Enriching a course in high school chemistry with articles selected from periodicals

Reed, Carl Eugene
Boston University

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ENRICHING A COURSE IN HIGH SCHOOL CHEMISTRY
WITH ARTICLES SELECTED FROM PERIODICALS

Submitted by

Carl Eugene Reed
(B.S., Colby College, 1935)

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READERS

1. Roy O. Billett, Professor of Education
2. John G. Read, Associate Professor of Education
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CHAPTER I
INTRODUCTION

The purpose of this study. - The purpose of this study is to provide one means of enriching a course in high school chemistry. More specifically, the purpose is to discover and to assemble a variety of interesting and readable articles to be used as an adjunct to the teaching of high school chemistry. The aim is to select the articles from recent periodicals and to organize them as a briefly annotated bibliography.

The status of reading lists in chemistry. - An examination of textbooks and published articles on the teaching of chemistry reveals that no such lists appear to be available. Teachers and writers in the field of science teaching advocate the use of supplementary reading, but the published lists of references include only readings from other texts, from technical journals, or from "popularized" books on science such as Slosson's "Creative Chemistry". Many teachers of other subjects use extensive readings of newspapers and periodicals as regular features of their teaching programs. Some of these readings have proved valuable for years. This study is an attempt to assemble from available periodicals a list of readings valuable to students and teachers of high school chemistry.

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Statement of the problem.- The problem involved in finding and assembling such a list may be resolved into four main parts:

1. The selection of those topics in chemistry which may be considered most functional at the high school level.
2. The selection of those periodicals to be used as a source of articles.
3. The selection of the articles.
4. The assembling of a list of those articles, organized so that each article is related to one of the chosen topics.

Scope of the problem.- Several aspects of the problem are eliminated because of the limited scope of the problem. There is no attempt to select readings in scientific journals, books, or works of a high level of authority in the field of chemistry. It might even be said that this list is on the level of "popular science", since the aim is to select very readable and interesting articles, rather than only those which are technically complete and exhaustive. There is no attempt to exclude articles, which, though they may contain only little chemical science, devote considerable space to economic, social, cultural, physical, or esthetic implications of some phase of chemistry. Finally, only articles included in periodicals from January 1, 1943 to
December 31, 1947 have been examined. The many advances made in wartime and during the recovery period are productive of many worthwhile articles which are up-to-date and quite coincident with the period of reading experience of the average high school student.

The methods used. - The four parts of this study involve the use of methods or modifications of methods already established in other studies.

The choice of functional topics. - The list of functional topics in chemistry is consolidated from lists compiled by other writers. Main topics from each study were written on individual cards. The cards were regrouped by placing all closely related topics together. Duplicate cards were made for each topic which was closely related to more than one group. Items not included from at least half of the sources were eliminated. The others were examined, group by group, for a common unifying item. This item was chosen as representing the functional element in the group. These elements were then classified under larger general topics.

The choice of periodicals. - The periodicals were chosen from lists available in two studies made to determine the interest and value of periodicals to secondary school students. Then ten periodicals rating highest with both boys and girls were chosen from each list. The periodicals which are primarily fictional in content were eliminated. Each of
those remaining was checked for availability in high school libraries by referring to a study of the periodicals subscribed to by those libraries. Five of the most commonly circulated periodicals were then chosen.

The choice of articles.- The choice of articles from these periodicals was then made by examining the table of contents of each issue from January 1, 1943 to December 31, 1947 for articles of possible value. These tentatively chosen articles were then examined individually from the viewpoint of these previously established criteria. First, the article must be closely related to one of the topics chosen as being of probable functional value in chemistry. Second, the article must be included in the table of contents of the periodical and be at least one page in length. Third, the article must be readable, containing relatively little complex technical matter.

The list of articles was prepared by using the numbers of the chosen topics to key each article. The articles were then rearranged in a list so that each is listed under the topic to which it is closely related.
Establishing a Reading Program

The values of extensive reading. — For many years the teaching of chemistry was confined to the intensive reading and interpretation of a single textbook. Even now it is a recognized fact that many chemistry teachers are setting tasks emphasizing the accumulation and retention of factual material from a single text. ¹ Such teaching is quite contrary to the more recent trends toward liberalizing the curriculum and toward changing the methods of teaching to meet the demands of a constantly changing and increasingly complex society. ²

In any of the methods of teaching chemistry advocated by leading educators and practiced by the best teachers, it is evident that the principal emphasis is upon the nature and needs of the individual rather than upon the assimilation of facts, concepts, generalizations, and principles for their own sake. These methods emphasize a closer and a broader contact of the individual with his environment and,


according to Billett, with the direct and the vicarious experience of the race. Several authoritative writers have indicated that such contact may be gained, in part, by an extensive reading program. Waples, Berelson, and Bradshaw have this to say.

Through reading the individual may extend his secondary relationships with the environment; and they may do as much to condition him, to make him what he is, as do his primary relationships.

This view is further supported by Bond and Bond:

Just as the life experiences of the individual add to his background, so do his reading experiences. Wide reading is recognized to be one of the foremost avenues through which the background of the individual can be enhanced or enlarged.

The place of an extensive reading program in chemistry.

Objective evidence more pertinent to this study is furnished by Rice who used 2500 pupils who were studying science in three Pennsylvania high schools. His experiment covered four years using control and experimental sections in each school. His conclusions state, in part, that extensive


reading of scientific materials is a significantly effective method of acquiring a knowledge of scientific facts, that many pupils prefer extensive reading to intensive textbook study, and that pupils doing extensive reading learn additional scientific facts which are not learned by the pupils doing intensive study.

From this evidence it seems reasonable that there be a trend away from the almost exclusive practice of intensive reading assignments and toward the increased use of extensive reading. Two more factors favor such a trend. First, there is the necessity of providing more thoughtfully for individual differences. Since it is a recognized fact that individuals differ quite widely in abilities, aptitudes, interests, and experiences it is obvious that one reading in one chemistry text cannot satisfy all individual needs. It seems more sound psychologically to provide many choices that are centered around a central theme. Second, there is the worthwhile objective of guiding and stimulating an interest in reading chemistry, both as an aid to effective study and to the better use of leisure time.

Though this trend toward the increased use of extensive


reading seems practiced more in English and the social studies, it is now spreading to all science subjects. This trend was indicated by Beauchamp in a study of practices considered to be innovating in improving instruction in science. It is now included in the principles to be followed in choosing course materials for chemistry as advocated by the National Society for the Study of Education. With a continually more complex society developing, it is important for the individual to do more extensive reading in order to keep up with the scientific advances that are close and important to him.

Sources of Material

The choice of functional topics. - The literature on the choice of functional topics for a course in high school chemistry is meager. In fact there seems to be no list of any sort of topics which have been completely validated for such a course. Several analyses have been made of chapter headings of texts and groups of texts, but these indicate only the content of the course or the tendencies in the change of content.


A study completed by Gillson in 1937 furnishes some evidence of topics which may be functional in a high school chemistry course. She analyzed chemistry texts for their important topics and then assembled them for rating in a questionnaire which was sent to two groups for ratings. The General Group consisted of 400 people contacted in a variety of ways, and representing many occupations in many states. The Special Group consisted of people who had completed a course in high school chemistry and who had gone on to college or professional life. More evidence of functionality was sought from a letter to a third group and also from a survey of an essay contest.

The items most functional for members of the General Group were:

1. The realization that new data may change one's idea of truth.
2. The habit of basing conclusions on data, not opinion or prejudice.
3. The habit of securing accurate data for the solution of problems.
4. The habit of analyzing problems before reaching conclusions.
5. Some knowledge of the uses of some of the common elements.
6. Knowledge of what impurities may be present in water and methods of removing them.
7. Knowledge of properties of water.
8. An appreciation of the importance of chemical research.

Margery Stewart Gillson, Developing a High School Chemistry Course Adapted to the Differentiated Needs of Boys and Girls, Contributions to Education, Teachers College, Columbia University, 1937.
10. Some energy manifestations are heat, light, electricity, mechanical energy.
11. Some knowledge of the work of the chemist toward conquering disease.
12. An appreciation of the part chemistry has played in progress of the country.
13. Knowledge of the properties of some of the common elements.
14. Chemistry deals with changes (chemical) in matter which results in the formation of new substances.
15. Matter may exist in these physical states: solid, liquid, gaseous.
16. The state of matter depends upon conditions of temperature and pressure.
17. During chemical change the quantity of matter and involved energy is never increased or decreased.
18. In a given compound the quantity of each element never varies, that is, the composition never varies.
19. Matter occupies space and has weight.
20. Some knowledge of the ways in which the fertility of the soil may be maintained.
21. An acquaintance with some of the things the chemist has created from coal tar.
22. Knowledge of the chemical explanation of burning.
23. The preparation, properties, and uses of common salt.
24. All existing compounds are made from 92 possible elements.
25. Matter is composed of element building materials.
26. Substances (as matter) are of two sorts, simple substances and compounds.
27. Compounds are made up of more than one kind of building materials.
28. In proper proportions acid and base neutralize each other forming water and salt. The solution does not affect litmus.
29. The knowledge of the common tests for some common substances, for example, sugar, starch, metals.
30. Elementary knowledge of use of microscope in identifying materials.
31. Energy is weightless and becomes apparent only in relation to matter.
32. Simple substances, "elements", are composed of only one kind of building material.
33. Acids are substances containing hydrogen which may be replaced by a metal, many of which in water solution turn litmus pink and sour to taste.
34. The source of our fats and oils.
35. Bases are substances containing the hydroxyl group, many of which in water solution turn litmus blue and taste tart.
36. Water solutions of acids, bases, or salts will conduct the electric current.
37. Elementary knowledge of the modern electron theory of the structure of matter.
38. Organic chemistry is the study of hydrocarbons and their derivatives.
39. Hydrocarbons are compounds containing hydrogen and carbon.
40. The hydrogen of the hydrocarbon may be replaced, giving many derived substances.
41. The preparation and properties of soap.

From the questionnaire submitted to the Special Group these additional items were rated most functional:

1. Knowledge of common methods of extinguishing fires.
2. Spontaneous combustion is due to the heat of slow oxidation.
3. Increasing the temperature usually increases the solubility of solids.
4. Knowledge of the meaning of chemical symbols and those of the common elements.
5. Knowledge of the common causes and remedies for hard water.
6. A solution has a higher boiling point and a lower freezing point than its solvent alone.
7. A saturated solution will hold more of the solute at the same temperature.
8. The molecules of solids, liquids, and gases are in constant motion.
9. Knowledge of how ammonia is prepared and used.

An examination of the topics listed above will show that the list is incomplete. The study shows that several other topics are rated of considerable importance either by the men of the group or by the women of the groups. However, the list is of value because it supplies items chosen as a result of objective evidence.
Another valuable list is that produced by Martin. His list contains 730 topics in physical science which were rated by two groups in respect to (a) the frequency of the use of each item in everyday life and (b) the importance of knowing the item. Those in one of the groups were highly trained in science while those in the other group had little science training.

In 1938 a list of functional topics was reported by Ahrens, Bush, and Easley. This list is a result of a twelve year period of reorganizing a course in high school chemistry. During this period the authors assembled and organized those topics pertinent to the solution of problems proposed perennially by the chemistry students in the high schools of Denver, Colorado. The main topics of their organization follows:

The fundamentals of chemistry.

1. Matter.
2. Energy.
4. Formulas.
5. Oxygen and hydrogen.
6. Solutions and ionization.
7. Equations.
8. Acids, bases, and salts.

1/ R. J. Martin, Relative Importance and Frequency of Use of 730 Topics Which Might Be Included in a Practical Course in High School Chemistry, Boston University, School of Education, Unpublished Master's Thesis, 1937.

2/ Progressive Education Association, Science in General Education, D Appleton-Century Co. New York, 1938
The chemistry of the individual.

1. Water in the body.
2. Foods and nutrition.
4. Disease.
5. Drugs and medicine.
6. Cosmetics.
7. Clothing.
8. Chemical hobbies.
9. Vocations related to chemistry.

The chemistry of the home.

1. The cooking and preservation of food.
2. Cooking utensils.
3. Tableware.
4. Fuels and heating.
5. Refrigeration and Air Conditioning.
7. Materials used in modern home construction.
8. Home decoration.

The chemistry of the community.

1. Water purification.
2. Disposal of sewage and other wastes.
3. Food production and distribution.
4. Warfare.

This list is valuable because it is an attempt to find those items which are functional in the lives of the students.

Later Billett\(^1\) translated and telescoped topics from Martin's list and assembled them roughly into 12 groups. His list follows, in part, with only the items included which were rated in the top fourth by both groups of judges:

\(^1\) op, cit. p.6, p. 274-279.
Air.

1. Composition of air.
2. Its relation to life.
3. The process of oxidation - in combustion, rusting of metals, decaying of organic materials, and release of bodily energy.
4. Its relation to the burning process.
5. Cause and prevention of spontaneous combustion.
6. Preventing the rusting of metals.
7. Reasons for painting.
8. Importance of nitrogen to the fertilizer industry.

Other common gases.

1. Carbon dioxide: its uses, as, for example, in fire extinguishers, in beverages, and in baking.
2. Carbon monoxide: production, properties, dangers.

Water.

1. Sources of water supply.
2. Impurities commonly found in water.
3. Methods of purifying.
5. Proper methods of sewage disposal.
6. Diseases caused by impurities in water.
7. Function of water in the body.

Heat, fuels, fire, explosives.

1. Conditions under which combustion takes place.
2. Heat values of common fuels in relation to current prices.
3. Possibly harmful gases liberated from fuels in burning.
4. Principles of extinguishing fires - common fire-fighting chemicals and extinguishers, and how to use them.
5. Explosion: source of power in gasoline engine; causes of mine explosions.

Acids, bases, and salts.

1. Treatment of acid and alkali burns.
2. Antidotes for acid and alkali poisoning.
Metals.

1. Uses of various types of iron and steel.
2. Lead: dangers of lead pipe carrying drinking water; lead tetraethyl in gasoline; arsenate of lead as an insecticide.

Alcohols, petroleum, and the hydrocarbons.

2. Dangerous properties of denatured and wood alcohols.

The soil and agriculture.

2. The soil as a source of minerals, nitrogen, and moisture for plants.
4. Kinds of fertilizers and the use of each.

Textiles and cleansing.

1. How soap cleans.
2. Composition of common washing powders and how they clean.
3. Kinds of stains and how they may be removed.

Foods and body processes.

1. Selection of diet - chemistry of digestion and assimilation.
2. Minerals required by the body, their function, and the foods which supply them.
3. Vitamins: kinds, sources, and harmful effects of a deficiency or an excess of vitamins.
5. Process of pasteurization.
6. Purpose of cooking foods.
7. Molds, yeasts, and bacteria in relation to food.
8. Preventing spoiling of food.
9. Contamination of food through uncleanliness.
10. Foods now sold containing adulterants.
11. Common adulterants and how they may be detected.
12. Providing safe containers for preserving and transporting food.
Medicines and drugs.

2. Dangers involved in the use of drugs.
3. Laxatives: essential constituents; effects on the body.
4. Antiseptics: values, limitations, composition, false claims, proper use.
5. Disinfectants: values, limitations, composition, false claims, proper use.
7. Tooth pastes: values, limitations, composition, false claims, proper use.
8. Talcum powder: values, limitations, composition, false claims, proper use.
10. Common poisons: places and substances in which they are likely to be found; antidotes.

Miscellaneous.

1. The area of human experience with which chemistry is concerned.
2. Opportunities for chemists in various professional, business, and industrial fields.
3. Agents which aid chemical change: heat, pressure, electricity, light, catalysts, and enzymes.

The items from the list by Billett and the items from the list by Ahrens, Bush, and Easley have formed the nucleus of the list of topics chosen for this study. The place of these items is substantiated by Gillson's list and also by the very condensed list of functional topics worked out by the Committee of Chemical Education of the American Chemical Society and reported by Kowald.1/

This list has been arranged, for convenience in relating articles to the proper topics, under 13 alphabetically listed headings as follows:

I. Acids, bases, and salts.
   A. Treatment of burns from these compounds.
   B. Antidote for poisoning by these compounds.
   C. Common acids, bases, and salts; their properties and uses.
   D. Neutralizing substances.
   E. Common salt; Composition, uses, effect on plant and animal tissues.

II. Agriculture.
   A. Composition of soil; sources of food for plants.
   B. Purposes and methods of cultivation.
   C. Kinds and values of fertilizers.
   D. Sulfur in fertilizers and fungicides.
   E. Arsenic compounds as insecticides and weed killers.

III. Air and the common gases.
   A. Composition.
   B. Relation to life, burning, oxidation, decay, energy.
   C. Pressure of gases; effect on the boiling points of liquids.
   D. Carbon dioxide.
      1. Role in breathing, burning, decay.
      2. Uses in fire extinguishers, beverages, cooking.
      3. Cycle with oxygen.
   E. Carbon monoxide; occurrence and dangers.
   F. Nitrogen.
      1. Occurrence in foods.
      2. Importance to fertilizer industry.
   G. Oxygen.
      1. Occurrence; properties.
      2. Use in pulmotors and in artificial respiration.
      3. Uses in industry.
   H. Hydrogen; occurrence, properties, uses.
IV. Foods and nutrition.

A. Production and distribution of food.
B. Carbohydrates, fats, proteins; composition, occurrence, value as food.
C. Vitamins and minerals; role of each in health; occurrence, effects.
D. Milk and pasteurization.
E. Butter and oleomargarine.
F. Coloring, flavoring, and adulteration.
G. Preservation; contamination.
H. Government regulation of preservatives.
I. Digestion and assimilation.
J. Effects of cooking on carbohydrates, fats, proteins, vitamins, minerals.

V. Fuels, fire, explosives, heat.

A. Conditions for fire, explosions, spontaneous combustion; chemical explanations.
B. Heat values of fuel in respect to price.
C. Harmful gases from burning fuels.
D. Role of fuels in engines.
E. Composition and properties of common fuels.
F. Effects of heat on solids, liquids, and gases.
G. Matches; composition; formation; dangers.
H. Coal; occurrence; formation; uses.
I. Petroleum and lubricants.
J. Other useful carbon compounds.
K. Principles of fire fighting.

VI. Health.

A. Antiseptics, disinfectants; properties, uses, dangers.
B. Common drugs and medicines; properties, uses, and dangers.
C. Alcohol.
   1. Denatured alcohol; wood alcohol; properties, uses, and dangers.
   2. Effect of alcohol on the body.
   3. Percentage in beers, wines, and liquors.
D. Common poisons and antidotes.
E. Insecticides.
F. Soaps and cleansers.
G. Cosmetics.
H. Function of water in the body.
I. Sanitation; sewage disposal.
VII. Materials used in and about the home; properties, uses, and protection.

A. Wood and wood products.
B. Stone.
C. Concrete and plaster.
D. Brick, earthenware, porcelain.
E. Glass.
F. Rubber; plastics.
G. Asphalt and asbestos.
H. Paints and other decorative materials.
I. Insulation.

VIII. Matter; its nature, structure, and composition.

A. Solids, liquids, and gases.
B. Elements, compounds, and mixtures.
C. Atoms, electrons, protons, and neutrons.
D. Molecules.
E. Interchange of matter with energy; conservation.
F. Atomic energy.
G. X-rays.

IX. Metals; occurrence, properties, uses, economic importance; important compounds; principal alloys.

A. Iron.
B. Aluminum.
C. Calcium.
D. Copper.
E. Magnesium.
F. Mercury and lead.
G. Silver and gold.
H. Sodium and potassium.

X. Place of chemistry.

A. Area with which concerned and value of study.
B. Relation to other sciences.
C. Relation to professions, business, and industry.
D. Relation to common hobbies.

XI. Principles and mechanics of chemistry.

A. Development of hypothesis; theory; law.
B. The steps in an experiment.
C. Formulas and equations.
D. Chemical and physical changes.
E. Agents which influence chemical changes; heat, pressure, electricity, light, catalysts, enzymes.
F. Fundamental laws.
XII. Textiles and fibers; identification, properties, uses, economic importance.

A. Cotton, wool, silk, rayon.
B. Synthetic products; rayons, nylon.
C. Paper.
D. Pre-shrinking and waterproofing; uses, values, limitations.
E. Dyes and bleaches; nature, action.
F. Laundry soaps; detergents; drycleaning.
G. Stain and spot removal.

XIII. Water.

A. Sources; impurities; purification.
B. Prevention of contamination.
C. As a source of disease.
D. Hardness; causes and treatment.
E. Physical changes; effect.
F. Solutions, ionization, and hydrolysis.

The choice of periodicals.- In choosing periodicals from which to select articles for an extensive reading program in chemistry, it seems psychologically sound to consider those which will interest the prospective reader. Sufficient studies have been made to gauge those interests with a considerable degree of reliability. Eells made a study of periodicals enjoyed and valued by 17,338 secondary-school pupils. Using a questionnaire he discovered that these fifteen rated highest; Reader's Digest, Life, The American Magazine, Time, Saturday Evening Post, Colliers, Literary Digest, Good Housekeeping, Ladies Home Journal, Popular Mechanics, Liberty, McCall's, Cosmopolitan, Popular Science, 


and National Geographic.

From a similar survey published by Witty and Coomer in 1943, the highest ratings were given to: Reader's Digest, Life, Saturday Evening Post, Ladies' Home Journal, McCall's, Good Housekeeping, Colliers, National Geographic, Scholastic, Popular Science, Time, Popular Mechanics, The American Magazine, Esquire, and Look.

Another criterion for choosing periodicals in this study is the availability of the periodicals in high school libraries. In 1945 Mallon examined the circulation of 516 different periodicals in 219 high schools scattered over the eastern part of the country. His results show that these are most common to high school libraries: National Geographic, Reader's Digest, Popular Mechanics, Popular Science, Newsweek, Science News Letter, Harpers Magazine, Time, Current History, Scientific American, Current Biography, Nature Magazine, Scholastic, Vital Speeches, and Hygeia.

The periodicals rating highest on all of these lists are: Reader's Digest, Life, Popular Science, Popular Mechanics, National Geographic, Time, and Saturday Evening Post. The five chosen as sources of articles were the first five.


The choice of articles.- In choosing articles from these magazines the writer assumes that his training and experience in teaching chemistry furnishes him with background enough to enable him to select those articles which have a reasonable bearing on the chemistry topics previously chosen. The articles chosen are assumed to be interesting since they have been included in the periodicals which, as a whole, have proved to be interesting to high school students. They may also be considered readable since they have been chosen for publications having wide circulation. The few articles which contain many technical terms have those terms rather completely defined and described. Many studies of readability have been published, but none of those surveyed gave a complete or objective method of rating articles.
CHAPTER III

BIBLIOGRAPHY OF ARTICLES

Concerning Acids, Bases, and Salts


Concerning Agriculture


8. "Weed Killer", Life (June 9, 1947) Vol.22, No.23, p.84-86. Pictures of results of using 2,4-D.


14. Hodges, Leigh Mitchell, "Are You Neglecting the Wonder Bean?", Reader's Digest (September, 1943) Vol.43, No.257, p.107-109. The use of soybeans; variety of products from; values as food; values to land.


25. "DDT", Life (July 8, 1946) Vol.21, No.2, p.47-54. The properties, uses, and potential dangers of DDT.
Concerning Air and the Common Gases

Uses of carbon dioxide in inflating life preservers and rescue boats; use in fire extinguishers on planes and ships.

An effective method of cleaning air by electrical means; types of material it removes from air.

Home experiments with nitrogen; characteristics and uses.

Method of obtaining and purifying helium; uses; properties.

The use of carbon dioxide in inflating rafts, in fire extinguishing systems on planes.

New methods in air-conditioning; new places where now necessary; chemicals used.

Use of sulfa drugs and glycol sprays in decreasing disease epidemics; army experiments.

The properties and new uses of helium in wartime industry.

New system to provide oxygen in varying amounts according to the needs of flyers.
The production and storage of helium; uses of helium in industrial processes.

Home experiments in the preparation of oxygen and the tests of its properties.

Home experiments in the preparation of hydrogen and the tests of its properties.

Home experiments in the preparation, properties, and uses of carbon dioxide.

Tests for war gases by chemicals; method of testing with a chemical testing device.

Effects of the lack of oxygen; tests in pressure chamber; problems of oxygen supply.
Concerning Foods and Nutrition,

The process of the dehydration of foods; characteristics of dehydrated foods; reconstitution; values.

The use of vitamins and proper diet to combat fatigue.

Description of some of the basic steps in the most used processes of canning and preserving.

Problems in nutrition in the U.S.; the status of the average diet.

The preparation and freezing of complete meals.

6. Clark, Blake, "Only One Way to Get Thin" Reader's Digest (November, 1943) Vol.43, No.259, p.31-34.  
Reason for overweight; dangers of freak diets or quick loss of weight; necessity of doctor's advice; features of good diets.

Diseases carried in milk; proper steps in the processes of pasteurization and storage; codes.

The use of soy beans in different forms as food; preparation; food values.

Work of keeping impure and dangerous foods and drugs off the market; prosecutions.
   The processes in the gathering, curing, and roasting of coffee; values of coffee as a stimulant and morale factor.

   New food discoveries; new food combinations; new treatments to make edible previously unused plant and animal life.

   Problems being solved by scientists to bring better foods to the table; processing, preservation; increasing vitamin content.

   Simple chemical tests for the presence of common poisons and adulterants.

   How to test for the presence of chicory; use of chicory as a "stretcher"; other substitutes.

   Production of basic foods; consumption of food in the world; basic elements of foods; uses in the body.

   The physiological and psychological effects of a famine type of diet; the elements of a starvation type of diet.

   The history of the development and manufacture of a popular beverage.

   The production of food from the resources of the sea; food values of plants from the sea.
Concerning Fuels, Fire, Explosions, Heat

   New products from petroleum.

   The composition of smoke from industrial furnaces; treatment of the smoke to extract mineral particles.

3. "No. 1 Enemy on the Home Front", Popular Mechanics, (April, 1944) Vol.81, No.4, p.82-87.
   Results of fire damage in the U.S.; methods of fire-fighting.

   The production of glycerine; economic importance; use in making explosives, solvents.

   The problems of burning applied to jets and rockets.

   Provisions for fighting fires at sea; training, equipment, methods.

   Problems in the discovery and production of petroleum; importance to the war effort.

   Mining and production of phosphorus; industrial uses of phosphorus and its compounds; use in incendiaries.

   Safety measures taken to prevent mine explosion; methods of rescue.


13. "Mining a Mountain of Oil", Popular Mechanics (September, 1946) Vol.86, No.3, p.156-160. The process of extracting oil from shale; problems to be solved; effect on petroleum reserves.


   Vol.21, No.18, p.97-100.
   Liquid invention with possible uses to conduct heat for all heating in the home.

20. "Jet Furnace", Life (December 16, 1946)
   Vol.21, No.25, p.51-54.
   New furnaces designed to extract more heat from oil fuels.

   Vol.22, No.15, p.53-56.
   The production of gasoline from coal; schematic diagrams of laboratory and plant operation; values of the method.

   Vol.23, No.5, p.85-86.
   Paint with chemicals added which give high insulating qualities and the protection against flames.

23. Atwood, Albert W., "Coal: Prodigious Worker for Man",
    Sources throughout the world; economic aspects; cause of industrial revolution; geology; types; process of strip mining; construction of mines; hazards in mines; shipping problems; place in coke and steel making; by-products.

24. Borland, Hans, "Where There's Smoke",
    Chemical warfare; the composition and use of smokes, incendiaries, signals.

25. __________, "What Will Be Tomorrow's Motor Fuel?",
    The process of cracking oils to produce gasoline; the meaning of "octane"; new fuels.

26. Cookman, Aubery O., Jr., "Don't Pour Coal up the Chimney",
    Methods of using coal efficiently for home heating.

27. Elliott, Allen Warren, "Diving for Oil",
    Popular Mechanics (June, 1945) Vol.83, No.6, p.82-87.
    Problems in the drilling for oil from deposits under sea or lake.


38. ----, "Hell's a-Poppin' in Kansas", Reader's Digest (April, 1945) Vol.46, No.276, p.35-37. Production of rocket fuels; dangers and safeguards; properties of the fuels.


The production of heat by radio frequencies; use of the method in the treatment of plastics and metals.

Steps in the process of producing T.N.T.; problems and safety devices.

Production; storage; uses; by-products; synthetics.

50. ————, "Now We Have Synthetic Gasoline";
Reader's Digest (March, 1946) Vol.49, No.287, p.31-32.
The synthesis of gasoline from natural gas.

51. ————, "Radio Heat Makes Production Jump",
Creating heat inside materials in order to change their properties.

Synthetic substances for lubrication; advantages over petroleum products.

Octane ratings of new fuels; problems for engineering.

Products from petroleum produced by chemists; by-products of the cracking process.

History of T.N.T.; present method of production; properties and uses.

56. Swezey, Kenneth M., "Chemistry Answers the Fire Alarms",
Popular Science (December, 1946) Vol.149, No.6, p.132-133.
The principles and action of fire extinguishers; home experiments.


Concerning Health


4. "Toilet Soap Kills Germs on Skin", Popular Science (September, 1945) Vol. 147, No. 2, p. 82-83. The addition of a new chemical to soap to make it an effective germicide.


10. "New Malaria Drugs", *Life* (July 22, 1946)
   Vol.21, No.4, p.55-56.
   Graphic results of tests of using quinine, atabrine,
   and SN 13,274 to combat malaria attacks.

   Vol.21, No.10, p.51-54.
   Use of benadryl and pyribenzene to treat allergies.

   p.51-54.
   How the sunlight affects the skin; the use of
   lotions and their effect; nature of different skins.

13. "What Science Learned at Bikini", *Life* 
   (August 11, 1947) Vol.23, No.6, p.74-85.
   Photographs of the physiological effects of radio-
   activity from the atom bomb.

14. "Lipstick", *Life* (October 20, 1947) Vol.23,
   No.16, p.87-99.
   The composition of lipstick; photographs of its
   manufacture and inspection.

15. Ackerman, Jean, "Drinking Water from the Sea", *Popular
    Science* (January, 1944) Vol.144, No.1, p.41-44.
    Methods of de-salting sea water; chemical and
    physical processes.

16. Armagnac, Alden P., "Can We Grow Hemp without Dope?",
    *Popular Science* (September, 1943) Vol.143, No.3,
    p.62-63.
    Problems of growing a variety of hemp which will not
    produce harmful drugs.

    No.1, p.102-108.
    Prevalence of malaria; role of the mosquito; effects;
    treatment.

    The use of chemicals as selective pest eliminators.

19. Clark, Blake, "Lifting the Cigarette Ad Smoke Screen",
    The true facts behind claims in cigarette ads;
    findings of the Federal Trade Commission.
    Claims made in dentifrice ads contrasted to facts; findings of the Federal Trade Commission.

21. ________, "Only One Way to Get Thin", Reader's Digest (November, 1943) Vol.43, No.259, p.31-34.
    Reasons for overweight; relation to health; proper treatment; dangers of freak or fast diets.

22. Colvin, James, "If the Axis Uses Gas", Popular Mechanics (December, 1943) Vol.80, No.6, p.27-31.
    Description of casualties from modern gases; first aid treatment; composition of gases.

    Uses of radio-active isotopes in tracing the course of medicine.

    The dangers resulting from the use of atomic bombs; methods by which radio-activity spreads; physiological effects.

    Problems in finding, gathering, and processing cinchona bark; importance to medicine.

    Recent discoveries and their uses in medicine; sulfas; penicillin; vitamins; hormones.

27. ________, "Pain Killers Save Lives", Popular Science (April, 1944) Vol.144, No.4, p.120-122.
    New drugs and new techniques in the treatment of pain.

    Diseases carried by milk; proper pasteurization.
Injections to combat hay fever; development of treatments.

Keeping impure and dangerous drugs off the market; legal limitations; prosecutions.

Effect of sun's rays on the eyes; correct and effective types of sun glasses; choosing glasses wisely.

Composition of sleeping pills; effects of habitual or over-use.

33. de Kruif, Paul, "Hope for the Victims of Arthritis", Reader's Digest (November, 1943) Vol.43, No.259, p.31-34.
Characteristics of arthritis; new drugs and treatments.

Use of penicillin and heparin in treatments for certain types of heart disease.

Life of a great chemist; dramatic experiments and their results; valuable products from research.

Development and use of prostigmin in the treatment of infantile paralysis.

Development and use of demerol as a substitute for morphine and other drugs.
   Function of new drugs in combatting allergies.

   The use of diet in conquering certain forms of anemia.

   The development and use of a vaccine in attempting to cure tuberculosis.

   The synthesis of quinine; history; problems in development; uses.

   Production and uses of ultra-violet and infra-red rays; uses in medicine and food protection.

   The use of curare in the treatment of disease.

   Investigations into the chemistry of cells and the results; production of a new and effective burn treatment.

   Use of sulfa drugs and glycol sprays in decreasing the extent of disease epidemics; results of army experiments.

   Use of isotopes and radio-active elements in the study and treatment of cancer; production of isotopes, method of tracing.


53. Sinks, Alfred H., "Rats Bite the Dust", Reader's Digest (October, 1946) Vol.49, No.294, p.52-54. The development and use of ANTU, a new chemical; use in killing rats; how it kills; prospects for use.

54. Stevenson, Charles, "If You Need a Drink Don't Take It", Reader's Digest (September, 1947) Vol.51, No.305, p.57-60. Scientific studies of the effects of alcohol on physiological and psychological processes.


58. Vogel, William, Jr., "The Truth about Tobacco", *Popular Science* (July, 1943) Vol.143, No.1, p.84-89. The composition of tobacco for different uses; growing and curing; myths and misinformation about use; poisonous contents.


62. Wickware, Francis Sill, "Liquor", *Life* (May 27, 1946) Vol.20, No.21, p.66-80. The history and myths concerning the use of liquors; the physiological and psychological effects; dangers resulting from the use of liquors habitually or to excess.
Concerning Common Materials


16. "Glass", Life (March 12, 1945) Vol.18, No.11, p.73-84. The raw materials and their use in the production of glass of different types; essential products; special features and properties.


18. "Electric Glass", Life (September 16, 1946) Vol.21, No.12, p.129-133. The surface treatment of glass with a substance which makes it a conductor of electricity; the uses for the combination.


Characteristics of synthetic rubbers; values of the synthetic products.

Methods of making concrete for various constructions about home.

Types of plastics and how they are made; schematic diagrams of production; methods of forming.

The substitution of glass for many devices; new qualities, methods of production.

The formation and uses of several plastics; composition and properties.

How chemists have produced useful things from wood waste; economic importance; simple steps in some of the processes.

Methods of insulation; how each saves heat; estimating savings.

Types of glass; uses; history; glass making, forging, blowing, polishing; composition, colors.

The production of optical glass; treatment; uses; composition.


37. Riis, Roger William, "Rubber - It's Coming at Last", Reader's Digest (July, 1943) Vol.43, No.255, p.81-83. Story behind the synthesis of rubber; raw materials; composition; properties.

Newest plastics; properties; versatility.

Use of fluoride coating of glass surfaces.

New compounding of glass with pure compounds; values of new glass.

Use of plastics in heavy construction; use in housing.

Development, Properties, use of a substance for waterproofing basement walls.

New methods of treating glass; new properties and uses in construction.

45. ———, "Color Punches the Time Clock", Reader's Digest (June, 1947) Vol.50, No.302, p.76-78.
The values of color in business and industry.

Home experiments with calcium compounds; explanation of the formation of mortar, plaster, and concrete.

Protection of surfaces with a new plastic varnish.

Simple experiments in the synthesis of rubber.

Experiments in polymerization and the use in the production of plastics.
The properties and uses of a versatile adhesive.

New plastics; properties and uses.
Concerning the Structure of Matter

   Structure of matter; atomic energy, its history and uses.

   Color photographs of atomic bomb blast.

   Pictures of molecules magnified by electron microscope.

   Explanation and illustration of nuclear fission and its results; research behind the atomic bomb.

   Color photographs of the principal effects of the emission of electrons under certain conditions.

   The chemical and physical effects of the atom bomb blast on some materials.

   Construction and use of a device to detect radioactivity.

   History of the development of work on the atom; laboratory problems; safety; essential methods.

   Photographs of the atom bomb blast.

    Production of a burst of electrons and its effect on materials.
11. Armagnac, Alden P., "What's behind Atomic Power?", Popular Science (October, 1945) Vol.147, No.4, p. 68-73. Basic terminology in atomic chemistry; fundamental principles; sources of materials; history; uses.


15. Davidson, Dr. W. L., Jr., "We Can Harness the Atom", Popular Science (December, 1945) Vol.147, No.6, p. 65-69. Essential facts of atomic power; terms; fundamental principles; prospective uses.


Concerning Metals


5. "Magnesium - The Light Weight Giant", Popular Mechanics (June, 1944) Vol.81, No.6, p.44-47. Source of magnesium, production; properties and uses.

6. "Silver Goes to War", Popular Mechanics (July, 1944) Vol.82, No.1, p.72-75. The wartime use of silver as a substitute for other metals.


11. "Blending Metals to Arm Our Fighting Men", Popular Science (June, 1943) Vol.142, No.6, p.98-103. Alloys; meaning; types; formation; important examples and the use of them.


Wartime uses of silver as substitute for other metals.

Use of heat and pressure in the formation of metal parts; special properties resulting.

The modern production of lead shot; metal alloy used.

Simple experiments with aluminum and its compounds.

Simple home test for the different common metals.

Experiments about the chemistry of the metal, its compounds and alloys.

Simple experiments with tin.

Experiments with silver and its compounds.

Experiments in plating metals with an electric current.

Experiments with magnesium and its compounds.

Experiments with chromium and its compounds.
Experiments with zinc and its compounds.

(October, 1945) Vol.84, No.5, p.11-15.
Two articles about the location and iron ore mining on the Mesabi range; composition of the ore; problems.

Simple experiments with iron.

Nature and causes of corrosion of metals; methods of combatting; new lubricants.

Using new techniques in order to make steel do the job of brass.
Concerning the Place of Chemistry

   Chemistry in the science of chemurgy; the production of useful products from wastes.

   The elements of recent color photographic processes.

   Method of developing and printing color films at home.

   What occurs in the essential steps of the photographic process.

   Method of printing photographs on any substance.

   Directions for developing color film at home; precautions.

   Steps in developing and printing own films.

   Essential features of a new process for developing and printing photographs.

   Description of the types of jobs chemists are doing in wartime.

    Simple experiments with sulfur and its compounds.


Experiments sometimes used in crime detection done in the home laboratory.

Experiments showing the properties of the metal; its compounds and alloys.

Experiments with tin and its compounds.

Experiments in making and testing hydrogen.

Experiments with the more common halogen compounds.

Experiments showing the nature of solutions.

Experiments showing what occurs in a flame and what the products are.

Experiments with silver and its compounds.

Experiments showing how rubber-like material may be produced.

Experiments in titration to show the strength of common acids.
Experiments in producing and testing the properties of carbon dioxide.

Experiments showing the properties of hydrogen peroxide.

Experiments showing the chemistry of spots and stains and their removal.

Experiments showing the chemical properties of alcohol.

Experiments in electrolysis.

Experiments showing why polymerization takes place; characteristics of compounds changed by polymerization.

Experiments showing the properties of cellulose.

Experiments with magnesium and its compounds.

Experiments with dyes; formation and proper use.

Experiments with chromium and its compounds.

Experiments showing the process of adsorption.
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<td>52</td>
<td>&quot;Chemistry Spins a Yarn&quot;, Popular Science (December, 1947) Vol.151, No.6, p.214-217.</td>
<td>Experiments showing how simple rayon fibers may be made.</td>
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Concerning the Principles and Mechanics of Chemistry

   Simple home experiments that illustrate some of the fundamental principles of chemistry.

   Mining of phosphate rock; principles used in making the mineral useful.

   The effects of light on chemicals; how the photographic process occurs.

   Principles of distilling turpentine, rosin, and tar from pine gum.

   The use of light to speed or retard the chemical processes occurring in plant growth and maturity.

   Principles of producing and purifying penicillin and streptomycin.

   The principle of producing ultra-violet and infra-red rays; their use in medicine and food production.

   Principles of producing and tracing isotopes.

   Two recently discovered elements; the nature of the atom; the periodic table and its uses.
Account of the synthesis of gasoline from natural gas; principles involved.

Source and mining of asphalt; processes of production; uses.

Principles involved in the use of dry ice to produce rain.

Experiments showing the use of catalysts and how they act.

Experiments showing the nature and properties of solutions.

Experiments showing the principles of burning.

Experiments showing how rubber may be synthesized.

Experiments showing the principles of electrolysis.

Experiments showing the principles of polymerization and its effects.

Experiments showing the principles of adsorption.

Experiments showing the formation and characteristics of emulsions; common emulsifying agents.
Experiments showing the formation and characteristics of colloids.

The science of testing gasolines for different properties; principles involved.
Concerning Textiles and Fibers

1. "America's No.1 War Crop", Popular Mechanics (October, 1943) Vol.80, No.4, p.40-43. Cotton; growth, processing, uses; values to the war effort.


Simple experiments showing the effects of different agents to remove spots and stains.

Experiments with dyes and their use on fabrics.

Experiments showing the properties of cellulose.

Chemical tests for the identification of common fabrics.

Experiments with the fundamental processes of making rayon fibers.
Concerning Water


Problems of obtaining water in an arid region; necessity for irrigation; relative amounts needed for plant growth.

The use of chemicals to soften water to increase its effectiveness in cleaning.
CHAPTER IV

CONCLUSIONS

Results of Study

1. This study produced a total of 357 different articles of possible use in enriching a course in high school chemistry. An examination of the articles shows that Popular Science furnished 129 articles; Popular Mechanics, 97; Reader's Digest, 75; Life, 48; and National Geographic, 8. Fifty-five of the articles chosen from Popular Science and one of those chosen from Life were experiments which might easily be done at home or in the high school laboratory.

2. Some of the articles were related to more than one topic. Seven articles were closely related to acids, bases, and salts; 25 to agriculture; 15 to air and the common gases; 18 to foods and nutrition; 62 to fuels, fire, explosions, and heat; 62 to health; 51 to common materials; 24 to the structure of matter; 35 to metals; 52 to the place of chemistry; 22 to the principles and mechanics of chemistry; 23 to textiles; and 11 to water.

3. Each chosen topic had several articles related to it. The periodicals had more articles, sixty-two, concerning health than concerning any other single subject. The

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periodicals also had sixty-two articles related to fuels, fire, explosions, and heat. Seven articles were related to acids, bases, and salts.

4. The length of the articles and the illustrative materials they contain make them desirable for supplementary reading. With the exception of those chosen from National Geographic most of the articles were short, consisting of less than five pages of text. With the exception of those chosen from Reader's Digest, the articles were liberally illustrated with photographs. Occasional articles from Popular Science, Popular Mechanics, and Life contained illustrative charts, diagrams, or graphs.

5. This study has not exhausted useful materials from these publications. Many shorter articles, single photographs, and articles on topics not included as functional, might be of value to some students.

Suggestions for Use of the Articles

1. These articles may prove to be useful for those who are developing the unit method of teaching. Several of the articles are directly and closely related to the basic learning products desired in a course in high school chemistry. Others provide a rich field for optional work. The list contains articles adaptable to a wide range of interests and abilities. Some of the articles devote a major portion of space to
photographs. Some are mostly text. Some have almost no technical terms. Some have simple technical terms and also explanations of more complex ones.

2. The fact that, in several instances, two or more articles are different viewpoints of exactly the same subject makes them valuable bases of discussion or of reports to the class.

3. The including of information on economic, social, historical, industrial, and other aspects of the subject enhances the value of the articles for collateral reading, especially in the unit method.

4. For any of the recently advocated methods of teaching chemistry, this list furnishes new material for extensive reading, bringing many concepts up-to-date.

5. Considering the numbers of articles obtained by reviewing each of these publications for the past five years, one might expect that the approximate yield each succeeding year would be twenty-five articles from Popular Science, twenty from Popular Mechanics, fifteen from Reader's Digest, ten from Life, and two from National Geographic.