

Look It Up, Freshman

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We as chemistry instructors are faced with numerous problems when teaching the beginning chemistry student. Most of us realize the need for learning facts, laws, theories, symbols, equations, properties, etc. Also, we hope to get our students to think, to use these facts and others in their experience in solving their problems, whether they are chemical in nature or not. Often it is necessary to utilize other sources of information so, we attempt to familiarize our beginner with texts other than his own and some of the pertinent journals.

Last fall I decided to put more emphasis on the use of these other sources of chemical information. So, I suggested they examine some of the available general chemistry books when problems arose. The results were like ideas that we all have, sound good, but backfire. This was no exception.

Then as questions went unanswered I kept note of them and decided to check the texts myself. The results of examining thirty general chemistry texts, printed since 1939, are most surprising in terms of our problems. The first problem was a result of the laboratory manual, directions which read "... use dilute alkaline permanganate solution." Of course, some students used ammonium hydroxide and a reaction took place before the other reagent was added. Why? Only one text of the thirty gave much information. Most of the rest stated that permanganate in acidic or basic solution was an oxidizing agent. Fourteen of these books did not have even potassium permanganate in the index. If one had wanted some information about this compound, it would have necessitated considerable searching.

Last year Dr. Brown of Purdue called attention to the inability of entering chemistry graduate students to give a method of hydrogen bromide production. We ran into this problem during a consideration of the halogens. Eight texts bypassed this completely, but some were very good. However, one might have picked the wrong ones.

The third unanswered problem was how one could precipitate lead chromate by adding lead ion to a dichromate solution. Most of the texts suggested this relationship $\text{Cr}_2\text{O}_7 = \overset{\text{Base}}{\rightleftharpoons} \overset{\text{Acid}}{\text{CrO}_4}$. However, this is of little help to the freshman if he adds lead nitrate, which is acid, to the already acidic dichromate solution and still gets PbCrO_4 . None of the texts were of much help on this one.

The fourth problem was an indicator problem, for in using phenolphthalein the students tried concentrated acids and bases and got some

peculiar colors. Textbook survey reveals that phenolphthalein should become pink to red in the range 8.2 ± 0.2 — 10.0 ± 0.2 . Fourteen of the examined books did not include this compound in their index.

The fifth question had to do with the methods of preparation and the properties of the phosphorus halides where phosphorus is tri or penta valent. Eleven texts did not mention them.

As a result of an attempt to answer these questions that might face any freshman it would seem that too many of our present general texts are not very satisfactory as reference books. I know the beginning book is not normally a reference, but for the beginner it should be, if he is to find help. Many of us like the shorter versions that are rather popular now, but he must have some other supplemental information if he is to succeed.

It was most interesting to note the variety of topics in some of the beginning books. For example, these: mayonnaise, van der Waals forces, horsepower, cyprian brass, American Chemical Society, getters, Mojave Desert, RDX, visual aids, etc., etc.

Perhaps we should examine more thoroughly the available references we have for our beginners. We should do our utmost to help them. Just turning them loose with chemistry texts is not sufficient.

Chemistry Texts as References

1. Bogert	6th	FUNDAMENTALS OF CHEMISTRY W. B. Saunders Company, Philadelphia, 1946.
2. Brinkley	3rd	INTRODUCTORY GENERAL CHEMISTRY The MacMillan Company, New York, 1945
3. Briscoe	3rd	GENERAL CHEMISTRY FOR COLLEGES Houghton Mifflin Company, Chicago, 1943.
4. Chapin & Steiner	5th	SECOND YEAR COLLEGE CHEMISTRY John Wiley & Sons, Inc., New York, 1943.
5. Currier & Rose	1st	GENERAL AND APPLIED CHEMISTRY McGraw Hill Book Co., Inc., New York, 1948.
6. Deming	2nd	FUNDAMENTAL CHEMISTRY John Wiley & Sons, Inc., New York, 1947.
7. Deming	5th	GENERAL CHEMISTRY John Wiley & Sons, Inc., New York, 1944.
8. Dodge	1st	INTRODUCTION TO CHEMISTRY C. V. Mosby Company, St. Louis, 1948.
9. Elder, Scott, Kanda	1st	(Revised) TEXTBOOK OF CHEMISTRY Harper & Brothers, New York, 1941.
10. Holmyard	2nd	INORGANIC CHEMISTRY Edward Arnold & Company, London, 1942.
11. Holmes	4th	INTRODUCTORY COLLEGE CHEMISTRY The MacMillan Company, New York, 1947.
12. Irvin & Sherwood	1st	GENERAL AND INORGANIC CHEMISTRY The Blakiston Company, Philadelphia, 1939.
13. Lewis	5th	AN OUTLINE OF FIRST YEAR COLLEGE CHEMISTRY Barnes and Noble, Inc., 1941.
14. McPherson Henderson Fernelius & Mock	1st	CHEMISTRY Ginn & Company, Chicago, 1949.
15. Parkes & Mellor	1st	(revised) MELLOR'S MODERN INORGANIC CHEMISTRY

- Longmans Green & Company, 1939.
16. Pauling 1st GENERAL CHEMISTRY
W. H. Freeman & Company, San Francisco, 1947.
 17. Price & Bruce 1st CHEMISTRY AND HUMAN AFFAIRS
World Book Company, Chicago, 1946.
 18. Ray 1st GENERAL CHEMISTRY
J. B. Lippincott Company, Philadelphia, 1947.
 19. Richardson 4th GENERAL COLLEGE CHEMISTRY
& Scarlett Henry Holt & Company, New York, 1947.
 20. Sherwood 6th INORGANIC AND THEORETICAL CHEMISTRY
Taylor William Heinemann Ltd., London, 1943.
 21. Schock 2nd GENERAL CHEMISTRY
Felsing & Watt McGraw-Hill Book Company, Inc., New York, 1946.
 22. Timm 1st GENERAL CHEMISTRY
McGraw-Hill Book Company, Inc., New York, 1947.
 23. Young & Porter 1st (revised) GENERAL CHEMISTRY
Prentice-Hall, Inc., New York, 1947.
 24. Glocker CHEMISTRY OF OUR TIMES
F. S. Crafts & Company, Inc., New York, 1947.
 25. Babor 1st BASIC COLLEGE CHEMISTRY
Thomas Y. Crowell & Company, New York, 1947.
 26. Roe 6th PRINCIPLES OF CHEMISTRY
C. V. Mosby Company, St. Louis, 1945.
 27. Ehert 6th SMITH'S COLLEGE CHEMISTRY
D. Appleton & Century Company, 1946.
 28. Briscoe 1st GENERAL CHEMISTRY FOR COLLEGE
Houghton Mifflin Company, Chicago, 1949.
 29. Sisler 1st GENERAL CHEMISTRY
VanWerf The MacMillan Company, 1949.
Davidson
 30. Hildebrand 5th PRINCIPLES OF CHEMISTRY
The MacMillan Company, New York, 1947.

TABLE I. Textbook Summary

Dilute Permanganate sol'n. + NH ₄ OH	Preparation of HBr	Why Cr ₂ O ₇ =CrO ₄ =	Behavior of Phenol- phthalein in strong acids and bases	Preparation and nature of PX ₃ or ₅
1. O	No	No Cr	Red in base	Nothing
2. O b	2 methods	Alkali	8.3-10 red	Both
3. NH ₃ R	1 method	Alkali	Red	Both
4. O b	No	None	Red	Nothing
5. O	No	Alkali	Pink	List only
6. O a	1	Alkali	Pink	None
7. ———	2	Alkali	———	Both
8. ———	No	No Cr	Red	None
9. ———	2	Alkali	Red	Both
10. O	2	Alkali	Pink	Both
11. NH ₃ R	1 ?	Alkali	Pink	PCl ₃ & ₅ only
12. ———	2	Alkali	———	Nothing
13. O.	1	Nothing	Red	Preparation
14. O.b.n.	2	Always get PbCrO ₄	———	Preparation

TABLE I. Textbook Summary—Continued

Dilute Permanganate sol'n. + NH ₄ OH	Preparation of HBr	Why Cr ₂ O ₇ = CrO ₄ =	Behavior of Phenolphthalein in strong acids and bases	Preparation and nature of PX ₃ or ₆
15. O.b.	4	Alkali	10 ^{-6.5} H ⁺ Pink	Both
16. O.b.n.	No	Alkali	Red	Nothing
17. O.	No	Nothing	Red	Nothing
18. NH ₃ R	1	In equilibrium	Red	Both
19. O	1	Alkali	Red	Both
20. O	2	Nothing	Red	Nothing
21. Complete Reaction	3	Alkali	—	Both
22. O.	2	Alkali	—	Both
23. O.	2	Alkali	—	Nothing
24. O	No	Nothing	Red	Nothing
25. NH ₃ R	4	No Cr	—	Both
26. —	No	No Cr	—	Nothing
27. O.b.	1	Pb++ get PbCrO ₄	Pink Show	Both
28. O.b.	2	Nothing	Structure	Both
29. O.b.	3	Alkali	Pink	Both
30. O.b.	No	Alkali	—	PCl ₃ only

O.—oxidizing agent

R.—reducing agent

a.—in acid

b.—in base

n.—in neutral