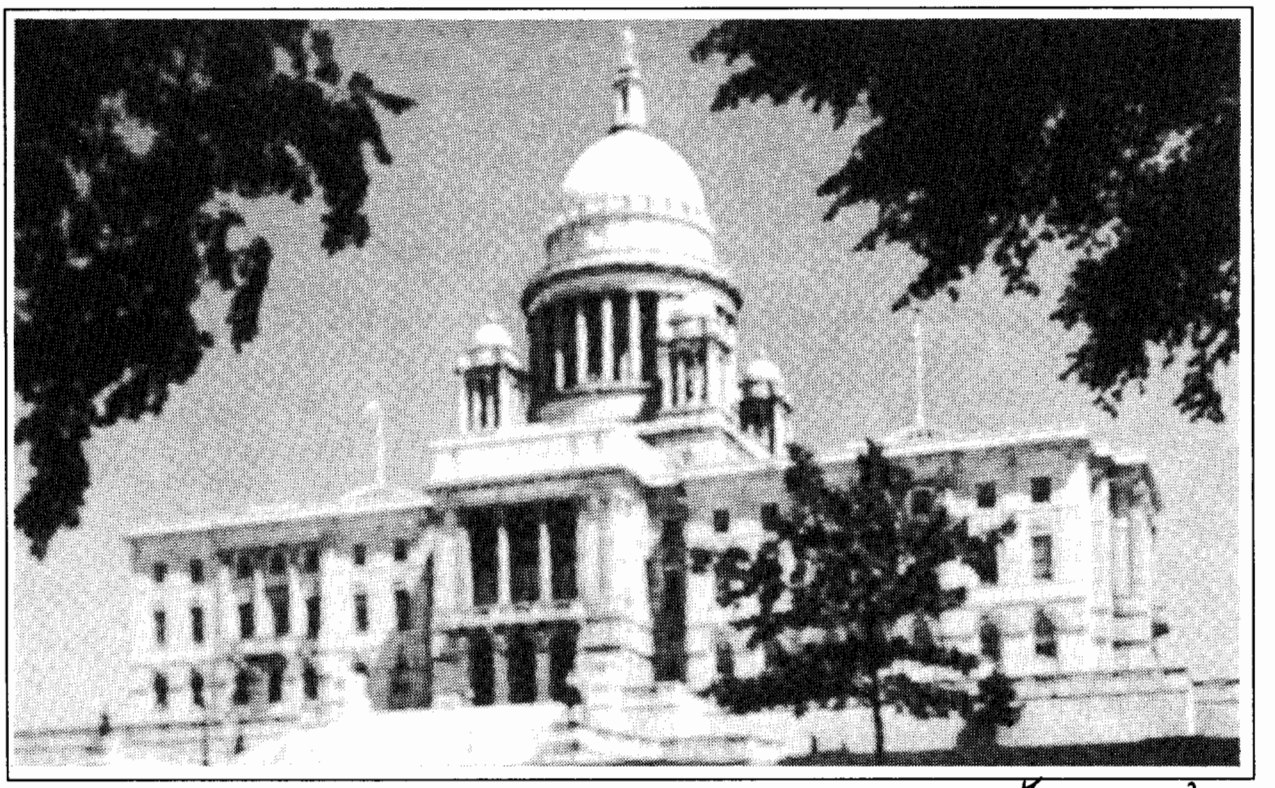
Fall 1992
Vol. 17, No. 4

C_3News

Newsletter of College Chemistry Canada / La Chimie Collégiale au Canada



State House of Providence, Rhode Island — or any other province?

Plans for the 1993 Joint C_3/2YC$_3$ conference, to be held June 3rd to 5th in Providence, Rhode Island are beginning to take shape. This issue of *C_3News* includes a call for papers and some suggested accommodations. Travel options will follow in the next issue, but some may wish to combine the C_3 conference with the CSC (Chemical Education Division) seminar to be held in Sherbrooke, P.Q. just prior to the Rhode Island event. There are likely to be C_3 members who will be taking the relatively easy drive from Sherbrooke to Rhode Island, so some car-pooling may be possible. If you have any interest in doing this, let Anne-Marie Weidler-Kubanek know (her address in on the back page).

In the meantime, this issue also provides a lot of chemical food for thought, and may perhaps stimulate you to submit a paper to the joint conference. In addition, any comments, ideas, demonstrations, opinions or anecdotes you think you would like to share with your colleagues across the country, can be done so through this Newsletter. The deadline for submission of materials for the spring edition is January 31st, 1993.

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1993 Joint C_3 - $2YC_3$ Conference: Providence, Rhode Island

CALL FOR PAPERS

This year's theme is concerned with Chemistry and the International Challenge. This gives us a wide scope of issues on which we might focus. As teachers at the collegiate level, we are near the final result of a process that began for the student some time before. The global nature of our modern society adds yet another variable to the host of problems both we and our students must deal with. So let us meet and discuss these challenges and create a process based on knowledge we have collectively to address the future.

We would like to solicit papers of two types:

1. Short ten minute efforts describing things that we do in class and laboratory which enhance the process of understanding and mastering Chemistry. These will be presented in two different groups so we would be able to accommodate more presenters.
2. More formal presentations of about twenty minutes on specific topics:
   a. Women and other under-represented groups in Science and/or Chemistry
   Challenge #1 – no country, in view of the global competition in science and technology, can afford not to involve significant portions of their populations because of gender, race, religion etc.
   b. Integration of instructional technology in the classroom and laboratory
   Challenge #2 – in a modern world driven by technology choosing appropriate technology which can make learning more effective, more efficient and more accessible must be a priority.
   c. New careers–New curricula
   Challenge #3 – new career paths are evolving very rapidly in this dyna-mic global environment and we must balance the maintenance of sound fundamentals against the necessity of pioneering at the cutting edge of change.
   d. New approaches to instruction in the classroom and laboratory
   Challenge #4 – which topics belong in which course; what is the relationship between laboratory and lecture are among those questions which need to be addressed as we update and upgrade our courses to address the requirements of the learners in our programs?
   e. New relationships between academic institutions, business and industry
   Challenge #5 – we need to promote smooth transfer and articulation between our academic institutions, as well as establish productive interfaces between academic institutions and business and industry if we are to compete against nations who have already begun these processes.

Send a copy of your proposal to:

Anne-Marie Weidler-Kubanek
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C3 News

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Articles of any length will be gladly accepted. Please send typewritten copy to the Editor at the above address or send by fax. Copy can also be sent on a $3^1/_2$" disk, MAC format using Microsoft Word, or any wordprocessor producing ASCII output.

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MOTEL LIST

June 3, 4, 5 1992

The Providence Airport, also called the T.F. Green Airport, is actually located in Warwick, RI very near the campus of the Community College of Rhode Island that our conference is being held at. Interstate 95 is adjacent to the airport (Exit 13) and the Community College is located off the next interchange (Exit 12). All of the motels listed here are within walking distance of the airport terminal or located at a I-95 interchange. We suggest that reservations be made early since a number of local colleges are holding graduations at the same time as our meeting. There may be some slight changes in the rates listed and we are in negotiations to achieve a conference rate at some of these places.

MOTEL	RATE	LOCATION
Comfort Inn 1940 Post Road Warwick, RI (401 732-0470 (800) 228-5150	$ 69.00 1 – 3 occupants conference rate	airport
Econolodge 2138 Post Road Warwick, RI (401) 737-7400 (800) 424-4777	$ 49.00 single	airport
Johnson & Wales Airport Hotel 2081 Post Road Warwick, RI (401) 707-7400 (800) 333-2066	$ 85.00 – $ 115.00	airport
Suisse Chalet 36 Jefferson Blvd. Warwick, RI (401) 941-6600 (800) 5 CHALET	$ 44.70 single	I-95 Exit 14/15
Holiday Inn at the Crossing 800 Greenwick, RI (401) 732-6000 (800) HOLIDAY	$ 115.00	I-95 Exit 12

All prices are US$ and there is currently a 7% tax. We are making arrangements for shuttle service from these motels to the Community College.

GETTING THOSE THOUSAND WORDS RIGHT: A (NON-EXHAUSTIVE) SURVEY OF TEXTBOOK ENERGY PROFILES USED TO EXPLAIN CATALYSIS

Julian M. Dust,
Department of Chemistry,
Sir Wilfred Grenfell College,
Corner Brook, Newfoundland, A2H 6P9.

In the First-year University and College courses and in the Senior High School curriculum two-dimensional energy-reaction co-ordinate diagrams (energy profiles) should be featured prominently. These energy profiles can provide an over-arching structure for General Chemistry courses. For example, energy profiles are valuable in illustrating such important concepts as Hess's Law of Enthalpy Summation, in indicating the fundamental difference between kinetic stability (i.e. persistence and thermodynamic stability[1], and in teaching the basic tenets of kinetics and equilibrium. Further, in the Introductory Organic courses the Reactivity-Selectivity Principle (RSP) is typically presented; it is tied to me conceptual framework of the two-dimensional energy profile[2]. Clearly, these diagrams are an example of the proverbial picture that is worth a thousand words.

In this regard, it is crucial that the picture convey a thousand words that are chemically correct. However, in the present non-exhaustive survey of University and College General chemistry texts (Table 1), High School texts (Table 2) and Nonspecialist[3] texts (Table 3), published recently, two different comparative energy profiles (Figures 1 and 2, *page 6*) are presented as pictorial explanations for catalysis.[4] In the category of University/College texts published between 1989 and 1993 (sic), nine of the eleven texts examined (Table 1) showed the catalysed pathway as a single elementary step with a transition state coincident with that for the uncatalysed pathway as a single elementary step with a transition state coincident with that for the uncatalysed rou; (Fig. 2). Only a lower activation barrier distinguished the catalysed from the uncatalysed pathway. Four texts reproduced the Figure 1 profile in which an intermediate is formed along the catalysed path. (Note that one University text included both profiles as examples of catalysis. Some of the texts include Figure 1 when discussing enzyme catalysis, but rely on Figure 2 to explain catalysis as a general phenomenon.) Generally, both types of comparative energy profile are drawn with the assumption that the overall reaction is exergonic.

Of the High School books surveyed (nine examples) six texts conformed to the Figure 2 presentation and three describe catalysis but provided no illustration. While it should be recognized that the longer publication cycle for High School texts generally means that the University/College books that are extant have more recent publication dates than the High School books, there appears to be no correlation between date of publication and the type of profile used to explain catalysis. A possible explanation for the prevalence of the Figure 2 in the High School texts arises from the ordering of topics. If energy profiles and catalysis are introduced before any discussion of intermediates, then the absence of intermediates in the energy profiles(s) follows logically.

The textbooks intended for nonspecialist Chemistry (General Education) courses did not present an energy profile in discussing catalysis. This may be a result of the relatively small number of books surveyed (four). Alternatively, the establishment of the conventions used in drawing energy profiles (e.g. exothermicity, the meaning of reaction co-ordinate and transition state, etc.) may place energy profiles beyond the scope of a typically nonspecialist course.

To assess the generality of either energy profile (Fig. 1 or 2) in explaining catalyst we must return to the basic definitions. Thus, a catalyst could be defined as a substance that acts to increase the rate of a chemical reaction but that may be recovered from the reaction chemically unchanged. In similar fashion the process of catalysis has been explained in the statement: "A catalyst provides an alternative reaction mechanism with a lower activation energy than the uncatalysed reaction".[5] The idea of a lowering of the kinetic barrier in catalysis is reinforced regardless of the energy profile presented.

However, numerous examples of catalysis involve one or more intermediates along the catalytic reaction route. With the possible exception of unimolecular surface reactions (which show zeroth order kinetics at high concentrations of adsorbed gas and first order kinetics at low concentrations) gas-solid catalytic reactions—the most commonly cited examples of heterogeneous catalysis—involved intermediates.[6] Conceptually, even unimolecular decompositions (e.g. NH_3 on W)[7] can occur in discrete steps: adsorption on the surface, reaction on the surface and, finally desorption of the product(s). The adsorbed reactant can be viewed as an intermediate of lower energy than the free gas molecules. Bimolecular gas-phase catalytic reactions, such as the hydrogenation of ethene (ethylene) over Ni, appear to involve intermediates—radicals in this case.[8] Homogeneous catalysis also generally involves intermediates. For example, in acid-catalysis also generally involves intermediates. For example, in acid-catalysed esterification (and ester hydrolysis) the protonated carbonyl group of the substrate is a frequently cited intermediate (among others)[9] and in enzyme catalysis the substrate-enzyme complex is a kinetically observable intermediate in the Michaelis-Menten treatment.[10,11] Therefore, an energy profile for a catalysed pathway *should show at least one intermediate,* even if the intermediate is a metastable one.

Finally, many of the same textbooks that advanced Fig. 2 as the appropriate catalytic comparative energy profile still included the following set of chemical equations to explain the exothermic decomposition of H_2O_2

to H_2O_2 and O_2, with and without I^- catalyst:

UNCATALYSED $2H_2O_2(aq) \longrightarrow 2H_2O(1) + O_2(g)$

CATALYSED $H_2O_2(aq) + I^-(aq) \longrightarrow H_20(1) + IO^-(aq)$ [fast]

$H_2O_2(aq) + IO^-(aq) \longrightarrow H_2O(1) + O_2(g) + I^-(aq)$ [slow]

It is interesting to note that this oft-cited example clearly involves IO^- as an intermediate along the catalysed pathway. Overall, the energy profile that best describes this set of chemical equations is Fig. 1, with the assumption that the uncatalysed reaction is a concerted one as implied by the equation above.

While Figure 2 may be viewed only as an over-simplification, we feel that it is a potentially misleading one. We hope textbook authors will take these facts into account in future editions—particularly those aimed at the University and College markets—but, at the same time, we wish to point out this problem to teachers and students of Chemistty.

ACKNOWLEDGEMENT

The author extends his thanks to G.W.Rayner-Canham for his insights into the vagaries of textbook publication and for valuable discussions.

References

1. a) M. J. Webb. *Chem. Educ. 61,* 988 (1984)
   b) R. Perkins. *Chem 13 News. 208,* 1 (1991)
2. E. Bruncel and H. Wilson, *J. Chem. Educ. 64,* 475 (1987).
3. Such Nonspecialist or General Education courses would, perhaps, be more typical in a Liberal Arts College setting. For more on Chemistty in the Liberal Arts College see (for example): G. W. Rayner-Canham and M. F. Rayner-Canham. *Educ. in Chem.* 148 (1988).

— *continued on next page*

Table 1 Survey of University/College Texts

Author(s)*	Publication date (publisher)	Type of profile
Atkins, P. W.	1989 (W. H. Freeman)	Fig. 2 (p. 466)
Bodner, G. M. and Pardue, H.L.	1989 (Wiley)	Fig. 2 (p. 852)
Zumdahl, S. S.	1989 (Heath)	Fig. 2 (p. 550)
Brady, J. E.	1990 (Wiley)	Fig. 2 (p. 640)
Ebbing, D. D.	1990 (Houghton Mifflin)	Fig. 1 (p. 584)
Radel, S. R. and Navidi, M.H..	1990 (West)	Fig. 1 (p. 612)
Brown, T. L., LeMay Jr., H. E. and Bursten, B.E.	1991 (Ptentice-Hall)	Fig. 1 and Fig. 2 (p. 505)
Chang, R.	199McGraw-Hill, 4th Ed.)	Fig. 2 (p. 576)
Holtzclaw Jr. H. F., Robinson, W.R. and Odom, J.D.	1991 (Heath)	Fig. 2 (p. 442)
Kotz, J. C. and Purcell, K. F.	1991 (Saunders, 2nd Ed.)	Fig. 1 (p. 344)
Masterton, W. L. and Hutley, C.N.	1993 (Saunders, 2nd Ed.)	Fig. 2

*Due to the similarity in titles the texts are listed only by author(s).

Table 2 Survey of High School Texts.[4]

Title (Author(s))	Publication date (publisher)	Type of profile
MODERN CHEMISTRY. (Metcalf, H.C., Williams, J.E. and Castka, J.F.)	1986 (Holt, Rinehart and Winston)	Fig. 2 (p. 483)
CHEMISTRY. THE STUDY OF MATTER (Dorin, H.)	1987 (Allyn and Bacon)	Fig. 2 (p. 384)
CHEMISTRY. A MODERN COURSE. (Smoot, R.C.,Price, J. and Smith, R.G.)	1987 (Merrill)	No profile
ALCHEM CHEMISTRY. (Smith, J.E., Mackellar, I.and Saumer, D.)	1987 (J. M. LeBel)	Fig. 2 (p. 437)
CHEMISTRY. (Wilbraham, A.C., Staley, D.D., Simpson, C.J. and Matta, M.S.	1987 (Addison-Wesley)	Fig. 2 (p. 398)
UNDERSTANDING No profile CHEMISTRY. (Bruckman, H.J. and Cruickshanks, A.)	1988 (Wiley)	
CHEMISTRY. A FIRST COURSE. (Rayner-Canham, G. Last, A., Perkins, R. and van Roode, M.)	1988 (Addison-Wesley)	No profile
CHEMISTRY TODAY 1. (Whitman, R.L., Zinck, E.E. and Nalepa, R.A.)	1988 (Prentice-Hall)	Fig. 2 (p. 277)
CHEMISTRY. A SECOND COURSE. (Rayner-Canham, G., Fisher, P., LeCouteur, P. and Raap, R.)	1989 (Addison-Wesley)	Fig. 2 (p. 256)

Table 3 Survey of High School Texts.[4]

Title (Author(s))	Publication date (publisher)	Type of profile
CHEMISTRY AND SOCIETY. (Jones, M.M., Johnston, D.O., Netterville, J. T., Wood, J. L. and Joesten, M. D.)	1987 (Saunders)	No profile
CHEMISTRY FOR CHANGING TIMES. (Hill, J. W.)	1988 (MacMillan)	No profile
THE EXTRAORDINARY CHEMISTRY OF ORDINARY THINGS. (Snydet, C. H.)	1992 (Wiley)	No profile
CHEMISTRY. AN INTRODUCTION TO GENERAL, ORGANIC AND BIOLOGICAL CHEMISTRY. (Tiberlake, K. C.)	1992 (Harper Collins)	No profile

76e Congrès de la Société Canadienne de chimie
76th Canadian Society for Chemistry Conference

Sherbrooke, Québec May 30 to June 3, 1993

CHEMICAL EDUCATION DIVISION

SYMPOSIA TITLES

1. **Organic Chemistry for Non-majors - Are we giving them what they need?**
   Organizer: **Gordon Bates**
   Chemistry Department
   University of British Columbia
   2036 Main Mall
   Vancouver, British Columbia, V6T 1Y6
   Tel: (604) 822-2834; Fax: (604) 822-2847
   Invited: B. Newbold, D. Harpp, F. Robinson, S. Ege

2. **Chemistry in Two-year Colleges and CEGEPs.**
   Organizer: **Pat Draper**
   Champlain Regional College
   Lennoxville, québec J1M 2A1
   Tel: (819) 564-3666; Fax: (819) 564-5171
   Invited: G. Rayner-Canham, H. Wilson

3. **Chemistry Competitions, National Examinations and the International Chemistry Olympiad.**
   Organizer: **Robert Cook**
   Bishop's University
   Lennoxville, Québec J1M 1Z7
   Tel: (819) 822-9633; Fax: (819) 822-9661
   Invited: J. Sichel, P. Dupuis, R. Friesen, R. Cook

4. **Computer Applications in the Undergraduate Curriculum — Computer interfacing and simulation and computers as classroom aids.**
   Organizer: **Eric Salin**
   Chemistry Department
   McGill University
   801 Sherbrooke St. W.
   Montréal, Québec H3A 2K6
   Tel: (514) 398-6236; Fax: (514) 398-3797
   Invited: G. Horlick, E. Voigtman, E. Salin

5. **The Role of the Chemical and Pharmaceutical Industry in Chemical Education.**
   Organizer: **Sandu Goldstein**
   Merck-Frosst Canada Inc.
   P.O. Box 1005
   Pointe Claire-Dorval, Québec H9R 4P8
   Tel: (514) 695-7920; Fax: (514) 695-0693
   Invited: T. Sourkes, R. N. Young, J. Pal, M. Tarnow, M. Falk

6. **Popularizing Chemistry.**
   Organizers: **Joe Schwarcz and Ariel Fenster**
   Chemistry Department
   Vanier College
   821 boul. Ste. Croix
   St. Laurent, Québec H4L 3X9
   Tel: (514) 744-7137; Fax: (514) 744-7952
   Invited: D. Hayword, A. Nursall, J. Taylor

7. **The Story Behind the Story: Round II.**
   Organizer: **Hugh J. Anderson**
   Department of Chemistry
   Memorial University of Newfoundland
   St. John's, Nfld. A1B 3X7
   Invited: A. Eastwood, H. Clark, Z. Valenta, P. Deslongchamps

8. **Women's Contributions to Chemistry.**
   Organizers:

Geoff Rayner-Canham	**Viola Birss**
Dept. of Chemistry	Dept. of Chemistry
Sir Wilfred Grenfell College	University of Calgary
Corner Brook, Nfld.	2500 University Drive N. W.
A2H 6P9	Calgary, Alberta
Tel: (709) 637-6200	T2N 1N4
Fax: (709) 639-8125	Tel: (403) 220-6432
	Fax: (403) 289-9488

   (A joint History of Chemistry/CIC Women's Committee Symposium)
   Invited: M. Julian, M. Ainley

9. **Women at the Forefront**
   Organizer: **Viola Birss**
   Department of Chemistry
   University of Calgary
   2500 University Drive N. W.
   Calgary, Alberta T2N 1N4
   Tel: (403) 220-6432; Fax: (403) 289-9488
   (CIC Women's Committee Symposium)
   Invited: M. Back, S. Bradley, S. Abrams, J. Osteryoung

10. **Harris Teaching Workshop** (Friday, June 4, 1992)
    (to be held at the Université de Sherbrooke)
    Organizers: **André Michel** (Université de Sherbrooke)
    Robert D. Cook (Bishop's University)

11. **General Poster Sessions.**

All who are interested in submitting a paper related to any of the above topics should contact the organizers directly.

All other papers related to chemical Education or any general questions about the symposia can be addressed directly to the program chairperson for Chemical Education, Robert Cook.

During one of the general sessions a debate might be organized on the topic:

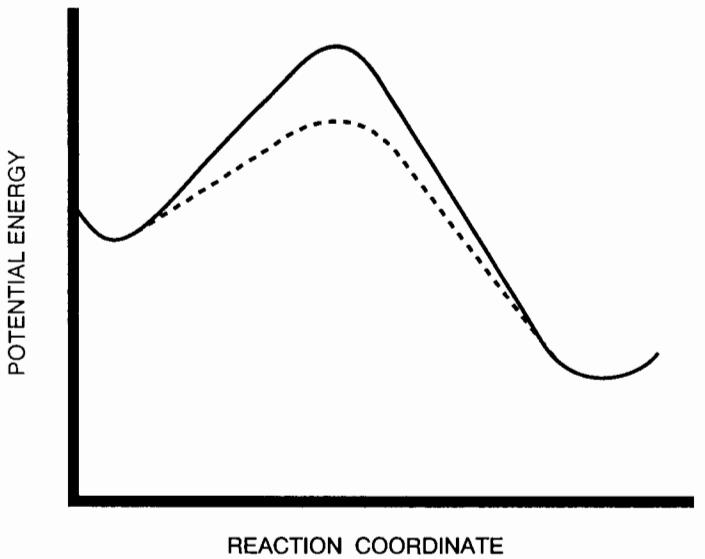
"Is the M.Sc. degree undervalued in our graduate program?

Those interested in taking either the pro or con side of this question are also asked to contact Robert Cook directly.

Program Chairperson: **Robert D. Cook**
Dean, Natural Sciences and Mathematics
Bishop's University
Lennoxville, Québec J1M 1Z7
Tel: (819) 822-9633;
Fax: (819) 822-9661

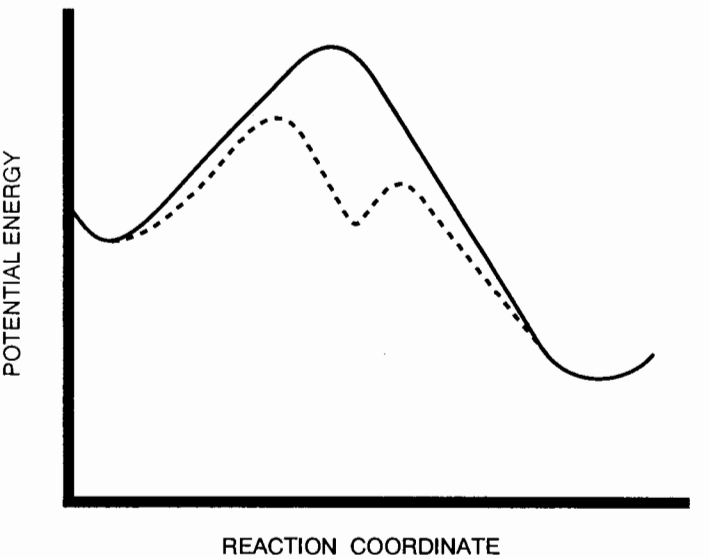
4. All of the texts were compared solely on the basis of the energy profiles used to explain catalysis. The comparison should not be misconstrued to be a thorough critique.
5. S. R. Radel and M. H. Navidi. *Chemistry.* West, 1990, p. 612.
6. K. J. Laidler. *Chemical Kinetics.* 3rd Ed., Harper and Row, 1987, pp. 241-268.
7. C. N. Hinshelwood and R. E. Burk. J. *Chem. Soc. 127,* 1051 and 1114 (1925).
8. G. I. Jenkins and E. K. Rideal. J. *Chem. Soc.* 2490 and 2497 (1955).
9. J. March. *Advanced Organic Chemistry.* 3rd Ed., 1985, p. 335 and references therein.
10. Chang, R. *Chemistry.* 4th Ed., McGraw-Hill, 1991, p. 581.
11. K. J. Laidler. *ibid.*, pp. 399-412.

Figure 1



The solid line indicates a concerted uncatalysed exergonic reaction; the dashed line represents a concerted catalysed pathway.

Figure 2



The solid line indicates a concerted uncatalysed exergonic reaction; the dashed line represents a catalysed path involving a metastable intermediate. Note that a stable intermediate could also be postulated.

Correction

The following note was received regarding the conference report "Crime in the Classrooms" in the volume 17, number 3 edition of in the volume 17, number 3 edition of *C3 News.*

"It was a fine write up except for the last two sentences. I would like to formally correct them. It was mentioned that cheating has been reduced to about 5% (a budget item for a Department Store for shoplifting). While it is true about the budget, that 5% was the level of DETECTABLE, FLAGRANT cheating. The real percent is clearly higher. With the scrambling system in place, as far as we can tell, flagrant cheating has been reduced to zero. The last sentence mentioned that most of the cheaters are in the "Fail to C" range. Actually, the main percentage of serious cheaters are in the "B+ to A" range!!"

It would be helpful to bring these corrections to your readers in a subsequent newsletter. Thank you very much."

— David Harpp, McGill University

Dr. David Harpp addresses the 19th Conference.

HOT FROM THE PRESSES

• Sartoris presents an alternative to the traditional year-long organic chemistry course (*J. Chem.* Ed. 69, p. 750–752, Sept. 1992).

• In the same issue of *J. Chem.* Ed., Wynn considers a question that many of our first semester students often wonder; i.e. does a theory ever become a fact? (p. 741)

• Gribbon and Wesson suggest that we do not need any of the fundamental constants such as the speed of light, Plack's constant etc. . . (*New Scientist*, #1828 pp. 30–33, July 4, 1992).

• A new method of destroying CFC's has recently been reported (*New Scientist*, #1829 p. 22, July 11, 1992). The CFC's are heated with water to 10,000 K and then added to sodium and calcium hydroxide. The processing costs are about $4.00 per kilogram, but the reactor cost is around $4,000,000.

• Some smokers in Brazil are getting more than they paid for. Some brands of cigarettes have an uranium content of up to 0.88 ppm (American brands average 0.07 ppm). The likely culprit is the fertilizers produced from phosphates extracted from high uranium deposits. (*New Scientist* #1834, P. 10, August 15, 1992).

• Bond selective chemical reactions is the subject of an interesting review of the use of lasers to excite specific covalent bonds in molecules. (*New Scientist* #1835, pp. 27–30, August 22, 1992).

• Japanese researchers have developed a process in which methane gas can be produced by passing hydrogen gas over finely divided magnesium and calcium carbonate with a nickel catalyst. The reaction takes place at 675 K, and the yield is about 35 cubic centimetres per hour. (*New Scientist* #1837, p. 14, September 5, 1992).

• Spelunkers are starting to limit the amount of time they spend underground as a result of measurements of the radon content in several caves in Britain. The limit for homes in Britain is 200 becquerels per cubic metre, while the average value for 40 caves was 2900 becquerels per cubic metre. The readings for the summer were elevated, with one cave peaking at 155,000 becquerels per cubic metre. *New Scientist* #1838, p. 4, September 12, 1992.

• A first sighting of buckyballs in the wild has been reported from a town 300 kilometres northeast of St. Petersburg. *Science* 257, p. 167, July 10, 1992.

— *Bob Perkins*

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