catalytic Reaction in Different Preparations of Zeolite HZSM-5. J. Herring and L. Riekert and L. Marosi	528
8.	Ammoxidation of Toluene and Related Aromatics over Zeolite ZSM-5. A New Application of Zeolite ZSM-5. J. C. Oudejans, F. J. van der Gaag and H. van Bekkum	536
9.	Aluminosilicate and Borosilicate Zeolites and Their Use in the Conversion of Methanol to Olefins. W. Holderich, H. Eichorn R. Lehnert L. Marosi, W. Mross, R. Reinke, W. Ruppel and H. Schlimper	545
	Discussion	556

GEOLOGY AND MINERALOGY

1. Mineralogy of Natural Zeolites: Present Status. R. Rinaldi.	570
2. Zeolite Occurrences in Triassic-Jurassic Sedimentary Rocks, Baja California Sur, Mexico. D. A. Barnes, J. R. Boles and J. Hickey.	584
3. Diagenetic Zeolite Zone Modified by Recent High Heat Flow in Miti-Kuromatsunai Hole, Southwest Hokkaido, Japan. A. Iijima, K. Aoyagi and T. Kazama.	595
4. Zonal Distribution of Zeolites and Authigenic Plagioclase. M. Utada and J. D. Vine.	604
5. Thermodynamic Studies of Zeolites. Analcime Solid Solutions. W. S. Wise.	616
Discussion	623

ION EXCHANGE

1. Binary and Ternary Cation Exchange in Zeolite A. L. V. C. Rees.	626
2. Thermodynamic Stability of the Silver-Pyridine Complex in Zeolite Y. E. Rasquin, A. Maes and A. Cremers.	641
3. Pore Size Engineering by Modifying the Zeolitic Pore system of Mordenite. G. Peeters, A. Thys, E. F. Vansant and P. DeBievre.	651
4. Evaluation of Zeolite Mixtures for Decontamination of High-Activity-Level Water in the Submerged Demineralizer System (SDS) Flowsheet at the Three Mile Island Nuclear Power Station, Unit 2. L. J. King, D. O. Campbell, E. D. Collins, J. B. Knauer and R. M. Wallace.	660
Discussion	669

NEW TECHNIQUES

1. Surface Properties of Offretite and ZSM-34 Zeolites. M. L. Occelli, R. A. Innes, T. M. Apple and B. C. Gerstein.	674
2. Study of Cation Effects in LiNaA Zeolites by Silicon-29 and Lithium-7 NMR. M. T. Melchior, D. E. W. Vaughan, A. J. Jacobson and C. F. Pictroski.	684

3.	A High Resolution Solid State ^{13}C NMR Investigation of Occluded Templates in Pentasil-Type Zeolites; Some ^{29}Si Solid State NMR Characteristics of ZSM-5 G. Boxhoron, R. A. van Santen, W. A. van Erp, G. R. Hays, N. C. M. Alma, R. Huis and A. D. H. Clague.	694
4.	The Application of Fast Atom Bombardment Mass Spectrometry (FABMS) to the Study of Zeolites. A. G. Ashton, J. Dwyer, I. S. Elliott, F. R. Fitch, G. Qin, M. Greenwood and J. Speakman.	704
5.	A Non-Empirical Molecular Orbital Study of the Siting and Pairing of Aluminum in Mordenite. E. G. Derouane and J. G. Fripiat.	717
	Discussion	727

STRUCTURE

1.	Structural Chemistry of Zeolites: the Interface Between Structure and Activity. W. J. Mortier.	734
2.	Recent Results in Structural Studies of Zeolites and Zeolite-Like Materials. S. Merlino.	747
3.	Zeolites: The Future. G. T. Kokotailo.	760
4.	Influence of Thallium Ion on Cupric Ion Locations in Cu-TLX Zeolite Studied by Electron Spin Resonance and Electron Spin Echo Modulation Spectrometry. M. Narayana and L. Kevan.	774
5.	Study of the Dealumination and Realumination of ZSM-5 Type Zeolites by ^{29}Si and ^{27}Al High Resolution Magic Angle Spinning NMR Spectroscopy. P. A. Jacobs, M. Tielen, J. B. Nagy, G. Debras, E. G. Derouane, and Z. Gabelica.	783
6.	High Resolution Electron Microscopic and Optical Diffractometric Studies of Zeolites. G. R. Millward, J. M. Thomas, S. Ramdas and M. T. Barlow.	793
7.	Three Dimensional Mapping of the Zoned Aluminum Distribution in ZSM-5. R. von Ballmoos, R. Gubser and W. M. Meier.	803
8.	The Effect of Dehydration upon the Crystal Structure of Zeolite RHO. L. B. McCusker and C. Baerlocher.	812
9.	The Possibilities and Limitations of the Powder Method in Zeolite Structure Analysis. The Refinement of ZSM-5. C. Baerlocher.	823

10. Topological Changes in Dehydrated Zeolites: Breaking of T-O-T Bridges. A. Alberti and G. Vezzalini.	834
11. Neutron and X-ray Refinements of Scolecite. J. V. Smith, J. J. Pluth, G. Artioli and F. K. Ross.	842
12. Framework Topology and Systematic Derivation of Zeolite Structures. M. Sato.	851
Discussion	858

SYNTHESIS

1. Isomorphous Replacements in Zeolites and Other Tectosilicates. R. M. Barrer.	870
2. Determination of Boundary Conditions of Crystallization of ZSM-5 - ZSM-11 in One "Al-Free" System. L. Y. Hou and L. B. Sand.	887
3. The Synthesis and Characterization of Zeolite EU-1. J. L. Casciand, T. V. Whittam and B. M. Lowe.	894
4. Crystallization of Zeolite Y from Solution Phase. S. Ueda, N. Kageyama and M. Koizumi.	905
5. On the Use of Multinuclear High Resolution Solid State NMR Spectroscopy to Characterize Intermediate Phases Formed During ZSM-5 Zeolite Synthesis. Z. Gabelica, J. B. Nagy, G. Debras and E. G. Derouane.	914
6. ²⁷ Al and ²⁹ Si NMR Studies of Aluminosilicate Species in Solution. L. S. Dent Glasser and G. Harvey.	925
Discussion	934

ZEOLITE TECHNOLOGY

1. The Use of Sodium Type A Zeolite in Laundry Detergents. R. A. Llenado.	940
2. Self-Bonded Phillipsite Pellets From Trachytic Products. R. Aiello, C. Colella, A. Nastro, and R. Sersale.	957
3. Effects of Surfactant Structure on Detergency Performance of Laundry Powders Formulated with Zeolite 4A as Builder. L. Kravetz.	966
4. Use of Zeolite NaA for Removal of Trace Heavy Metals from Metal Plating Wastewater. E. P. Hertzenberg.	975
Discussion	984

GEOLOGY AND MINERALOGY AD HOC MEETING	985
POSTER PAPERS	986
DEPOSITORY OF SUPPLEMENTARY MATERIAL	990
AUTHOR INDEX	991
SUBJECT INDEX	995

DON BRECK MEMORIAL SYMPOSIUM

BRECK

zeolite molecular sieves

STRUCTURE, CHEMISTRY, and USE

Donald W. Breck



zeolite molecular sieves



"THE WORD AND WORK OF DON BRECK"

E. M. Flanigen

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Don Breck's contributions to zeolite science and technology are reviewed with emphasis on the remarkably prolific years of the early 50's. In the brief span of a few years the accomplishments included the discovery of zeolites Y, S, L, T and others, the determination of the structure of zeolites A and X, the growth of large crystals of zeolite A, novel methods for metal loading of zeolites, and the development of characterization methods to routinely determine structural and physicochemical properties. His book "Zeolite Molecular Sieves: Structure, Chemistry and Use" published in 1974 represents the culmination of his pioneering work and stands as a monument to his contributions to zeolite chemistry.

INTRODUCTION

Just three years ago at Naples I spoke to this Conference and concluded my talk with the words, "The zeolite future is bright". Shortly thereafter, on the same day, Don Breck presided over his last IZA Council Meeting as President, and said to the Council, "Your expiring President bids you good-bye". The unfolding of history proved Don Breck the better prophet. For the zeolite future dimmed in a short few weeks when Don died suddenly on July 7, 1980.

In July of 1981, just one year after Don Breck's death, the British Zeolite Association honored his memory by holding the Don Breck Memorial Meeting at Chislehurst. At this meeting, the first after Don's death, the International Zeolite Association honors him at this Symposium.

To set the stage for the Symposium, I would like to review with you some of The Word And Work Of Don Breck. Don was one of the pioneers in molecular sieve science and technology. His sudden and untimely death on July 7, 1980 deprived the world of molecular sieves of one of its most illustrious scientists. The breadth of his work spanned the entire field of molecular sieve science.

HIS EARLY LIFE

Don was born January 5, 1921 in Wentworth, N.H., a small rural community set in the mountains and streams of the New England countryside. He lived on a farm. His father was a railroad man. In Figure 1a we see a photo of Don and his family in those early years.

His early education was in a two-room school house in Wentworth. In this setting he already showed some of the signs of the later scientist.

His mother tells the story of when he was eight or nine years old. He sat on a fence in front of the farm watching a large steam shovel repairing the roadway. After watching for a short while he went up to the shed inside of the