THE DEVELOPMENT OF MATERIALS
FOR A COURSE OF INSTRUCTION
ON
THE HISTORY OF NUTRITION

A Project
Presented in Partial Fulfillment of the
Requirements for the Degree of
Master of Science

by
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The Ohio State University
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Approved by

[Signature]
Adviser

Department of Human Nutrition
and Food Management
ABSTRACT
The Development of Materials for a Course of Instruction on the History of Nutrition


A syllabus and materials were developed for a course of instruction on the history of nutrition. Books and other publications were searched for events, personages and dates pertinent to the emergence of nutrition as an independent field of study. A questionnaire was developed and sent to students who had recently completed a similar course requesting their suggestions. The history of nutrition science was traced from its inception in ancient times to the present. Reports of research in chemistry, biochemistry, physiology and related sciences provided the series of items which was organized into a chronological history of events as Study Guide: Part I, on which the class schedule was then based. Study Guide: Part II was prepared as a second approach to teaching the histories of special nutrients or nutrition-related topics, and each was handled separately to provide a rapid and comprehensive reference to a given subject. Supplementary materials and reference lists were prepared and suggestions made for additional publications to be placed on library closed reserve. Specific topics or activities were assigned for each of the thirty lecture periods.
ACKNOWLEDGEMENTS

The author wishes to express her sincere appreciation to Dr. Virginia Vivian for her guidance and assistance in the preparation of this project and for her encouragement during the course of the graduate program. A grateful word of thanks is extended also to the students who returned a one-hundred-percent response to the questionnaire and whose comments and suggestions were very helpful in developing the material. Finally, a very special appreciation is expressed to my husband for his unswerving support and encouragement and for patience beyond the call of duty.
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INTRODUCTION

The history of nutrition is the history of man's endeavors in many fields of science—medicine, chemistry, biology, biochemistry, physiology, microbiology, agriculture, physics. To properly understand what nutrition is today, it is helpful to reach back into those disciplines and to learn how each has made its contribution to present knowledge and how all have interacted to lead man's thinking toward a separate but related field, human nutrition. Investigators in nutrition are now in a position to make positive contributions to the growing body of knowledge directed toward improving the quality of life in all dimensions.

Purpose and Objectives

The purpose in this project was to develop a syllabus and materials for a course in the history of nutrition which would assist students in integrating the information which comes to them from many areas of study. The growth of nutrition science was traced from its conception in the minds of the philosophers and physicians of ancient Greece to its present status as a synthesis of many sciences. An increased awareness of people and events in the field of nutrition, past and present, should enhance the potential of students for making their contributions to the future.
REVIEW OF LITERATURE

Early historical and scientific events have been well documented and related to various fields of study. Various investigators in food and nutritional sciences have provided major sources of information: Lusk (1928), McCollum (1957), Taylor (1966) and Maynard (1962). Todd-hunter (1976) has developed a chronology of important events. She has also published extensive bibliographic materials in various journals of the American Dietetic Association, such as "Classics of Nutrition and Dietetics" (1964).

Other valuable sources of information included Pike and Brown (1975), American Men and Women of Science (1976), and Recommended Dietary Allowances, Food and Nutrition Board (1974).
PROCEDURE

A syllabus and materials were developed for a course of instruction on the history of nutrition. Several books and other publications were searched for information which was included in two study guides. A questionnaire was distributed to students who had recently completed a similar course and their suggestions were considered in preparing the materials (Appendices A and B).

Subject matter for the course was organized for presentation in chronological order based on thirty lecture periods, and students' reading and reporting assignments were designated for specific periods.

Study Guide: Part I was arranged in chronological order and was composed of selected events from nutrition history along with the investigators involved. Study Guide: Part II was prepared to provide a second approach to the histories of selected nutrients and nutrition-related topics. Each topic was handled without reference to other subject matter.

In addition to the syllabus itself and the two study guides, special instructions were outlined for oral reports and term papers; a comprehensive bibliography was included; and suggestions were made for certain publications to be placed on closed reserve for easy student access.
MATERIALS FOR THE COURSE

HISTORY

OF

NUTRITION
SYLLABUS: HISTORY OF NUTRITION

   Persons, discoveries, and methods in the evolution of nutrition as a science and a factor in the control of human welfare.

2. **Prerequisite**: Humn. Ntr. 610 and permission of instructor.

3. **Objectives of Course**:
   1) To study the evolution of nutrition as a science through examination of individual scientific contributions.
   2) To correlate information concerning discoveries, methodology and investigators with the development of specific areas of nutrition knowledge.
   3) To attain an appreciation of the relationship of nutrition to human welfare.

4. **Course Organization**:
   The course consists of the study of individual scientific investigations in the development of nutrition science. Material will be presented in chronological order. Students will prepare:
1) Short biographical sketches of assigned researchers or events.

2) Term paper in which a nutrition topic is developed, the paper relating nutrition history to the body of knowledge.

3) Summary of the term paper for oral presentation followed by class discussion. Submit outline one week prior to presentation; outline to be duplicated and distributed to class.

5. **Text:** None. Some study materials will be made available. Reading assignments will be made from reference lists.

6. **Grading:**
   - 50% Term paper and presentation.
   - 25% Participation in discussion and individual class reports.
   - 25% Final examination.

7. Class Meetings: M, W, F.

8. **Content Format** (based on 30 class periods):

    Class Period
    1 Introduction, philosophy, definitions

    The ancient world
Class Period

2 Continuation of above.


3 The Middle Ages and the 16th Century.


4 Continuation of above.

5 The 17th Century.


6 Continuation of above.

Begin study of the 18th Century.

Assigned reading: "Early studies in Calorimetry and Respiration" (See "Supplementary Materials", page 17).

7 Continuation of above.

8 1800-1820


9 1820-1840

10 1840-1860
Class Period
11 1860-1880
12 1880-1900
13 1900-1910

14 1910-1920
15 1920-1930
16 1930-1940
17 Continuation of above
18 1940-1950
19 1950-1960
20 Continuation of above
21 1960-1970
22 1970-1980
23 Summary of current research.

Instructor input: Review of status of current research and projected emphasis.

Student input: What does the student believe to be the most important event or issue of the past five years? What is now being emphasized? What should be emphasized now and in next 10 years?

24 Students' oral reports on term papers.

to (6 periods)

29 Review

30 Review
GUIDELINES FOR BIOGRAPHICAL SKETCHES FOR ORAL REPORTS

1. Limit report to five minutes.

2. Include the following information:
   1) Name
   2) Nationality
   3) Education and profession
   4) Fields of research; contributions; publications
   5) Other information which you consider to be particularly important or interesting
   6) Cite any world events which occurred at about the same time to help relate the progress of nutritional research to progress in other fields.

3. If resources permit, prepare a master copy of outline for duplication and distribution to class.
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Department of Human Nutrition
and Food Management

DIRECTIONS FOR TERM PAPER

The paper should not exceed ten typewritten (double-spaced) pages, excluding bibliography. Subject matter may deal with such topics as a single nutrient (e.g., discovery and role of vitamin A); cholesterol metabolism; or one facet of a larger topic.

Reference citations should be written according to The Council of Biological Editors Style Manual (on reserve in the Home Economics Library). A complete list of accepted abbreviations of journal titles can be found in a January issue of Cumulated Index Medicus (Health Sciences Library).

Examples of correct citations include:


REFERENCES

A. GENERAL REFERENCES FOR BIBLIOGRAPHIC INFORMATION

1. American Men of Science
2. American Men and Women of Science
3. Biographical Dictionaries Master Index
4. Biographical Directory of Leaders in Education
5. Chemical Who's Who
7. Who Knows - and What
8. Who's Who in America
9. Who's Who in American Education
10. Who's Who of American Women

B. CLASSICS OF NUTRITION, DIETETICS, AND HOME ECONOMICS


C. GENERAL REFERENCES FOR THE HISTORY OF NUTRITION


General References for the History of Nutrition (cont'd.)


15. MacLeod, Grace. 1941. Mary Swartz Rose. J. Home Econ. 33:221.


General References for the History of Nutrition (cont'd.)


D. BOOKS REVIEWED IN THE COURSE WITH ADDITIONAL REFERENCES ON AUTHOR AND SUBJECT


Books Reviewed in the Course with Additional References on Author and Subject (cont'd.)


Books Reviewed in the Course with Additional References on Author and Subject (cont'd.)


24. Rose, Mary Swartz. (Editorials in memoriam)
   J. Biol. Chem. 40:687. 1941
   J. Home Econ. 33:221. 1941
   J. Amer. Diet. Assoc. 17:243. 1941
   J. Amer. Diet. Assoc. 17:976. 1941


Books Reviewed in the Course with Additional References by Author and Subject (cont'd.)


38. 1937. Little journeys to the homes of great physicians. Mosby, C. V. St. Louis.

BOOKS


OTHER

Compilation of bibliographies written principally by Neige Todhunter for the Journal of the American Dietetic Association.

* Reissued by Johnson Reprints, 111 Fifth Ave., New York City, N. Y. 10003.
EARLY STUDIES IN CALORIMETRY AND RESPIRATION

The end result of energy metabolism—the production of ATP—is not measurable except under special laboratory conditions. It is, therefore, usual to measure processes which have been shown to be proportional to the production of ATP: the consumption of oxygen, the production of carbon dioxide, or the liberation of heat.

The measurement of whole body metabolic rate is commonly referred to as calorimetry. Although heat production rate is rarely measured directly as in the earlier days of study of energy metabolism when heat loss from the body was measured directly and results expressed in kilocalories. This earlier direct calorimetry method provided much of the information which made possible the formulation of quantitative description of energy metabolism.

Antoine LAVOISIER (1762) stated: "Respiration is only a slow combustion of carbon and hydrogen which is entirely similar to that which obtains in a lamp or lighted candle and, from this point of view, animals which respire are truly combustible bodies which burn and consume themselves. In respiration as in combustion it is the air which furnishes the oxygen—but in respiration it is the body substance which furnishes the heat. If animals do not repair constantly the losses of respiration, the lamp scon lacks oil, and the animal dies, as a lamp goes out when it lacks food." Measurements taken in the fasting and resting states, as initially performed by LAVOISIER, represent essentially basal metabolism.

MAGENDIE, an early 19th century chemist, was the first to distinguish between the different types of food stuffs (CHO, PRO, FAT). This information was not applied to studies of respiratory exchange until REGNAULT and RIESELT (1840) showed that ratio of carbon dioxide expired to oxygen consumed varied with the kind of food (respiratory quotient).

In the 19th century, the German LIEBIG calculated some calorie values for foodstuffs. The first balance type study was by BOUSSINGAULT (France). He measured carbon, hydrogen, oxygen, nitrogen and salts of a cow's ration and excreta. At the same time in Germany, BIDDER and SCHMIDT performed a similar experiment but related their balance data to the animal's respiratory exchange, a closer approximation of modern calorimetry. They described a "typical minimum" of necessary metabolism.
VOIT performed a series of calorimetric and balance experiments. He demonstrated that protein metabolism is not affected by muscular work and that oxygen is not the cause of metabolism, but that the amount of metabolism determines oxygen consumption.

Outstanding of VOIT's students was RUBNER who confirmed that in animals heat production is equal to heat elimination, and related heat production in the basal state to surface area. He determined caloric values of urine, feces and many food-stuffs, and described the specific dynamic effect of food.

Adam CRAWFORD (1778), a pupil of Joseph BLACK, is said to have been the first to measure animal heat. He built a combustion chamber at the suggestion of PRIESTLY "to determine the heat which is extricated from pure and inflammable air (oxygen and hydrogen) when they are burned together in closed vessels." CRAWFORD measured the heat by the increase in temperature of a given amount of water.

LAVOISIER and LAPLACE (1780) constructed a combustion calorimeter for animals which, instead of measuring sensible heat, measured the latent heat of melting ice. The animal's heat melted the ice, water formed ran out of the chamber, and the weight of the water measured the animal's heat production.

ATWATER and ROSA (1899) built a respiration chamber for humans which involved measurements of heat exchange and respiratory exchange. They demonstrated that heat production and work of humans is derived from the chemical energy of catabolized food or body substance as predicted by the law of conservation of energy. An offspring of this calorimeter, but one for larger animals, was ARMSEY's respiration calorimeter for steers. SWIFT (1957) adapted this calorimeter to studies of humans. WILLIAMS (1912) built a calorimeter for dogs at Cornell and performed work on bicalorimetry. In these calorimeters removal of heat is accomplished by a cooling stream of water. AUGRET and LEPFURZ (1929) constructed a human calorimeter in which heat was removed by a cooling stream of air. In both cases the flow of heat is measured by the product of temperature difference between inflow and outflow, and rate of flow of the cooling medium.

Instead of preventing heat flow through the calorimeter walls, both RICHET (1889) and RUBNER (1894) estimated the rate of flow from differences in temperature in two concentrically arranged air spaces surrounding the calorimeter.

In the respiration calorimeter both heat loss and respiratory exchange are measured (oxygen consumption and carbon dioxide exchange), which increase in accuracy due to employment of two independent methods.
In indirect calorimetry oxygen consumption is measured and the results can be expressed directly in terms of rate of oxygen consumption, or rate of heat production can be calculated from tables of caloric value of oxygen in the oxidation of various foodstuffs (the number of kilocalories of heat liberated when 1 liter of oxygen is used).

Methods of indirect calorimetry include two general types, referred to as open-circuit or closed-circuit methods. In the former, the subject inhales air and exhales into a collecting spirometer or bag. At end of a timed collection period the volume of expired air is measured and a sample analyzed for oxygen concentration. Oxygen consumption is then calculated.

In the closed-circuit method the subject rebreathes from a spirometer which is initially filled with oxygen. The expired air passes through a carbon dioxide absorber before reaching the spirometer, so that the volume of gas in the spirometer is progressively reduced as oxygen is absorbed by the subject. The rate of decrease in gas volume is therefore equal to rate of oxygen consumption. Usually the excursions of the spirometer bell are recorded by a kymograph and the oxygen consumption in ml/min is obtained by multiplying the fall in level of bell in mm/min by the calibration factor of the bell. This method is simple but less accurate than the open-circuit method.
GREAT AGES OF WESTERN CIVILIZATION

The chart at right is designed to show the position of the Renaissance in Italy, which is the subject of this volume, and to relate it to the other cultures of the Western world that are considered in one major up of volumes of this series. This chart excerpted from a comprehensive world history which appears in the introduction of the series. Comparison of the chart seen here with the world chronology will enable the reader to relate the ages of Western civilization to important cultures in other parts of the world. The following two pages are printed a chronological table of the important events that took place within the Italian peninsula during the era covered by this book.
THE OHIO STATE UNIVERSITY
SCHOOL OF HOME ECONOMICS
Department of Human Nutrition
and Food Management

STUDY GUIDE: PART I

A CHRONOLOGICAL HISTORY OF NUTRITION

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The Sixteenth Century ............................................. 28
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22
"It was with the most unbounded confidence that the early philosophers of Greece entered upon the work of physical speculation—they quite expected to be able to discern, at a single glance, the whole import of nature's work."

469-399 B.C.  SOCRATES

Executed by the Athenians for atheism.
Induced people to think for themselves.
The Socratic Method.

427-347 B.C.  PLATO

The greatest pupil of Socrates.
Warned against seeing things from one point of view only and urged others to guard against superficial impressions.
His theory of function of the lungs.

384-321 B.C.  ARISTOTLE

A pupil of Plato.
Founded the peripatetic school (the Lyceum).
Methodical in his thinking—conceived of separate categories of learning including philosophy, mathematics, physics, logic, psychology, ethics, and aesthetics.

More than a thousand years later, Sir Francis Bacon, essayist and writer on the scientific method, was to say of him: "He had made up his mind beforehand. He did not consult experience in order to make right propositions and opinions, but when he had settled his system to his own will, he twisted experience around."
504-423 B.C.  EMPEDOCLES  Introduced the idea of four elements: earth, water, air, and fire; and four qualities: hot, cold, wet, and dry.

460-377 B.C.  HIPPOCRATES  Attached great importance to nutrition but stated:

"To me it appears....that nobody would have sought for medicine at all, provided the same kinds of diets had suited men in sickness as in good health."

310-250 B.C.  ERASISTRATOS  The first experimental physiologist. Devised first respiration apparatus. Placed fowl in respiration apparatus, weighed them and their excretions before and after food. (2000 years later he was followed by Sanctorius who added the dimension of "insensible perspiration."

53 B.C. - 7 A.D.  CELSUS  In first Latin treatise on medicine he classified food-stuffs and emphasized their role in maintaining health. Transmitted the traditions of Greek medicine to the Romans.

130-200 A.D.  GALEN  The greatest medical man of ancient times. His explanation of nutrition:

"When the matter which flows to each part of the body in the form of nu-
130-200 A.D.  GALEN (cont'd.)  triment is being worked up into it, this activity is nutrition, and its cause is the nutriture faculty."

200 A.D.  ARATAEUS of Cappadocia  Gave first known description of diabetes; also described diphtheria and sprue.

6th Century  THE HINDUS  First discovered excretion of sugar in urine.
The Middle Ages

About 400-1400 A.D. Period between ancient and modern times, as between the fall of the Roman Empire and the revival of letters. Also called "The Dark Ages", which refers primarily to the first half of the period.

1250 Scurvy among troops of Louis IX at the siege of Cairo.

1452-1519 Leonardo (Ital.) Educated in Florence; called "the father of modern science."
An anatomist, a biologist, an engineer, a great humorist. He wrote:

"Those who study only the ancients, not the works of nature, are step-sons but not sons of nature, the mother of all good authors."

1493-1541 Paracelsus (Swiss) An army surgeon in Denmark and Sweden; visited England, France, Belgium and Italy, acquainting himself with the universities in those lands.

Described by Lusk as a turbulent character who "turned to chemistry for the preparation of medicine for the sick, deeming that more worthy than the seeking for the transmutation of base metals into gold. He therefore was the first biological chemist, establishing the iatrochemists (iatros being the Greek word for physician)."

26
1493-1541 PARACELSUS (cont'd.) He stated:

"But I praise the chemical physicians for they do not consort with loafers or go about in gorgeous satins, silks, and velvets, gold rings on their fingers and silver daggers hanging at their sides and white gloves on their hands, but they tend their work at the fire patiently day and night."
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<th>Year</th>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>1519</td>
<td>MAGELLAN</td>
<td>(Port.) Scurvy among crew as they circumnavigated the globe.</td>
</tr>
<tr>
<td>1536</td>
<td>CARTIER,</td>
<td>(Fr.) Navigator and explorer; cured scurvy in sailors with an infusion of leaves and bark of evergreen trees.</td>
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<td></td>
<td>Jacques</td>
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<td></td>
<td>(1491-1557)</td>
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<tr>
<td>1531-41</td>
<td></td>
<td>Conquest of Peru and probably introduction of the potato in Spain.</td>
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<tr>
<td>1542</td>
<td>BORDE,</td>
<td>Published &quot;A Dyetary of Health&quot;, one of the first publications in English; described factors affecting the health of man and the part played by diet.</td>
</tr>
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<td></td>
<td>Andrew</td>
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<td>1543</td>
<td>VERSALIUS</td>
<td>His &quot;Fabrica&quot; became foundation of modern anatomy.</td>
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<tr>
<td>1553</td>
<td>SERVETUS</td>
<td>(Span.) Theologian and martyr. Described pulmonary circulation.</td>
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<td></td>
<td>(1511-1553)</td>
<td></td>
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<tr>
<td>1554</td>
<td>LANGE, Johann</td>
<td>Described chlorosis.</td>
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THE SEVENTEENTH CENTURY

1601 LANCASTER, J. (Eng.) Sea captain who recorded that lemon juice was protective against scurvy.

1609-10 GALILEO (Ital.) Invented the telescope and microscope.

1612 WOODALL In "Surgeon's Mate", recommended citrus fruit for protection against scurvy on sea voyages.

1614 SANCTORIUS (Ital.) Published his studies of body weight, food, and excreta; performed first metabolic studies. Determined amount of "insensible perspiration" lost.

1615 BARTOLOTTI Discovered milk sugar.

1620-30 VAN HELMONT, Jean Baptiste (1577-1644) Stressed the chemical role of gastric juice and bile in digestion. Coined the word "gas" from the Greek "chaos" meaning "air". Was the first to differentiate between air and water vapor. Contributed to the development of chemistry as distinct from alchemy.

1628 HARVEY, William Published his classic work on circulation of the blood.
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<th>Author</th>
<th>Event</th>
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<tbody>
<tr>
<td>1642</td>
<td>BONTIUS, Jacobus</td>
<td>Described beriberi.</td>
</tr>
<tr>
<td>1645</td>
<td>WHISTLER, Daniel</td>
<td>Described rickets. &quot;Inaugural Medical Disputation on the Children's Disease of the English which the Inhabitants Idiomatically Call the Rickets&quot; was published in Latin at Leyden, Netherlands.</td>
</tr>
<tr>
<td>1648</td>
<td>REDI, F.</td>
<td>Disproved the theory of spontaneous generation.</td>
</tr>
<tr>
<td>1650</td>
<td>GLISSON, Francis (1597-1677)</td>
<td>Regius Professor of Physics at Cambridge University. Classic description of rickets, &quot;De Rachitide.&quot;</td>
</tr>
<tr>
<td>1650-62</td>
<td>Founding of the medical societies</td>
<td></td>
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<tr>
<td>1650</td>
<td>In Germany</td>
<td>Akademie der Naturforscher (Kaiserliche Leopoldina Deutsche)</td>
</tr>
<tr>
<td>1660</td>
<td>In France</td>
<td>The Academic des Sciences</td>
</tr>
<tr>
<td>1662</td>
<td>In England</td>
<td>The Royal Society</td>
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<tr>
<td>1658</td>
<td>SWAMMERDAM</td>
<td>Described red blood corpuscles in frog.</td>
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</table>
1662 DESCARTES (Fr.) Wrote first formal textbook on physiology. Believed that living things were machines; compared body to clock with counter-weights and wheels. Stated that medical doctrines should be established on infallible experiments.

1660-66 BOYLE, Robert (1627-1691) (Eng.) Published major works establishing the experimental approach to chemistry.

1665 HOOKE, Robert (1635-1703) (Eng.) Published "Micrographi" describing the cellular structure of cork.

1675 NEWTON, Sir Isaac (1642-1727) (Eng.) Developed the law of gravitation and the binomial theorem.

1670 WILLIS (1621-1675) Discovered the sweet taste of diabetic urine.

1674 WATSON, John (1643-1679) Demonstrated that only a part of ordinary air is capable of supporting combustion.
Stahl's phlogiston theory of combustion was a misconception which dominated scientific thought at the beginning of the eighteenth century. He maintained that all combustible materials contained phlogiston, which passed from them into the atmosphere when the substances were burned. According to the theory, when bodies burn or are calcined, phlogiston escapes. Zinc, when heated strongly, burns with a brilliant flame, and there remains calx of zinc (ZnO). Zinc was, therefore, conceived to be a compound of calx of zinc with phlogiston. Charcoal, oil, and wax, for example, were supposed to be extremely rich in phlogiston, and when calx of zinc was heated with charcoal, phlogiston was restored. The phlogiston theory, along with the generally held misconception that air was an elemental substance, profoundly influenced scientific thinking and interpretation of new discoveries for almost a century. (Pike and Brown, 1975, pg. 4; McCollum, 1957, pg. 117.)

1700 STAHLE, George (1660-1734) Developed the phlogiston theory.

1730 CASAL, Gaspar Described pellagra.

1742 BECCARI, I. B. Suggested "animalized matter" in vegetable substances; considered the "glutenous part of flour to be peculiarly of an animal, and the starch of a vegetable, nature."

1742 CELSIUS, Anders (1701-1744) (Swed.) Described the Centigrade (Celsius) thermometer.

1746 MENGHINI Found that the iron content of blood could be increased by feeding iron-containing foods.
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<th>Year</th>
<th>Name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1748</td>
<td>GAHN</td>
<td>Explored the chemical nature of bones.</td>
</tr>
<tr>
<td></td>
<td>BERZELIUS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DAVY, H.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FORDYCE</td>
<td></td>
</tr>
<tr>
<td>1754</td>
<td>BLACK, Joseph</td>
<td>(Scot.) Discovered &quot;fixed air&quot; (carbon dioxide).</td>
</tr>
<tr>
<td></td>
<td>(1728-1799)</td>
<td></td>
</tr>
<tr>
<td>1757-60</td>
<td>HALLER, von Albrecht</td>
<td>(Ger.) A great physiologist. Discussed the significance of food on the deposition of fat.</td>
</tr>
<tr>
<td></td>
<td>(1708-1777)</td>
<td></td>
</tr>
<tr>
<td>1766</td>
<td>CAVENDISH, Henry</td>
<td>(Eng.) Described &quot;inflammable air&quot; (hydrogen) and believed it to be phlogiston.</td>
</tr>
<tr>
<td></td>
<td>(1731-1810)</td>
<td></td>
</tr>
<tr>
<td>1772</td>
<td>RUTHERFORD, Daniel</td>
<td>(Eng.) Described &quot;residual air&quot; (nitrogen).</td>
</tr>
<tr>
<td></td>
<td>(1749-1819)</td>
<td></td>
</tr>
<tr>
<td>1773-83</td>
<td>SCHEELE, Carl Wilmhelm</td>
<td>(Swed.) Discovered oxygen and glycerol</td>
</tr>
<tr>
<td></td>
<td>(1742-1786)</td>
<td></td>
</tr>
<tr>
<td>1773</td>
<td>ROVELLE</td>
<td>Identified urea in urine.</td>
</tr>
<tr>
<td>1774</td>
<td>PRIESTLEY, Joseph</td>
<td>(Eng.) Described &quot;dephlogisticated air&quot; (oxygen).</td>
</tr>
<tr>
<td></td>
<td>(1733-1804)</td>
<td></td>
</tr>
</tbody>
</table>
"The early history of nutrition, by-and-large, is the history of metabolism. Many have said that nutrition as a science began with Lavoisier. One must be mindful of the fact that most of the dietary deficiency diseases were known before 1780. During the century following Lavoisier's work (1780-1794), beginnings were made in the study of the chemistry of proteins and the chemical constitution of fats was discovered...." (Goldblith and Joslyn, 1964, pg. 15).

<table>
<thead>
<tr>
<th>Year</th>
<th>Person</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1777</td>
<td>LAVOISIER,</td>
<td>(Fr.) Published his experiments on the respiration of animals.</td>
</tr>
<tr>
<td></td>
<td>Antoine</td>
<td>(1743-1794)</td>
</tr>
<tr>
<td></td>
<td>(1743-1794)</td>
<td></td>
</tr>
<tr>
<td>1780</td>
<td>SPALIANZANI,</td>
<td>Provided experimental evidence that digestion was not fermentation but was</td>
</tr>
<tr>
<td></td>
<td>Lazara</td>
<td>the chemical action of gastric juice.</td>
</tr>
<tr>
<td></td>
<td>(1729-1799)</td>
<td></td>
</tr>
<tr>
<td>1781</td>
<td>CAVENDISH</td>
<td>Showed that water is a compound of oxygen and hydrogen.</td>
</tr>
<tr>
<td>1789</td>
<td>LAVOISIER and</td>
<td>Made first measurements of human energy metabolism.</td>
</tr>
<tr>
<td></td>
<td>SEGUIN</td>
<td></td>
</tr>
<tr>
<td>1792</td>
<td>SENEBIER</td>
<td>(Swiss,) Discovered that rancidity in fats involved oxidation.</td>
</tr>
<tr>
<td></td>
<td>(1742-1809)</td>
<td></td>
</tr>
<tr>
<td>1796</td>
<td></td>
<td>Lemon juice officially introduced into the British Navy.</td>
</tr>
</tbody>
</table>
1797 WOLLASTON (Eng.) Identified uric acid
William H. in the chalky deposits of
(1776-1826) gout patients.

1797 DARCET Professor at the College de
with France
LEFEVRE Performed chemical examin-
and ations of fats.

PELLETIER
1800-20  BRACONNOT, Henri  
(1781-1855)  (Fr,) Professor of natural history in the Lyceum at Nancy. Concluded that "the organic force, assisted by sunlight, produces in plants substances regarded as elementary, such as earths, alkalies, metals, sulfur, phosphorus, carbon, and perhaps even nitrogen." Discovered glycine. Demonstrated the hydrolysis of cellulose to glucose by action of sulfuric acid.

1800  SCHRADER, J.C.  Wrote prize essay on origin of plant ash constituents; stated that his studies indicated that the earthy matter was generated during the process of vegetation.

1803  YOUNG, J.R.  (Amer,) Showed gastric digestion to be a chemical process.

1803-04  PROUST, J.L.  (Fr,) Wrote memoir on fecula describing confusion of thought concerning its nature. Identified it with albuminous substances of plants. Was first chemist to prepare grape sugar in its pure form.

1804  de SAUSSURE  (Swiss,) Illustrious plant physiologist. Stated that his investigations had indicated that the nature of the soil has a pronounced influence on mineral content.
<table>
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<tr>
<th>Year</th>
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<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1806</td>
<td>VANQUELIN and FOURCROY</td>
<td>Studied albuminous substances in seeds other than wheat.</td>
</tr>
<tr>
<td>1807</td>
<td>DAVY, Humphrey (1778-1829)</td>
<td>Isolated sodium, potassium, calcium, magnesium, sulfur, and boron.</td>
</tr>
<tr>
<td>1810</td>
<td>WOLLASTON</td>
<td>Isolated cystic oxide (cystine) from urinary calculus; discovered first amino acid.</td>
</tr>
<tr>
<td>1810</td>
<td>MARZARI</td>
<td>Believed that maize was the cause of pellagra.</td>
</tr>
<tr>
<td>1811</td>
<td>BERTHOLLET</td>
<td>Made earliest distinction among proteins; quantitatively measured ammonia from distillation of meat and cheese.</td>
</tr>
<tr>
<td>1811</td>
<td>GAY-LUSSAC, Joseph</td>
<td>(Fr.) Determined elementary composition of cane sugar.</td>
</tr>
<tr>
<td>1812</td>
<td>KIRCHHOFF</td>
<td>Demonstrated conversion of starch to sugar.</td>
</tr>
</tbody>
</table>
1811-23 CHEVREUL, Michel (1786-1889) (Fr.) Professor at Lycee Charlemagne. Contributed pioneer studies on separation and description of fatty acids and glycerol; found that lard contained two oily bodies—one solid and one liquid at room temperature.

1815-41 GELATIN COMMISSION Was appointed by the Academy of Paris to conduct studies to determine whether or not the gelatinous extract of bones could replace meat in the diet.

1816 MAGENDIE Francois (1783-1855) (Fr.) Served as chairman of Gelatin Commission. Described vitamin A deficiency symptoms in dogs on restricted diets.

1818 VOGEL, L. (Ger.) Used term "fecula" to denote starch.

1824 SCHUETTE Was the first to recommend cod liver oil for rickets.

1825-70 LIEBIG, von, Justus (1803-1873) (Ger.) Outstanding investigator and teacher in the field of chemistry during first half of 19th century. Believed that albuminous substances, fuel foods, and certain mineral salts were all that animals needed for nourishment.
1825-31  BEAUMONT, William B. (Amer.) Conducted classic studies on digestion on Alexis St. Martin who had fistulous opening into stomach as result of gunshot wound. (Subject lived to age 83.)

1833  PAYEN, Anselmo (1795-1871) and PERSOZ Discovered presence of diastase in malt.

1834  HUBL Developed practical method of determining "iodine number" of fats (number of unsaturated C-C bonds).

1835  SCHWANN, Theodor (1810-1882) (Pruss.,) Described the action and properties of pepsin.

1839  Introduced his theory of the cell as a primary fundamental unit of matter.

1839-48  MULDER, Gerrit Jan (1802-1880) (Dutch) Studied albuminous substances; introduced term, protein.

1842  WIEGNANN and POLSTORFF (Ger.) Professor and apothecary, respectively, in Braunschweig; produced convincing evidence that inorganic substances are important in plant nutrition.
1843  THOMSON, Thomas (1773-1852) (Scot.) Chemist and historian. Stated that "animals are principally formed from the glutinous or albuminous principles of vegetables."

1843  LIEBIG vs. DUMAS and BOUSSINGAULT

1843  REDTENBACHER

1844  SCHMIDT, Carl (Russ.) Was first to identify sugar in the blood. Suggested the term "carbohydrate" to include sugars, starches, and other natural products which yield sugar on hydrolysis.

1844  GOBLEY (Fr.) Discovered the phospholipids; isolated from egg yolk a substance containing nitrogen, phosphorus, glycerol and fatty acids which he called lecithin.

1848-50  ROSE, H. (1795-1864) (Ger.) Was first to study extensively the mineral constituents of animal substances.
1849  REGNAULT, Henri V. (Fr.) Determined the "respiratory quotient":
and
        REISET, J.

1849  BERNARD, Claude (Fr.) One of the greatest experimenters among 19th
        (1813-1878) century physiologists. Discovered relationship be-
        tween pancreatic secretions and fat digestion.

1852  BIDDER, Frederick (Ger.) At Univ. of Dorpat, Estonia, investigated the
        (1810-1892) physiology of nutrition; objectives were to determine
        oxygen absorption, carbonic acid and urea elimination in
        fasting and fed animals.

1854  LAWES, John B. (Eng. and Can.) Animal feeding studies at Rothamsted,
        (1814-1900) England.
        and
        GILBERT, Sir Joseph H. (1817-1901)

1857-59 SMITH, Edward Performed treadmill experiments; studied energy metab-
        (1818-1874) olism.

1857  LIVINGSTONE, D. Made clinical observations: described effects on native
        carriers forced to subsist on sugarless coffee, manioc
        and meal, and stated: "The eyes became affected as in
        the case of animals fed on experiment on pure gluten
        and starch."
<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Nationality</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1859</td>
<td>DARWIN, Charles</td>
<td>(Eng.)</td>
<td>Published &quot;Origin of Species&quot;.</td>
</tr>
<tr>
<td>1859-70</td>
<td>VOIT, von, Carl</td>
<td>(Bav.)</td>
<td>Father of modern nutrition science. Great teacher (Munich). Performed nitrogen balance studies with dogs.</td>
</tr>
<tr>
<td>1862</td>
<td>GRAHAM, Thomas</td>
<td></td>
<td>Distinguished between colloids and colloids (biological concepts changed by physical chemistry).</td>
</tr>
<tr>
<td>1863</td>
<td>BITOT</td>
<td></td>
<td>Associated eye disorder with malnutrition (Bitot spots).</td>
</tr>
<tr>
<td>1866</td>
<td>FRANKLAND, E.</td>
<td></td>
<td>Used combustion calorimeter to determine caloric value of foods.</td>
</tr>
<tr>
<td>1867</td>
<td>HUBER, F.</td>
<td>(Swiss)</td>
<td>Described the pelagra-preventive substance, its physical properties, and determined percentage of the elements in its composition.</td>
</tr>
<tr>
<td>1868</td>
<td>STRECKER, A.F.</td>
<td>(Ger.)</td>
<td>Hydrolysis of the phospholipid, lecithin, yielded a nitrogenous base which he identified as the choline he had isolated from bile.</td>
</tr>
</tbody>
</table>
1871  DUMAS, Jean B. A. (1800-1884)  Published report of investigations which indicated unknown essential nutrient in milk, ignored for 10 years.

1872  WEGNER  Used elemental phosphorus to treat rickets.

1872  VOIT and BISCHOFF  Studied protein-sparing effect of feeding gelatin as opposed to meat protein.

1873  FORSTER  Experimented with nearly ash-free diets.

1876  ESCHER, T.  Introduced concept of essential amino acids.

1877  PAVLOV Ivan P. (1849-1938) (Russ.) Classic studies on digestion in dogs.

1877  INDEX MEDICUS  Publication began.

1878-85  HESSE  Studied plant sterols

1879  HAMMERSTEIN  Investigated the significance of calcium in blood coagulation.
1879  BLYTH     Discovered yellow pigment in milk which he called lactochrome. It received no further attention until 1925 (46 years later).

1880  LUNIN, N.  Experiments indicated that "...other substances indispensable for nutrition must be present in milk besides casein, fat, lactose and salts."

1883  KJELDAHL  (Dan.) Developed method of quantitative determination of ammonia (as a measure of nitrogen) from catalytic digestion of protein.
        John G. C.  (1849-1900)

1884  THUDICHUM,  (Ger.) Isolated the phospholipid, cephalin.
        Johann, L. W.  (1829-1901)

1885  RINGER    (Eng.) Discovered that various organic structures best retained their functional activity in a solution containing sodium chloride, potassium chloride, and calcium chloride.
        (1835-1910)

1885-91 RUBNER, Max  Studied energy expenditure in relation to body surface.
        (1854-1932)
<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Nationality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1887</td>
<td>HOFF, van't</td>
<td>(Dutch)</td>
<td>Called attention to the analogy between the laws of osmotic pressure of dissolved substances and gases.</td>
</tr>
<tr>
<td>1888-89</td>
<td>ATWATER, Wilbur O.</td>
<td>(Amer.)</td>
<td>Constructed first calorimeter in U. S. to study energy exchange in humans.</td>
</tr>
<tr>
<td>1899</td>
<td>BLAND-SUTTON</td>
<td>(Eng.)</td>
<td>Described rickets in animals in London zoo and recommended supplementing diet with crushed bones and cod liver oil.</td>
</tr>
<tr>
<td>1889</td>
<td>TANRET</td>
<td></td>
<td>Discovered sterols in plants.</td>
</tr>
<tr>
<td>1889</td>
<td>BUNGE, von, Gustav B.</td>
<td>(Ger.)</td>
<td>Speculated about the effects of ash-free diets.</td>
</tr>
<tr>
<td>1890</td>
<td>OSBORNE, Thomas Burr</td>
<td>(Amer.)</td>
<td>Began his studies of vegetable and seed proteins, his major work.</td>
</tr>
<tr>
<td>1891</td>
<td>SCHULZE, Ernst</td>
<td>(Ger.)</td>
<td>Studied the chemistry of plants, especially proteins; worked with phytosterols and plant phospholipids, hemicellulose and pentosans.</td>
</tr>
<tr>
<td>1895</td>
<td>MAGNUS-LEVY, Adolf</td>
<td>(Ger.)</td>
<td>Made observations on basal metabolic rate.</td>
</tr>
<tr>
<td>Year</td>
<td>Author</td>
<td>Description</td>
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<tr>
<td>1896</td>
<td>BIJKMAN, Christian (1858-1930)</td>
<td>Concluded that overmilled rice caused polyneuritis in chicks and beriberi in humans; emergence of the vitamin theory.</td>
<td></td>
</tr>
<tr>
<td>1898</td>
<td>WIJS</td>
<td>Suggested improvements in Hubl's method for determining iodine number of fats.</td>
<td></td>
</tr>
<tr>
<td>1898</td>
<td>MÖRNER</td>
<td>Studied the nutritive value of gelatin supplemented with amino acids.</td>
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</tbody>
</table>
"Nutrition is a relatively new science that evolved from chemistry and physiology just as biophysics has more recently evolved from biology and physics. Recognition of nutrition as an independent field of study came only after the beginning of this century following a developmental period that stemmed from the experiments of Antoine Lavoisier almost 200 years earlier. Lavoisier's work formed the basis for the studies on respiratory exchange and calorimetry, the beginnings of scientific nutrition. Almost 100 years elapsed before carbohydrates, fats, and proteins were identified as the sources of energy for the animal body.....

However crude the early work appears from the vantage point of current methodology and instrumentation, much of it was sophisticated, elegant in design, and carefully executed; this work provided the basic information that is the core of the science of nutrition." (Pike and Brown, 1975.)

<table>
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<tr>
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<th>Event Description</th>
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</thead>
<tbody>
<tr>
<td>1900</td>
<td>LOCKE, F.</td>
<td>Studied the physiological antagonism of inorganic ions.</td>
</tr>
<tr>
<td>1900-06</td>
<td>HOPKINS, Frederick G. (1861-1947)</td>
<td>(Eng.) Tryptophan was discovered in the enzymatic digest of casein by Hopkins and Cole and identified as an essential amino acid by Hopkins and Willcox.</td>
</tr>
<tr>
<td>1902</td>
<td>Term &quot;dietitian&quot; began to be used in hospitals.</td>
<td></td>
</tr>
<tr>
<td>1902</td>
<td>RUBNER, Max</td>
<td>Described specific dynamic action of food.</td>
</tr>
<tr>
<td>1905</td>
<td>KAUFMAN, M.</td>
<td>Studied the nutritive value of gelatin supplemented with amino acids (Gelatin Commission.</td>
</tr>
</tbody>
</table>
1905  PEKELHARING  Cornelius A.  (1848-1922)  (Dutch) Professor of hygiene at University of Utrecht. Searched for unidentified nutrients.

1905  HENRIQUES and HANSON  Performed early work on protein in Copenhagen; prologue to discovery of the vitamins.


1906  EIJKMAN and GRIJNS, Gerrit  (1865-1944)  (Dutch) Discovered the antineuritic factor (thiamin).

1906  LUSK  Published the first of four editions of his classic "The Science of Nutrition".
1906

JORDAN

Phytin suggested as source of phosphorus for dairy cows.

HART

and

PATTON

1907

FISCHER, Emil

Synthesized a protein molecule of 18 amino acids.

1907-17

MCCOLLUM, Elmer V.
(1879-1967)

During years at Univ. of Wisconsin formulated basic concepts of modern nutrition; established first experimental colony of rats; introduced biological method for analysis of food; performed early work with vitamins A and D; synthesized organic phosphorus-containing compounds from inorganic phosphorus.

1907

BENEDICT

Began 30 years of research on respiration calorimetry and energy metabolism of man and animals at Nutrition Laboratory of Carnegie Institute, Boston.

1907

HOLST

(Nor.) Ushered in new era in study of scurvy; studied effect of diet on inducing or curing scurvy in guinea pigs.

and

FROELICH
<table>
<thead>
<tr>
<th>Year</th>
<th>Person</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1908-70</td>
<td>WIDDOWSON, E. M.</td>
<td>Investigated chemical composition of the body, under-nutrition and development, nutritional individuality, and composition of foods.</td>
</tr>
<tr>
<td>1908</td>
<td>MCLEAN</td>
<td>Showed that not all of the base in lecithin preparations was choline.</td>
</tr>
<tr>
<td>1911-12</td>
<td>LCEB (1859-1924)</td>
<td>Studied the dynamics of living matter with respect to the antagonistic physiological action of inorganic ions in living tissues.</td>
</tr>
<tr>
<td>1912</td>
<td>FUNK, Casimir (1884-1967)</td>
<td>Propounded the theory that beriberi, scurvy, pellagra, and possibly rickets were caused by a deficiency in the diet of &quot;special substances which we will call vitamins&quot;. Introduced concept of dietary deficiency diseases.</td>
</tr>
</tbody>
</table>
1912  VEDDER and WILLIAMS
Discovered that the anti-neuritic substance (thiamin) could be isolated by adsorption to charcoal.

1912  SUZUKI, SHIMAMURA, and OHDAKE
Worked on isolation of the beriberi-curative substance.

1913  BENEDICT and CATHCART
Studied metabolic activities of the body as a machine.

1913  TRIER
Identified the nitrogenous base in cephalin as an amino ethyl alcohol.

1913-14  MCCOLLUM and DAVIS
Discovered unsuspected nutrient carried by certain fats; found the new nutrient (called fat-soluble A) in glandular organscomplexed with soluble fats; also in plants.

1913-14  OSBORNE and MENDEL
Reported that 18% of egg white, when fed as the sole source of protein, supported normal growth in rats (early investigations of biotin). Confirmed findings of McCollum and Davis and increas-
<table>
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<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913-14</td>
<td>Osborne and Mendel (cont'd.)</td>
<td>Ed the list of fats which contained or did not contain vitamin A.</td>
</tr>
<tr>
<td>1914</td>
<td>Voegtlin</td>
<td>Prepared an extract of liver for treatment of pellagra and reported fairly good results; earliest study with human pellagrins which proved that human pellagra is unquestionably caused by a dietary deficiency.</td>
</tr>
<tr>
<td>1914</td>
<td>Hess, Alfred F. (1875-1933)</td>
<td>Reported high rate of scurvy among bottle-fed infants from whose diets fruit juice had been eliminated.</td>
</tr>
<tr>
<td>1915</td>
<td>Goldberger, Joseph (1874-1929) and Associates</td>
<td>Conducted institutional studies to determine whether or not pellagra can be caused by a faulty diet; concluded that it is a deficiency disease rather than one due to poisoning or infection.</td>
</tr>
<tr>
<td>1915</td>
<td>Sippy</td>
<td>Developed the Sippy diet (milk and cream mixture) for gastric and duodenal ulcer.</td>
</tr>
<tr>
<td>1915</td>
<td>Palmer</td>
<td>Attempted to discover correlation between yellowness and vitamin A content; beginning of pro-vitamin A (carotene) investigations.</td>
</tr>
<tr>
<td>1915</td>
<td>Denis</td>
<td>Discovered magnesium content of blood plasma.</td>
</tr>
<tr>
<td>Year</td>
<td>Name(s)</td>
<td>Contribution</td>
</tr>
<tr>
<td>------</td>
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<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1915-25</td>
<td>MCCOLLUM and DAVIS</td>
<td>Developed biological method of analysis of grains; observed physiological responses of animals fed known supplements.</td>
</tr>
<tr>
<td>1917</td>
<td>CHITTENDEN, Russell H. (1856-1943) and UNDERHILL</td>
<td>Experimented with production of a pellagra-like syndrome (blacktongue) in dogs.</td>
</tr>
<tr>
<td>1917</td>
<td>MCCOLLUM and SIMMONDS</td>
<td>American Dietetic Association founded.</td>
</tr>
<tr>
<td>1917</td>
<td>MCCOLLUM and SIMMONDS</td>
<td>Observed development of ophthalmia in vitamin A-deprived rats.</td>
</tr>
<tr>
<td>1917</td>
<td>OSBORNE and MENDEL</td>
<td>Pointed out high incidence of urinary calculi in vitamin A-deprived rats.</td>
</tr>
<tr>
<td>1918</td>
<td>COHEN and MENDEL</td>
<td>Produced scurvy in guinea pigs on a diet nutritively complete except for the anti-scorbutic vitamin.</td>
</tr>
</tbody>
</table>
1918  MARINE, D. and KIMBALL, C. P.
       Demonstrated beneficial effect of iodine in areas of endemic goiter (Akron, Ohio).

1918  OSBORNE and MENDEL
       Observed restrictions in phosphorus-deprived rats.

1919  MELLANBY, Sir Edward (1884-1955)
       Performed experimental studies on rickets; proved conclusively that it is a dietary deficiency disease and showed that certain fats, notably cod liver oil, exerted marked preventive and curative effects.

1919-33
       Multiple nomenclature of riboflavin: vitamin B2; vitamin G; P-P (pellagra-preventive).

1920  DRUMMOND, Sir Jack C. (1891-1952)
       (Eng.) "Vitamine" changed to "vitamin" on his recommendation. Suggested the antiscorbutic substance be called vitamin C.

1920  WHIPPLE, G. H. (1878- )
       Demonstrated hemoglobin regeneration in dogs fed raw liver.

1921  SHIPLEY
       Tested the therapeutic value of sunlight in rickets.
1922  MCCOLLUM, PARK, and SHIPLEY  Demonstrated existence of a second fat-soluble factor (vitamin D).

1922-24  EVANS and BISHOP  Discovered vitamin E.


1923  GOLDBLATT and SCOAMES  Found that the livers of irradiated rats on a rickets-producing diet had acquired antirachitic properties.

1925  GOLDBERGER and TANNER  Classified common foods on the basis of their effectiveness in preventing or curing human pellagra.

1925  BLEYER and KALLMAN  Separated milk pigment and described its more obvious properties; importance of the pigment (riboflavin) was not suspected.

1926  HOJER  Developed a method of assay for vitamin C. Histologic examination of the teeth.
1926  GOLDBERGER
and
LILLY

1933  BOOHER

1936  KOEHN
and
ELVEHJEM
Conrad A. (1901-1962)

1926  HAUKE
and
CARRICK

1926  MINOT
and
MURPHY

1926  HESS
and
WEINSTOCK

1926  ROSENHEIM
and
WEBSTER

At tempted to resolve confusion over the relationship between vitamin B₂ deficiency and pellagra.
Produced evidence refuting the two-vitamin theory.
Tested the effects of feeding liver to patients with pernicious anemia and demonstrated it to be a nutrient-deficiency disease.
Demonstrated that calcification caused by phosphorus was pathological in character, and this therapy for rickets was abandoned.
Found cholesterol to be precursor of vitamin D.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1926</td>
<td>EGGLETONS</td>
<td>Studied phosphorus compounds in metabolic processes, discovered an organic, labile phosphate in muscle which he named &quot;phosphagen&quot;.</td>
</tr>
<tr>
<td>1927</td>
<td></td>
<td>Vitamin B recognized as a complex of many factors.</td>
</tr>
<tr>
<td>1927</td>
<td>ROSENHEIM and</td>
<td>Announced independently the isolation of ergosterol and its identification as provitamin D.</td>
</tr>
<tr>
<td></td>
<td>WEBSTER and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WINDHAUS and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HESS, A.</td>
<td></td>
</tr>
<tr>
<td>1927</td>
<td>BOAS</td>
<td>Described egg white injury in rats given raw egg white (dermatitis, spasticity, edema of the feet, skin hemorrhage).</td>
</tr>
<tr>
<td>1927</td>
<td>BILLS</td>
<td>Found vitamin D in various fish liver oils.</td>
</tr>
<tr>
<td>1927</td>
<td>SALMAN</td>
<td>Provided evidence to support the two-vitamin theory.</td>
</tr>
<tr>
<td>1928</td>
<td>SZENT-GYÖRGYI (1893-)</td>
<td>Isolated hexuronic acid (vitamin C) from adrenal glands, cabbage, and orange.</td>
</tr>
</tbody>
</table>
1928  JACKSON, SOMMER, and ROSE

Still conducting studies on the nutritive value of gelatin supplemented with amino acids (Gelatin Commission).

1928  EULER, EULER, and HELLSTROM

Used carotene as a source of vitamin A and confirmed Steenbock's findings that carotene was not vitamin A but was related to it.

1928  CHICK and ROSE

Developed assay procedure for B₁₂, based on experimental diet.

1928-29  AUB, J.C.

Investigated calcium and phosphorus metabolism; showed increased excretion of urinary calcium and phosphate to be indicators of bone mineral mobilization, associated with acidosis.

1929  KING

Showed that ascorbic acid possessed distinct acidic properties.

1929  CASTLE

Showed that beef contained an "extrinsic factor" and normal gastric juice an "intrinsic factor" which given together caused red blood cell formation in pernicious anemia.
1929  BURR, J. H. and BURR, M. M. Discovered essential fatty acids (linoleic) in diet of rat.

1929  KINNERSLEY and PETERS Discovered lactic acid accumulates in brain of thiamin-deficient pigeon; in vitro addition of thiamin produced large increases in oxygen uptake.

1929  FISKE and SUBARROW Identified phosphagen as phosphocreatin.

1930s  HILDITCH, T. P. Studied fatty acid metabolism; developed series of rules (metabolism, oxidation, appearance of molecule, etc.).

1930-40 "The furor created by the discovery of the minute factors (vitamins) in food reached a peak between 1930-40.... The literature of this period is crowded with new discoveries, wrong turns, and rediscoveries...." (Pike and Brown, 1975, pg. 16).

1930  WEST and DAKIN Conducted research on vitamin B₁₂.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931</td>
<td>SHERMAN</td>
<td>Developed a method of assay for vitamin C; animal assay, preventive method.</td>
</tr>
<tr>
<td></td>
<td>SMITH, Sybil</td>
<td></td>
</tr>
<tr>
<td>1931</td>
<td>BOURQUIN</td>
<td>Developed assay procedure for B&lt;sub&gt;2&lt;/sub&gt; based on experimental diet.</td>
</tr>
<tr>
<td></td>
<td>SHERMAN</td>
<td></td>
</tr>
<tr>
<td>1931</td>
<td>MCCOLLUM</td>
<td>Described magnesium deficiency syndrome.</td>
</tr>
<tr>
<td></td>
<td>ORENT</td>
<td></td>
</tr>
<tr>
<td>1932</td>
<td>KING</td>
<td>Obtained Szent-Gyorgyi's &quot;hexuronic acid&quot; in crystalline form and showed that the antiscorbutic factor resided in the crystals rather than an impurity.</td>
</tr>
<tr>
<td></td>
<td>WAUGH</td>
<td></td>
</tr>
<tr>
<td>1932</td>
<td>RYGH</td>
<td>Reported that he had identified vitamin C in a preparation with antiscorbutic activity about ten thousand times that of an equal weight of the crystals of King and Waugh.</td>
</tr>
<tr>
<td>1932</td>
<td>BAUER, W.</td>
<td>Studied mode of action of irradiated ergosterol; its effect on the calcium, phosphorus, and nitrogen metabolism of normal individuals.</td>
</tr>
</tbody>
</table>
1932  TILLMANS  Developed chemical method of vitamin C assay.

1932  STIEBELING, Hazel  Studied pellagra in the human.

        and

        MUNSELL, Hazel

1932  STRAUSS  Performed studies on antipernicious factors and pellagra.

        and

        CASTLE

1932  WARBURG  Described new oxidation enzyme with yellow pigment which was easily detached from protein component; was called lumiflavin.

        and

        CHRISTIAN

1933  SOMOGYI, M.  Studied cell membrane transport of sugars.

1933  WILLIAMS, Cicely  Identified kwashiorkor as a nutritional disease.

1933  BESSEY  Animal assay for vitamins, curative method; also a chemical method was developed the same year.

        and

        KING, Charles G.
1933  Szent-Gyorgyi and Hayworth

1933-34  Parsons, Helen

1934  McLean and Hastings

1934  Todd, W. R. Elvehjem and Hart, E. B.

1934  Dam, Henrik (Dan.) Discovered vitamin K.

1935  Wald, George (1906-) Presented evidence that visual purple is a conjugated protein in which vitamin A is a prosthetic group. Hastings, A. B. Examined the physiology of fatigue; acid-base balance; intermediate metabolism.

1935  Elvehjem Investigated relationship of copper to iron metabolism.
<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1935</td>
<td>EULER, von. ALBERS, and SCHENCK</td>
<td>Studied the preparation of cozymase, the coenzyme necessary for the alcoholic fermentation of glucose by apozymase (DPN). On hydrolysis, cozymase yielded nicotinic acid—first evidence that nicotinic acid was part of an enzyme.</td>
</tr>
<tr>
<td>1935</td>
<td>KARRER and KUHN</td>
<td>Independently reported synthesis of B₂.</td>
</tr>
<tr>
<td>1935</td>
<td>GYORGY, Paul</td>
<td>Showed by animal experiments that synthetic B₂ had the same biological activity as the naturally-occurring pigment.</td>
</tr>
<tr>
<td>1935</td>
<td>LOHMAN</td>
<td>Isolated adenosine diphosphate from heart muscle and from smooth muscle.</td>
</tr>
<tr>
<td>1935</td>
<td>ROSE, William C. (1887- )</td>
<td>Isolated and identified the final essential amino acid, threonine; demonstrated for the first time that rats could be reared to maximum growth on mixture of purified amino acids.</td>
</tr>
<tr>
<td>1936</td>
<td>LEPKOVSKY, JUKES, and KRAUSE</td>
<td>Distinguished between Factor I (B₆) and Factor II (pantothenic acid).</td>
</tr>
</tbody>
</table>
1936  WARBURG  Showed nicotinic acid to have a second function as a co-enzyme structural unit.
        and  CHRISTIAN

1936  FUSON  Reported chemical synthesis of vitamin A.
        and  CHRIST
        KUHN
        and  MORRIS

1937  SPIES,  Studied pellagra in the human.
        COOPER,
        and  BLANKENHORN

1937  LOHMANN  Discovered B1 functions as a coenzyme.
        and  SCHUSTER

1937  ELVEHJEM  Identified nicotinic acid as curative factor for blacktongue in dogs.

1938  ROSE, W. C.  Classified amino acids as essential and non-essential.
1937-74  MCCAN ACE, R. A.  Conducted studies on body composition; absorption and excretion of iron; calorie and protein deficiency; and nutrition and growth.

1938  SCHMIDT and SYDENSTRICKER  Noted that certain pellagrous patients who had been cured with nicotinic acid relapsed when put on maintenance dosages (symptoms later recognized as riboflavin deficiency)—Goldberger and Wheeler's "pellagra sine pellagra".

1938  SEBRELL, W. H. and BUTLER  Showed that the differing symptoms observed by others and diagnosed as pellagra was frequently a state of multiple vitamin starvation.

1938  KERESZTESY and STEVENS and GYORGY  Independently reported crystallization of vitamin B₆.
1938  KUHN  (Ger.) Isolated B6.
      and
    WENDT

1938  ICHIBA  (Jap.) Isolated B6.
      and
    MICHIC

1939  HARRIS  Determined molecular structure of, and synthesized, pyridoxine.
      and
    FOLKERS

1939  WILLIAMS, Roger J.  Isolated pantothenic acid.

1939-51  HAHN, P. F.  Used radioactive isotopes in study of iron metabolism.

1940  GYORGY  Obtained conclusive experimental evidence that vitamin H, biotin, and coenzyme R were the same substance; that a deficiency of the nutrient which caused egg white injury in birds and mammals was also essential for yeasts and certain bacteria.

1940  GYORGY  and  Found that graying of hair in rats was caused by deficiency of pantothenic acid.
     POLING
1940  EAKIN, R. E.  Isolated the protein avidin from raw egg white (forms union with biotin and prevents absorption).

     SNELL, E. E.  
     and

     WILLIAMS, R. J.

1940  SALMAN  Studied lesions of the adrenal glands of pantothenic acid-deficient rats.

     and

     ENGEL

1940  Pantothenic acid became accepted member of the family of B-complex vitamins.

1940-60  MCCAY, C. M.  Conducted research in fats and oils.

1940-62  SCRINSHAW, N. S.  (1918- )  Worked in clinical and public nutrition; world food supply; nutrition and infection; amino acid metabolism; nutritional intake and status of man.

1941  CORI, C. F.  Elucidated the role of phosphoric acid in carbohydrate synthesis; action of epinephrin on metabolism; the fate of sugar in the animal body.

     and

     CORI, G

1942  MELNICK  Suggested that the minimum requirement for thiamin be 0.3 mg/1000 kcal.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1942</td>
<td>SCHOENHEIMER, R.</td>
<td>Stated there is nothing static in the body—dynamic metabolism. Prepared peptides, sterols.</td>
</tr>
<tr>
<td>1942</td>
<td>Du VIGNEAUD</td>
<td>Suggested correct structure for biotin.</td>
</tr>
<tr>
<td>1943</td>
<td>HARRIS, S. A.</td>
<td>Synthesized biotin.</td>
</tr>
<tr>
<td>1944-46</td>
<td>KEYS, Ancel</td>
<td>Conducted classic studies on effects on young men of experimentally induced semi-starvation, and methods of dietary rehabilitation.</td>
</tr>
<tr>
<td>1944-51</td>
<td>MOORE, C. V.</td>
<td>Absorption of iron from foods tagged with radioactive iron.</td>
</tr>
<tr>
<td></td>
<td>BLOCH, Konrad E. (1912—   )</td>
<td>Worked in biosynthesis of steroids and role of acetate in cholesterol formation.</td>
</tr>
<tr>
<td>1946</td>
<td>STEGGERDA F. R.</td>
<td>Studied the variability of calcium requirements and metabolism in the adult.</td>
</tr>
<tr>
<td>1946</td>
<td>BLOCK, R. J. and MITCHELL, H. H.</td>
<td>Calculated the &quot;chemical score&quot; of proteins from amino acid composition.</td>
</tr>
</tbody>
</table>
1946
KREHL and ELVEHJEM
Performed research on the transformation of tryptophan to niacin.

1947
SARRETT and GOLDSMITH, G.
Worked with transformation of tryptophan to niacin.

1947
KLEIBER, M.
Studied metabolic rate as related to body size.

ALBANESE, A. A. (1908-
Studied the use of lysine in infant formulas; electrolytic method for determination of basic amino acids in protein; fat metabolism; enzymes.

1948
SMITH and PARKER
(Eng.) Conducted B₁₂ research.

1948
RICKES and FOLKERS
Conducted B₁₂ research.

ASTWOOD, E. B. (1909-
Worked with thyroid gland and anti-thyroid compounds; radioactive iodine; pituitary hormones; sex hormones; fat metabolism.
STARE, Frederick  
(1910-  )  
Applied nutrition to problems of medicine and public health. Worked on unsaturated fatty acids.

1950  
STEARNS, Genevieve  
Studied requirements of humans for calcium, phosphorus, and magnesium.

1952  
SANGER  
Determined method of order of amino acids on polypeptide chains.

1952-73  
HEGSTED, D. M.  
Conducted studies on calcium and phosphorus requirements; protein utilization in growing rats.

1953  
HENRY, K. M.  
AND  
KON, S. K.  
Relationship between calcium retention and body stores of calcium in the rat.

1953  
MALM, O. J.  
Studied calcium requirements and adaptation in adult men.

1953  
Snyderman, Selma  
Studied pyridine deficiency in human infants.  
and  
HOLT
<table>
<thead>
<tr>
<th>Year</th>
<th>Authors</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>WATSON and CRICK</td>
<td>Resolved the structure of DNA.</td>
</tr>
<tr>
<td></td>
<td>BROBECK, J. R.</td>
<td>Studied physiological controls and regulators; control of energy balance; physiology of the hypothalamus.</td>
</tr>
<tr>
<td>1954</td>
<td>SWIFT, R. W.</td>
<td>Described various instruments used in determining energy exchange. Used Armsby’s calorimeter for human studies.</td>
</tr>
<tr>
<td>1954-55</td>
<td>ROSE, W. C.</td>
<td>Determined amino acid requirements of young men.</td>
</tr>
<tr>
<td>1954-73</td>
<td>SHAW, J. H.</td>
<td>Experiments with rat caries; effect of fluorine in purified ration; nutrition in relation to dental medicine.</td>
</tr>
<tr>
<td>1955</td>
<td>DUBACH, Reubenia</td>
<td>Investigated iron transport and metabolism.</td>
</tr>
<tr>
<td>1955</td>
<td>ALLISON, James</td>
<td>Made biological evaluation of protein; net protein utilization.</td>
</tr>
</tbody>
</table>
1956  COMAR, C. L. (Eng.) Studied metabolism of calcium and strontium; association in foods and deposition in body.

PIKE, Ruth (1916- ) Conducted studies on nutrition during pregnancy; sodium homeostasis and blood pressure.

1956-60 LEVERTON, Ruth) (1908- ) SWENSEID, Marion E. REYNOLDS, May ) Worked together on the determination of amino acid requirements of young women; nitrogen balance studies.

1956-59 Essential trace elements More than 20 years after the discovery of the essentiality of zinc, three more trace elements were demonstrated to be essential nutrients: MOLYBDENUM, SELENIUM, CHROMIUM.

1957 ARMSBY, J. P. (1853-1921) Built second large calorimeter in U.S. to study large farm animals.

1957 KEYS, Ancel Showed that epidemiological studies suggested a relationship between high-fat diets and heart disease.

1957 OKEY, Ruth Studied dietary fat and cholesterol metabolism.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958</td>
<td>WIESE, H.</td>
<td>Demonstrated requirement for linoleic acid in human infants.</td>
</tr>
<tr>
<td>1958</td>
<td>BRIN, Myron</td>
<td>Conducted studies on transketolase activity of erythrocytes.</td>
</tr>
<tr>
<td>1958-64</td>
<td>VIVIAN, Virginia</td>
<td>Investigated tryptophan-niacin metabolism; amino acid metabolism; preschool dietary adequacy and nutritional status.</td>
</tr>
<tr>
<td>1959</td>
<td>BEHAR, M. and BRESSANI, R.</td>
<td>Studied treatment and prevention of kwashiorkor; protein research with certain minerals; amino acid fortification of grains.</td>
</tr>
</tbody>
</table>
VAN ITALLIE, T. B. (1919- )_worked in carbohydrate and lipid physiology and biochemistry; regulation of food intake.

1959-64 WHEDON, G. D. Studied effects of high calcium intake on bones, soft tissue, blood; combined use of balance and isotopic studies of calcium metabolism.

1959-71 FINCH, C. A. Investigated body iron exchange; ferrokinetics and hemoglobin synthesis in man; criteria for evaluation of status of iron nutrition; iron fortification of foods.

MAYER, Jean (1920- ) Studied regulation of food and water intake; obesity; general nutrition.

1960 HOLT, L. E. Jr. Worked in clinical pediatrics; amino acid requirements for children; nitrogen balance criteria.

1961 CONSOIAZIO, F. C. Showed that energy requirements increase when work is performed at high temperatures; that basal metabolic rate is not affected by hot climates.

1961 ALTSCHUL Conducted studies in niacin and cholesterol metabolism.
<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>S.AUBERLICH, Howard</td>
<td>Studied relationship between pyridoxine and amino acid metabolism.</td>
</tr>
<tr>
<td>1964</td>
<td>VILTER, R. W.</td>
<td>Studied the vitamin B6-hydroxy relationship; nutritional anemias.</td>
</tr>
<tr>
<td>1965</td>
<td>S.NYDERMAN</td>
<td>Conducted research on the amino acid requirements of infants.</td>
</tr>
<tr>
<td>1966-71</td>
<td>WASSERMAN, R. H.</td>
<td>Studied metabolic roles of vitamins D, E, and K; vitamin D-dependent calcium-binding protein.</td>
</tr>
<tr>
<td>1967</td>
<td>FREDRICKSON, D.</td>
<td>Top research team in lipid research.</td>
</tr>
<tr>
<td></td>
<td>LEES, R. S.</td>
<td>Classified lipoproteinemias.</td>
</tr>
<tr>
<td></td>
<td>LEVY, R.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Name</td>
<td>Contribution</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1968</td>
<td>GREER, M. A.</td>
<td>Studied thyroid physiology.</td>
</tr>
<tr>
<td>1967</td>
<td>DURNIN and PASSMORE</td>
<td>Studied energy requirements as related to age and activity.</td>
</tr>
<tr>
<td>1968</td>
<td>DELEUCA, Hector</td>
<td>Seven nutrients added to RDA: vitamins E, B₆, B₁₂, folacin, and three minerals: iron, magnesium, phosphorus.</td>
</tr>
<tr>
<td>1968-71</td>
<td>DELEUCA, Hector</td>
<td>Identified 25-hydroxycholecalciferol as an active metabolic form of vitamin D₃.</td>
</tr>
<tr>
<td>1968</td>
<td>ALFIN-SLATER Roslyn B. (1916-)</td>
<td>Investigated essential fatty acids; lipid metabolism; cholesterol; aflatoxin; atherosclerosis, and worked in cancer research.</td>
</tr>
<tr>
<td>1969</td>
<td>WATERLOW, J. C. (Br.)</td>
<td>Worked with the assessment of protein nutrition and metabolism in man; leaf and algae protein; world food supply.</td>
</tr>
<tr>
<td>1970</td>
<td>ARMSTRONG, W. D.</td>
<td>Studied placental transfer of fluoride and calcium.</td>
</tr>
</tbody>
</table>
1970  MCCLURE, J. J.  Conducted studies on water fluoridation.

1971-72  LEVEILLE, Gilbert A.  Worked with lipid metabolism; fat content and composition of animal products; atherosclerosis; gluconeogenesis; amino acid metabolism.


1972-74  HAMBLET, K. M.  Studied zinc deficiency in humans; trace element metabolism; concentrations in hair.

1972  DARBY, William J.  Found iron deficiency in Arab middle east, especially Egypt. Worked in biochemistry of nutrition; clinical nutrition; nutrition surveys and public health; nutritional anemias; zinc metabolism.

1974  One nutrient added to new edition of RDA--zinc. (Biotin and pantothenic acid are shown on some U.S. RDA lists.)

ca 1978  SUTTIE, John W.  Described gamma-carboxyl glutamic acid on prothrombin controlled by vitamin K
Estimated safe and adequate daily dietary intakes of vitamin K, biotin, pantothenic acid, copper, manganese, fluoride, chromium, selenium, molybdenum, sodium, potassium, and chloride added to RDA.
HISTORY RELATED TO SPECIFIC NUTRITION TOPICS

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79
"As early as 1780 Lavoisier wrote that life processes were those of oxidation with the resulting elimination of heat. In his studies on respiratory metabolism with calculations of the amount of carbon dioxide exhaled and the amount of heat liberated, he made the earliest attempt to determine quantitatively the magnitude of the combustion involved in respiration and the amount of heat produced by the body in the process. He found that the amount of oxygen absorbed depended on food, work, and temperature. His important observations set the direction of future study of energy metabolism over two courses:

**respiratory metabolism**, the study of oxygen absorption and carbon dioxide elimination under various conditions;

**calorimetry**, the study of the production of heat in various bodily states."  (Kruse, 1969. pg. 19)

A. **Theory of function of the lungs**  
427-347 B.C.       PLATO

B. **Earliest experiment with the atmosphere**  
150 B.C.       PHILO of Byzantium

C. **Seventeenth century investigators**

1630     VAN HELMONT  
(1577-1644)     Introduced the word "gas"; dissociated chemistry from alchemy.

1660-66     BOYLE, Robert  
(1627-1691)     (Eng.) Boyle's Law elaborated. His works establishing the experimental approach to chemistry published.

1665     HOOKE, Robert  
(1635-1703)     (Eng.) Description of cellular structure of cork published.

1674     MAYOW, John  
(1643-1679)     Demonstrated that only a part of ordinary air is capable of supporting combustion.
D. The discovery of oxygen and its function in respiration.

1700  
STAHNL (1660-1734)  
Phlogiston theory.

HALLER, von  
(1708-1777)  
(Switz.)

1754  
BLACK, Jos.  
(1728-1799)  
(Scot.) "Fixed air" (carbon dioxide).

1766  
CAVENDISH  
(1731-1810)  
"Inflammable air" (hydrogen)

1772  
RUTHERFORD  
"Residual air" (nitrogen).

1773  
SCHEELE, C. W.  
(1742-1786)  
Discovered oxygen.

1774  
PRIESTLEY  
(1733-1804)  
"Dephlogisticated air" shown to be oxygen.

E. The work of Lavoisier

His friend LaGrange said:  
"It took but a second to cut off his head; a hundred years will not suffice to produce one like it."

LAVOISIER  
(1743-1794)  
(Fr.) Father of chemistry, of nutrition.

1779  
Gave the name "oxygen" to dephlogisticated air.

1780  
LAVOISIER and  
LAPLACE  
Studies in calorimetry.

1789  
LAVOISIER and  
SEGUIN  
Made first measurement of human energy metabolism.

F. Treadwheel experiments and studies

1857-59  SMITH, Edward

G. The theories of Bischoff and Voit

1860  BISCHOFF and  
VOIT  
Observed that the output of urea ran proportional to the nitrogen ingested.
H. The calorie value of foods

PRANKLAND
(1825-1899)

I. The respiratory quotient

1849 REGNAULT
and
REISÉT

1852 BIDDER, F. and
and
SCHMIDT

At University of Dorpat.

J. Respiration apparatus

1860 PETTENKOFER
(1818-1901) First professor of hygiene at
and
VOIT, C.
(1831-1908) any university.

K. Energy expenditure in relation to body surface

1885-91 RUBNER, Max
(1854-1932)

Specific dynamic action of food

1902 RUBNER, Max

L. Observations on basal metabolic rate

1895 MAGNUS and
and
LEVY

M. 20th century investigators

ARMSBY, J. P.

ATWATER, W. O.
BENEDICT, F. G.

BOOTHBY, W. M.

BROBECK, J. R.

CATHCART, E. F.

CONSOLAZIO, P. C.

DUBOIS, E. P.

DURNIN, J. V. G. A.

FORBES, E. B.

KALDANE, J. S.

KARPOVICH, P. V.

KLEIBER, M.

MCELOD, Grace

MCCCRACKEN

83
PASSMORE, R.

RICHARDSON, M.

SWIFT, R. W.
HISTORY OF PROTEINS

A. The early chemists

PARACELSIUS (Switz.)
(1493-1541)

THOMSON, Thomas (Scot.)
(1773-1852)

B. Animalized matter in vegetable substances

1742 BECCARI, I. B.

C. Fecula

1803 PROUST, Jos. L.
(1754-1826)

D. Albuminous substances in seeds other than wheat

1806 VAUQUELIN
and
FOURCROY

D. The earliest distinction between proteins
Distillation studies.

1811 BERTHOLLET

F. Studies on albuminous substances

1839-48 MULDER, G. J. (Holl.)
(1802-1880)

G. The Gelatin Commission

1815 Appointed by the Academy of
Paris

1816-41 MAGENDIE Served as chairman.
Studied to determine if gelatinous extract of bones could
replace meat in the diet.

VAUQUELIN Served as member.
History of Proteins

1872 VOIT, Carl and BISCHOFF Studies on protein-sparing effect of feeding gelatin as opposed to meat protein.

1898 MÖRNER ) All studied the nutritive
1905 KAUFMAN ) value of gelatin supple-
1928 JACKSON, SOMMER, ) 
and ROSE ) 

H. Animal feeding studies at Rothamsted, England

1854 LAWES
and
GILBERT

I. Study of seed proteins

1890 OSBORNE, T. B.

J. 20th century investigators

ALBANESE, A. A.

ALLISON, J. B.

BLOCK, R. J.

CLARK, Helen

ELEVEHJEM, C. A.

HARPER, A. E.

HOLT, L. E.

LEVERTON, Ruth
LEWIS, H. B.

MENDEL, L. B.

MITCHELL, H. H.

OSBORNE, T. B.

REYNOLDS, May

RITTENBERG, D.

ROSE, W. C.

SCHOENHEIMER, R.

SNYDERMAN, Selma E.

SWENDESEID, M. E.

VIVIAN, Virginia

WHIPPLE, G. H.

YANG, S. P.

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Concerned with world problem of protein supply

AUTRET, M.

BEHAR, M.

BRESSANI, R.

BROCK, S. F.

DEAN

GOPALAN

JELLIFFE

SCRIMSHAW, N. S.

VAN VEEN, A. G.

WATERLOW, J. C.
HISTORY OF FATS

The preparation and use of various fatty substances in foods, technology, and medicine is as old as history.*

A. Significance of food on the deposition of body fat
   1757-60 HALLER, Von
   (1708-1777) (Ger.) Great physiologist.

B. Chemical examination of fats
   1797 DARCET
   (1725-1801) (Fr.) Professor at the College de France. Worked with Lefevre and Pelletier.
   1805 VOGEL
   1811 CHEVREUL
   (1786-1889) (Fr.) Professor at Lycée Charlemagne. Contributed pioneer studies on separation and description of fatty acids.

C. Discovery of glycerol
   1783 SCHEELE, C. W.
   (1742-1786) Swedish chemist.

D. Rancidity in fats
   1792 SENEBIER
   (1742-1809) Swiss clergyman and pioneer plant physiologist.

E. Analysis of fats for their components
   1815 BRACONNOT
   Professor of natural history at the Lyceum at Nancy, France.

F. Identification of acrolein
   1843 REDTENBACHER

G. Controversy over synthesis of fat in the body from carbohydrate.
   1843 LEIBIG (Pro)
   (Ger.) versus
H. Digestion of fats

1849 BERNARD, Claude (1813-1878) (Fr.) One of the greatest experimenters among 19th century physiologists. Discovered relationship between pancreatic secretions and fat digestion.

I. First synthesis of fats

1860 BERTHELET

J. Sterols

1814 CHEVREUL (1786-1889) Showed that lard contained two oily bodies—one solid and one liquid at room temperature.

1878-85 HESSE Study of plant sterols.

1889 TANRET Discovered sterols in plants.

K. Absorption of the halogens by unsaturated fatty acids

1822 DAVY, E. Gave first account of the action of iodine on unsaturated compounds.

1834 HUBL Developed practical method for determining "iodine number" of fats (determination of the number of C-C bonds in a molecule of fatty acid).

1898 WIJS Suggested improvements in Hubl's method for determining the "iodine number" of fats.

L. Discovery of phospholipids

1844-46 Gobeley

1868 STRECKER
History of Fats (page 3)

1884 THUDICHUM
1908 McLEAN
1913 TRIER

M. 20th century investigators

AAES-JORGENSON, E.

ALFIN-SLATER, Roslyn B.

BLOCH, K.

BRONTE-STEWART, B.

BROWN, J. B.

BURR, G. O.
and
BURR, M. M.

DEUEL, H. J., Jr.

FREDRICKSON, D.

HILDITCH, T. P.

HANSON, A.

JOHNSON, R. M.

91
KEYS, Ancel

LEES, R. S.

LEVY, R.

McLEAN

OKEY, Ruth

OLSON, R.

RAMSOS, Dale

STARE, F.

TRIER

WIESE, H.
HISTORY OF CARBOHYDRATES

A. Origin of the term "carbohydrate"
1844
SCHMIDT, C. (Ger.) Suggested the term to include sugars, starches, and other natural products which yield sugars on hydrolysis.

B. Conversion of starch to sugar
1812
KIRCHHOFF (Russ.)

C. The starch-digesting enzyme
1814
KIRCHHOFF

The discovery of diastase
1833
PAYEN and
PERSOZ

D. Grape sugar — dextrose
1804
Proust (1754-1825) (Fr.) First chemist to prepare grape sugar in its pure form and make careful studies of its properties.

E. The sugar of the blood and urine
6th century
Hindus first discovered excretion of sugar in urine.
1670
WILLIS (1621-1685) (Eng.) First to describe sugar excretion in Europe.
1815
CHEVREUL (1786) (Fr.) Identified sugar in urine.
1844
SCHMIDT Identification of sugar in urine.

F. The discovery of glycogen
1856
BERNARD, Claude (813-1878) (Fr.)
Hemicellulose and pentosans
1891 SCHULZE, E.

20th century investigators

CORI, Gerty and CORI, C. F.

HALDI, J.

HASTINGS, A. B.

MARGROFF

SOMOGYI, M.

VAN ITALLIE, T. B.
### History of the Minerals

<table>
<thead>
<tr>
<th>Year</th>
<th>Author/Contributor</th>
<th>Note</th>
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<tbody>
<tr>
<td>1804</td>
<td>SAUSSURE, de</td>
<td>(Switz.) Illustrious plant physiologist.</td>
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<tr>
<td>1800</td>
<td>SCHRADER</td>
<td></td>
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<td></td>
<td>BRACONNOT</td>
<td>Professor of natural history in the Lyceum at Nancy, France, and director of the botanical gardens.</td>
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<tr>
<td>1842</td>
<td>WIEGMANN and</td>
<td>Professor at Braunschweig</td>
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<td></td>
<td>POLSTORFF</td>
<td>Apothecary at Braunschweig</td>
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<td>1748</td>
<td>GAHN</td>
<td>(Swed.)</td>
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<td></td>
<td>DAVY, H.</td>
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<td></td>
<td>BERZELIUS</td>
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<td>FORDYCE</td>
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<td>1862</td>
<td>GRAHAM, T.</td>
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<td></td>
<td>(1805-1869)</td>
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<td>1887</td>
<td>HOFF, van't</td>
<td>Dutch physical chemist.</td>
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<td></td>
<td>(1852-1911)</td>
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<td></td>
<td>ROSE, Heinrich</td>
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<td></td>
<td>(1795-1865)</td>
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<td>LIEBIG, von, J.</td>
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<td>(1803-1873)</td>
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<td>1873</td>
<td>FORSTER</td>
<td>Experiments with nearly ash-free diets.</td>
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### History of the Minerals (page 2)

<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Description</th>
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<tbody>
<tr>
<td>1889</td>
<td>BUNGE, von</td>
<td>Speculations about the effects of ash-free diets.</td>
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<td>1885</td>
<td>RINGER</td>
<td>Physiological antagonism of inorganic ions. (Eng.)</td>
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<td>(1835-1910)</td>
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<tr>
<td>1900</td>
<td>LOCKE</td>
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<td>1911-12</td>
<td>LOEB</td>
<td>The dynamics of living matter</td>
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<td></td>
<td>(1859-1924)</td>
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<td>1879</td>
<td>HAMMERSTEIN</td>
<td>Studies of calcium</td>
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<tr>
<td></td>
<td></td>
<td>Significance of calcium in blood coagulation.</td>
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<td>1908</td>
<td>McCALLUM and</td>
<td>Studies of magnesium</td>
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<tr>
<td></td>
<td>VOEGTLIN</td>
<td>Content of blood plasma</td>
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<td>1915</td>
<td>DENIS</td>
<td>Deficiency syndrome.</td>
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<td>1931</td>
<td>McCOLLUM and</td>
<td></td>
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<td></td>
<td>ORENT</td>
<td></td>
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<tr>
<td>1909</td>
<td>McCOLLUM</td>
<td>Studies of phosphorus</td>
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<tr>
<td></td>
<td></td>
<td>The synthesis of organic phosphorus-containing compounds from inorganic phosphorus.</td>
</tr>
<tr>
<td>1918</td>
<td>OSBORNE and</td>
<td></td>
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<td></td>
<td>MENDEL</td>
<td>Growth restrictions in phosphorus-deprived rats.</td>
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<tr>
<td>1906</td>
<td>JORDAN, HART,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and PATTON</td>
<td>Phytin as a source of phosphorus for dairy cows.</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Contribution</td>
</tr>
<tr>
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<td>------------------------------------------------------------------------------</td>
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<tr>
<td>1926</td>
<td>EGGLETONS</td>
<td>Phosphorus compounds in metabolic processes. Discovered an organic labile phosphate in muscle to which he gave the name, phosphagen.</td>
</tr>
<tr>
<td>1929</td>
<td>FISKE and SUBBARROW</td>
<td>Phosphagen identified as phosphocreatin.</td>
</tr>
<tr>
<td>1935</td>
<td>LOHMAN</td>
<td>Isolated adenosine diphosphate from heart muscle and from smooth muscle.</td>
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<tr>
<td>1941</td>
<td>CORI, C. F. and CORI, G.</td>
<td>The role of phosphoric acid in carbohydrate synthesis.</td>
</tr>
</tbody>
</table>

L. Twentieth century investigators in minerals

**CALCIUM**

- AUB, J. C.
- BAUER, W.
- COMAR, C. L.
- HEGSTED, D. M.
- HENRY, K. M.
- HENRY, S. K.
- KON
- MALM, O. J.
McCanne, R. A.

McLean
and
Hastings

Reifenstein, E. D. Jr.

Sherman, H. C.

Signnaes, R. F.

Stearns, Genevieve

Steggerda, F. R.

Whedon, G. D.

Widdowson, E. M.

Phosphorus

Hart, E. B.

McCollum, E. V.

Smith, A. H.
COPPER
ELVEHJEM, C. A.

GLASS, G.

HART, E. B.

IRON
DARBY, W. J.

DUBACH, Reubenia

FINCH, C. A.

HAHN, P. F.

HEGSTED, D. M.

JOHNSTON, Frances

MOORE, E. V.

WHIPPLE, G. H.
IODINE

ASTWOOD, E. B.

CURTIS, G. M.

GREER, M. A.

HAMWI, G. J.

HARRINGTON, C. R.

KENDALL, E. C.

KIMBALL, C. P.

McCLENDON, J. F.

MARINE, D.

SCRIMSHAW, N. S.

FLUORINE

ARMSTRONG, W. D.

DEAN, N. T.
McCLURE, F. J.

SCHOUR, I.

SHAW, J. H.

SMITH, Margaret C.
HISTORY OF THE DISCOVERY OF THE VITAMINS

A. Adequacy of a diet of only protein, carbohydrate, and fat

1871 DUMAS, J.B.A. (1800-1884)

1880 LUNIN, N. Experiments indicated that "...other substances indispensable for nutrition must be present in milk besides casein, fat, lactose, and salts."

B. Unidentified nutrients

1905 PEKELHARING Professor of Hygiene, University of Utrecht.

C. Early work on protein--prologue to the discovery of vitamins

1905 HENRIQUES and HANSEN

1906 HOPKINS, F. G.

D. Experiments with purified diets

1907 McCOLLUM

1909 OSBORNE and MENDEL

E. Emergence of the vitamin hypothesis

1896 EIJKMAN (1858-1930) Concluded that overmilled rice caused polyneuritis in chicks and beriberi in humans.

1912 FUNK Propounded the theory of "vitamines".

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F. Discovery of the first fat-soluble vitamin

1913 Osborne and Mendel

1914 McCollum and Davis

G. The "biological method of analysis" of foods

1907-08 Experiment stations suggested supplementation of corn fed to pigs with protein-rich concentrates.

1915-25 McCollum, E. V. and Davis, C. Studies on grains; observed physiological responses of animals fed known supplements.
HISTORIES OF SELECTED VITAMINS

A. VITAMIN A

1. Early observations
   1816 MAGENDIE Laboratory studies.
   1857 LIVINGSTONE, D. Clinical observation.

2. Association of eye disorder with malnutrition.
   1863 BITOT
   1917 BLOCH Studies with Danish children.
   1917 McCOLLUM and SIMMONDS
   1917 OSBORNE and MENDEL

3. Correlation of vitamin A values in foods with yellowness
   1915 PALMER
   1919 STEENBOCK and GROSS
   1928 EULER, EULER, and HELLSTROM
   1929 MOORE

4. Vitamin A deficiency on bone growth
   1926 MELIANBY, E.
   1941 WOLBACH and BESSEY
VITAMIN A (cont'd.)

5. Synthesis of Vitamin A
   1833 KARRER
   1936 FUSON
       and
       CHRIST
   1936 KUHN
       and
       MORRIS

6. Vitamin A and visual purple
   1925 FRIDERICIA
       and
       HOLM
   1935 WALD

7. Conversion of carotene to vitamin A
   1931 OLcott
       and
       McCANN
   1947 DUELL, H. J., Jr.
   1954 BIERI, J. G.

8. Absorption
   DRUMMOND, J. C.
   ROWNTREE, Jennie

9. Methods of determination
   BAUMANN, C. A.
       and
   STEENBOCK, H.
   COWARD, Katharine
   SHERMAN, H. C.

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B. VITAMIN D

1. History of rickets

1650  GLISSON, Francis Regius Professor of Physics 1597-1677) at Cambridge University.
1917  FINDLAY
1922  DICK

The early use of cod liver oil

1824  SCHUETTE
1889  BLAND-SUTTON, Sir John

The use of elemental phosphorus to treat rickets

1872  WEGNER
1884  KASSOWITZ
1926  HESS and WEINSTOCK

2. Studies of experimental rickets

1919  MELLANBY, Edward
1920  MELLANBY "Toxamin" theory
1922  KORENCHIEVSKY

3. The second fat-soluble factor

1922  McCOLLUM, PARK and SHIPLEY

4. The separation of vitamin D from vitamin A
VITAMIN D (cont'd.)

5. The therapeutic value of sunlight in rickets
   1921 SHIPLEY
   1924 GOLDBLATT and SOAMES
   STEENBOCK and BLACK
   HESS and WEINSTOCK

6. Precursors of vitamin D
   1927 ROSENHEIM and WEBSTER
   1927 WINDAUS and HESS
   1930 BOURDILLON and Associates

7. Vitamin D content of various fish liver oils
   1927 BILLS

8. Requirement of infants for vitamin D
   JEANS, P. C. and STEARNS, Genevieve

9. Other investigators of vitamin D
   EEG-LARSEN, Nicolay
   HARRISON and HARRISON
   WASSERMAN
C. THIAMIN, the anti-neuritic vitamin

1. Isolating the beriberi-curate substance

1897 Eijkman
1906 Eijkman and Grijns
1912 Suzuki, Shimamura and Ohdake
1912 Funk
1912 Vedder and Williams
1917-26 Seidel
1926 Jansen and Donath
1932 Ohdake
1932 Windaus
1935 Williams, R. R.

2. Function of thiamin

1929 Kinnerley and Peters
1937 Lehmann and Schuster

3. Requirement for the human

1942 Melnick
1943 Williams, Mason and Wilder
THIAMIN (cont'd.)

4. Decarboxylation reactions
   1957-58 BRESLOW

5. Transketolase activity of erythrocytes (urinary thiamin)
   1958 BRIN

D. RIBOFLAVIN

1. Early history
   The multiple nomenclature
   Vitamin B2
   Vitamin G
   P-P (pellagra-preventive)

2. Evidence refuting the two-vitamin theory
   1917 EMMETT
   (of Parke-Davis)
   1919 MITCHELL, H. H. His analysis
   1926 HAUGE
   and
   CARRICK

3. Evidence supporting the two-vitamin theory
   1927 SALMAN

4. An assay procedure for B2
   1928 CHICK
   and
   ROSEC
   1931 BOURQUIN
   and
   SHERMAN

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Histories of Selected Vitamins (page 7)

RIBOFLAVIN (cont'd.)

5. Confusion over the relation between B₂ deficiency and pellagra

1926 GOLDBERGER and LILLIE
1933 BOOHER
1936 KOEHN and ELVEHJEM
1937 SEBRELL

6. Isolation, chemical identification and synthesis of riboflavin

1879 BLYTH Lactochrome
1925 BLEYER and KALLMAN Lactochrome
1932 WARBURG and CHRISTIAN Lumiflavin
1933 KUHN Isolation of the pigment
1935 KARRER Synthesis
1935 KUHN Synthesis
1936 AYKROYD Riboflavin deficiency
1938 SEBRELL, W. H. Riboflavin deficiency
1940 KRUSE, H. D. and SYDENSTRICKER, V. P. Riboflavin deficiency

E. NIACIN

1. Pioneer dietary studies with human pellagrins

1914 VCOETLIN

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### NIACIN (cont'd.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
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<tr>
<td>1915</td>
<td>GOLDBERGER</td>
<td>Institutional studies</td>
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<td>2.</td>
<td><strong>Experimental production of a pellagra-like syndrome in dogs.</strong></td>
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<td>1917</td>
<td>CHITTENDEN and UNDERHILL</td>
<td></td>
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<tr>
<td>1925</td>
<td>UNDERHILL and MENDEL</td>
<td></td>
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<tr>
<td>3.</td>
<td><strong>Heat-stable factor; the anti-pellagra vitamin</strong></td>
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<td>1914</td>
<td>VOEGTLIN</td>
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<tr>
<td>1935</td>
<td>EULER, von, ALBERS and SCHLENCK</td>
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<td>1936</td>
<td>WARBURG and CHRISTIAN</td>
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<td>1937</td>
<td>SUBBARROW and ELVEHJEM</td>
<td>MADDEN, STRONG and WOOLLEY</td>
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<td>4.</td>
<td><strong>Pellagra in the rat</strong></td>
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<td>1926</td>
<td>GOLDBERGER and LILLIE</td>
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<td><strong>Black tongue in dogs</strong></td>
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<td>1937</td>
<td>ELVEHJEM, MADDEN, STRONG and WOOLLEY</td>
<td>111</td>
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NIacin (cont'd.)

1937  COWGILL
1937  CHICK, Harriette

6. Pellagra in the human

1818  GOLDBERGER,
      WHEELER
      and
      SYNDENSTRICKER

1924  GOLDBERGER
      and
      TANNER

1932  STIEBLING, Hazel
      and
      MUNSELL, Hazel

1937  SPIES,
      COOPER
      and
      BLANKENHORN

1941  SYDENSTRICKER, V. P.

7. Antipernicious anemia factors and pellagra

1932  STRAUSS
      and
      CASTLE

8. Transformation of tryptophan to niacin

1946  KREHL
      and
      ELVEHJEM

1947  SARRETT
      and
      GOLDSMITH, Grace

9. Niacin and cholesterol metabolism

1961  ALTSCHUL

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F. FRACTIONATION OF THE B-COMPLEX

1. Biotin
   1913 OSBORNE and MENDEL
   1927 BOAS
   1933-34 PARSONS
   1940 GYORGY
   1942 Du VIGNEAUD
   1943 HARRIS, S. A.

2. Pyridoxine
   1935-36 GYORGY
   1936 LEPKOVSKY, JIKES, and KRAUSE
   1938 KERESZTESY and STEVENS
   1938 GYORGY
   1938 KUHN and WENDT
       ICHIBA and MICI

Structure of pyridoxine

   1939 STILLER, HARRIS, POLKERS KERESZTESY and STEVENS
FRACTIONATION OF THE B-COMPLEX (cont'd.)

Synthesis of pyridoxine
1939 HARRIS
and
FOLKERS

Pyridoxine and amino acid metabolism
1961 SAUBERLICH

Other investigators of pyridoxine
CHOW, Bacon

ELVEHJEM, C. A.

PIKE, Ruth

Snyderman
and
HOLT

VILTER, R. W.

3. Vitamin B₁₂
1926 MINOT
and
MURPHY Treatment of pernicious anemia

1930 WEST
and
DAKIN

1936 CASTLE Intrinsic factor

1948 SMITH
and
PARKER

1948 RICKES
and
FOLKER

In England
G. ASCORBIC ACID

1. Early history and production of experimental scurvy

1753    LIND (1716-1794) Published A Treatise on the Scurvy.
1907-12 HOLST and FROELICH
1914    HESS, A. F.
1918    COHEN and MENDEL

2. The name of the vitamin

1920    DRUMMOND
1933    SZENT GYORGYI and HAWORTH

3. Concentrates of the vitamin

1918    ZILVA
1929    KING

4. Methods of assay for vitamin C

1926    HOJER Histologic examination of the teeth
1931    SHERMAN and SMITH, Sybil Animal assay, preventive method
1932    TILLMANS and Associates Chemical method.
1933    BESSEY and KING Curative method.

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### ASCORBIC ACID (cont'd.)

5. **Isolation of ascorbic acid**

<table>
<thead>
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<th>Year</th>
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<tr>
<td>1928</td>
<td>Szent-Gyorgyi</td>
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<td>1932</td>
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<td></td>
<td>and</td>
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<td>Waugh</td>
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<tr>
<td>1932</td>
<td>Rygh</td>
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REFERENCES CITED


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APPENDIX A

QUESTIONNAIRE
QUESTIONNAIRE

Encircle the letter for the answer which best reflects your thinking on each question and (if you wish) make comments or suggestions pertinent to each one.

1. Which of the following should be given increased class time?
   a. Lecture
   b. Students' reports
   c. Class discussion
   d. None

   Comments:

2. Do you consider your notes to be good, permanent sources of reference and how would you rate them?
   a. Good
   b. Moderately good
   c. Poor

   Comments:

3. Do you think that you might get a better sense of history and remember the sequence of events and personages more readily if material were presented:
   a. By individual nutrient, with a complete history of each being completed before going on to the next, or
   b. Chronologically, with each time segment being associated with the discoveries and researchers of that period.

   Comments:
4. How would you describe your knowledge of research currently in progress and of the names of the people and institutions involved?
   a. Good
   b. Moderately good
   c. Poor

   Comments:

5. Further general comments and suggestions (use back of sheet to complete responses):
APPENDIX B

COVER LETTER FOR QUESTIONNAIRE
Have you time to contribute a few thoughts which might help the next wave of nutritionists and dietitians (and a current Master's candidate as well)? As a former student in the class myself, I have accepted Dr. Vivian's challenge to develop a syllabus for "History of Nutrition" (Human Nutrition 711) which would be most effective from the student's point of view. With her approval, I am soliciting input from those who have recently completed the course.

The questionnaire has been kept brief to encourage your prompt and willing response, but please comment fully on anything which comes to mind, and offer any suggestions which you feel might make the course more meaningful. No signature is needed, and the form may be returned to me in the enclosed stamped, self-addressed envelope.

Thanks very much for your help.

(Signature)