

4. Repetition of evolutionary stages of the race.

- a. Primitive nervous system
- b. Primitive muscular system
- c. Primitive circulatory system
- d. Later development of special organs.

5. The mature foetus.

D. PRENATAL PERIOD

The prenatal period extends from the moment of conception to the moment of birth. In considering the development of the new individual, remember that from the instant of conception the fertilized cell fuses with no other cell; it takes into itself no further living substance. It begins manufacturing its own protoplasm from the food substances it receives from the mother. The book of heredity for the individual is closed at conception. But the book of environment is just opening.

E. NATAL PERIOD

During the 280 days of parasitic life the human foetus has carried forward its processes of nutrition, respiration (internal), excretion, and growth at the expense of the mother. Then comes the phenomenon of birth or separation of the foetus and its appendages from the body of the mother. It is a hazardous and momentous change for this infant, when it suddenly is cast into the outer world to take up its independent existence.

- REFERENCES: *Kirkpatrick and Huettnor--Fundamentals of Health, Pp. 34-55, 411-450.
Martin--Human Body, Pp. 592-613.
Conklin--Heredity and Environment, Chap. 1
Guyer--Being Well Born, Chap. 4
Dorsey--Why We Behave Like Human Beings, Chap. 1
McMurrich, J.P.--Development of the Human Body

*Required reading.

F. HEREDITY AND ENVIRONMENT - GROWTH AND DEVELOPMENT (the first determining force of Constructive Hygiene)

From the moment of conception this new individual has been subject to two forces: Heredity or Nature, and Environment or Nurture. The great problem of development is the unraveling of the effects of these two and the assignment of its true value to each. Through ages of speculation and scientific research these relationships have fascinated man and have given rise to an immense volume of investigation.

1. Environmentalist View

Early thinkers believed that species might be transmuted by environmental changes and that life itself could arise from lifeless matter. Philosophers of the 17th and 18th centuries believed that man was the product wholly of environment.

2. Hereditarian View

Modern biology has been responsible for the establishment of the vital importance of heredity both to the race and to the individual. It has failed to produce life artificially or to create

species by means of experimental evolution.

Neither heredity nor environment is all-inclusive. Both are necessary for the highest form of development.

Heredity is the first determining force in constructive hygiene. It may be defined as "the process which is responsible for the particular combination of transmissible characters possessed by an organism." (Burlingame)

3. Methods of Study of Heredity

Our knowledge of heredity has come to us by three principal methods:

- a. Observational. "Like produces like" came as a result of mankind comparing individuals, species, and races and observing certain constant resemblances and differences.
- b. Statistical. This method studies characters singly and applies quantitative methods to them. Francis Galton was its founder. His researches were applied to several selected traits, as: Genius, artistic ability, stature, eye color, and certain diseases.

The two principles connected with the name of Galton are:

- (1) Law of Ancestral Inheritance: A statistical evaluation of the contribution of each ancestor to the individual.
- (2) Law of Filial Regression: Or tendency of children to return to the average of the group.

The weakness of the method lies in the fact that it is not always possible by observation alone to distinguish between inherited and environmental resemblances and differences. The statistical method outlined the problem of heredity; it did not solve it.

c. Experimental

- (1) Mendel is the outstanding pioneer, with his study of the breeding of peas. His experiments enabled him to formulate what are known as Mendel's Laws:

Law of segregation
Law of independent assortment

The principles of Mendelian inheritance apply to man. Many inheritable traits, both normal and abnormal, have been shown to be of this nature. See the list given in Storey's Principles of Hygiene, Pp. 253-260.

- (2) Later research has confirmed and extended Mendel's observations greatly. It has also added new conceptions which explain some facts which were apparently inconsistent with his findings. The foremost of these newer principles are:

- (a) Linear order of genes
- (b) Linkage of genes in chromosome
- (c) Crossing over of groups of genes
- (d) Sex linkage of some traits

G. RACE BETTERMENT THROUGH CONSCIOUS CONTROL

The growing problems of caring for the mentally and physically defective have led to a careful study of the causes of these conditions. Much defectiveness has been found to be directly or indirectly inheritable. As a result of such studies a basis for improvement of the race, through the guidance of heredity, has been found. The application of our knowledge to this end is called Eugenics. It is the name given to a program for improvement of the human race by limiting the multiplication of inferior stocks and encouraging the increase of superior ones. The problem has these two broad phases and it is proposed to approach its solution by two lines of attack.

1. Positive or Constructive Eugenics--measures to encourage reproduction of the best.
 - a. Education regarding heredity
 - b. Selective mating
 - c. Reproduction of superior strains

2. Negative or Restrictive Eugenics--measures to control the mating and reproduction of the unfit.
 - a. Segregation or sterilization of defectives
 - b. Prevention of war
 - c. Intelligent charity
 - d. Safeguarding the quality of immigration

3. Menaces to Racial Stock
 - a. War
 - b. Unwise charity
 - c. Undesirable immigration
 - d. Infertility of superior strains

- REFERENCES: *Storey--Principles of Hygiene, Chap. 4
*Burlingame and Martin--General Biology, Chaps. 28-31
Carr-Saunders--Eugenics
*Conklin--Heredity and Environment, Chaps. 2-6
Gosney and Popenoe--Sterilization for Human Betterment
Guyer--Being Well Born, Chaps. 1,2,6,7,8,13,15,23.
Hutington and Whitney--The Builders of America, Chaps. 19-21
*Jennings--Biological Basis of Human Nature, Chaps. 6,8,10,15
Popenoe--The Child's Heredity
Popenoe and Johnson--Applied Eugenics
Stockard--Physical Basis of Personality
*Kirkpatrick and Huettnner--Fundamentals of Health, Chap. 3

*Required reading.

IV. NUTRITION, the second determining force in Constructive Hygiene.

"The growth of the human body, its weight, its physical and mental energy and vigor and its vital endurance are the results of the chemistry going on within and surrounding the human tissue cell."--Storey.

The establishment of the cell-theory through the cumulative efforts of many investigators furnished a sound basis for understanding body processes, as well as solving many of the puzzles of heredity. As a basis for understanding the processes of nutrition by which the body provides for growth, maintenance, and repair, certain facts about the tissue cells should be remembered:

Every tissue cell is a constructing and manufacturing chemical and physical laboratory which is absolutely dependent upon the chemical supplies that are brought to it by blood and lymph streams.

The chemicals proven necessary for normal functioning of the human tissue cells are:

Carbon	Phosphorus	Calcium
Hydrogen	Sulphur	Magnesium
Oxygen	Chlorine	Iodine
Nitrogen	Sodium	Iron
	Potassium	Copper
		Manganese

Tissue cells are the "bricks" out of which every part of the human body is built. These cells vary greatly in size, shape, and function. They are all composed essentially of the same basic material, protoplasm. From the chemical materials brought to them by the blood the human tissue cells build, repair, or replace their own structure and manufacture their own special "functional material."

The relation of the chemicals within the cell are both physical and chemical. The life of the cell is a continuous effort to reach static equilibrium. This is never reached during the life of the individual.

A. CELL ENVIRONMENT AND HEALTH

Health is dependent upon the chemical and physiochemical conditions within and surrounding the cells. These conditions are directly influenced by certain definite factors in the cell environment.

Important factors in cell environment are:

1. Temperature
2. Water content
3. Inorganic salts
4. Nutrients
5. Vitamins
6. Hormones
7. Waste products
8. Reaction (Hydrogen in concentration)

An intelligent understanding of the relation of nutrition to health must be based upon a working knowledge of:

1. The physiology of the tissue cell.
2. The character, composition and values of foodstuffs.
3. The mechanisms of digestion and assimilation.
4. The hygiene of nutrition.
5. Some guides to adequate nutrition.

B. PHYSIOLOGY OF THE TISSUE CELL

All cells exhibit two types of functions, anabolic or constructive functions--performed chiefly by the nucleus; katabolic or destructive functions--performed chiefly by the cytoplasm.

Thus the nucleus of the cell is chiefly an organ of growth, construction, repair and reproduction while the cytoplasm is an organ of power production through energy transformation. Both of these functions are dependent upon the delivery to the cell of adequate nutritive materials and removal of the waste products.

1. Metabolism: The sum total of the chemical activities occurring in living protoplasm. For purposes of study it may be further subdivided:

Basal metabolism: The chemical reactions which are concerned with the immediate maintenance of the living state.

Growth metabolism: The whole group of reactions by which new protoplasm is produced and new supporting structure laid down.

Functional metabolism: Those reactions associated with the activities of which protoplasm is capable, i.e., muscular, nervous, or glandular, etc.

C. THE CHARACTER, COMPOSITION, AND VALUE OF FOODSTUFFS.

1. Foods - Composition and values

Normal functioning of the cells of the body, which constitutes health, requires an adequate supply of the chemicals composing the human body. These chemicals are taken into the body in the food we eat, the water we drink, and the air we breathe. The foods are needed for three main purposes:

- a. To secure energy.
- b. To build and repair tissue.
- c. To regulate body processes.

2. Sources: Soil and air are the ultimate sources of the chemicals required by the body. Plant life is the primary source of human food. Animal ~~life is~~ a secondary source.

3. Variety of Foodstuffs: Humans have found by centuries of experience and experiment that the needed chemicals can be secured from an almost endless variety of animal and vegetable sources.

4. Classification of Foods: Food compounds have been classified into groups according to their chemical composition and their physiological action. Most foods belong in more than one class, though usually they have one dominant function or value.
5. Food Groups: The food compounds and principles essential for human life may be classified into the following groups:
 - a. Water
 - b. Inorganic salts
 - c. Proteins
 - d. Fats
 - e. Carbohydrates
 - f. Oxygen
 - g. Vitamins
 - h. Food accessories
6. Food Values: Our estimate of the value of various foodstuffs has been secured through three main standards of measurement:
 - a. Chemical: For many centuries the sole unit of measurement was secured by chemical analyses.
 - b. Physical: Values have been attached to foods, based upon their ability to produce heat, measured in heat units.
Unit of measurement--Calorie (large) the amount of heat necessary to raise 1 kilogram of water 1° centigrade.
 - c. Biological: The newer values are based upon carefully controlled feeding experiments on animals.
7. Minimum Essentials: While the exact chemical composition and physiological action of the numerous substances used for food would be useful and desirable, it is not necessary in order to intelligently select a well balanced diet to fit your peculiar needs.

The following facts, however, are considered the minimum essential knowledge about each one of the food groups as guides to adequate nutrition:

- a. Function of group in body.
- b. Source from which it can be most economically secured
physiologically
financially
- c. Quantity required by body.
- d. Quality producing best results.

(Note--Student is expected to look up the above facts about each one of the groups of foods enumerated above.)

D. MECHANISMS OF DIGESTION AND ASSIMILATION

1. Preparation of Food

To understand the varied aspects of the preparation of foods is one of the essential foundations of a nutrition program. This may be considered from the standpoint of its crude preparation by plants and animals; its refinement and distribution by man; and its physiological preparation by the body.

- a. Plant: Assembled by plants from the air and soil.
- b. Animals: The making over of plant life into animal tissue.
- c. Production, transportation and distribution by man.
- d. Domestic: Preparation for consumption.
- e. Physiological preparation: digestion.

2. Digestion

The preparation of food for use by the body cells is called digestion. It is essentially a refining process. A useful conception may be obtained by considering the purposes of digestion:

- a. **Mechanical:** To break up the food into small particles. Accomplished by mastication and movements of stomach and intestines.
- b. **Physical:** To dissolve or suspend particles in a semi-liquid. Accomplished by secretions of alimentary system with assistance of hormones and secretagogues.
- c. **Chemical:** To break up complex molecules of proteins, fats and carbohydrates and by recombination making them acceptable for assimilation by the body cells. This is accomplished through the various enzymes.

3. Anatomy of Alimentary or Digestive System

Alimentary canal is essentially a tube running through the body and lined by a vascular membrane, a large part of which is specially adapted for absorption. The tube is strengthened by muscular fibers. In the walls of the intestines are numerous glands, blood vessels, and lymphatics. Connected with alimentary tube are some larger glands whose function it is to pour the digestive juices into the canal.

Subdivision of alimentary canal:

- | | |
|-----------------------|----------------------|
| (1) Mouth | (4) Stomach |
| (2) Pharynx or throat | (5) Small intestines |
| (3) Esophagus | (6) Large intestines |

Glands - The large glands which form an essential part of the digestive system are:

- (1) Salivary glands
- (2) Liver
- (3) Pancreas

(Note: Student is expected to look up the anatomy and physiology of the digestive system. See references at end of Section on Nutrition.)

4. Stages of Digestion

- a. Mouth Digestion: Or better a mixture of the food with secretions as preparation for salivary digestion. Importance of mastication.

Saliva: Supplied by three pairs of glands: parotid, sublingual, and submaxillary. Character and amount. Content and action of enzyme, Ptyalin.

Swallowing: A complex procedure involving a voluntary stage. Bolus of food is crowded back into the pharynx by the tongue where it is grasped by involuntary muscles and pressed on by peristalsis.

b. Gastric Digestion

The stomach is an important muscular organ guarded at its entrance and exit by sphincter muscles. It is not an empty cavity. It contracts around the food and goes through an orderly sequence of contractions and relaxations. These movements seem to further break up food and add to it the gastric secretions. When the digestive process has proceeded to a certain stage, the acid chyme causes pyloric sphincter to open and let out a small quantity of contents into the intestines.

c. Gastric Secretions

Character: Acid reaction (Hydrochloric acid)
Amount: Three pints daily
Secretions: (a) Psychic (b) Secretagogues
Enzymes: (a) Pepsin (b) Rennin

d. Intestinal Digestion

Movements of Intestines: Peristalsis is slower and gentler than in the esophagus. Rhythmic motion moves food along in stages.

Secretions: Bile, pancreatic juice; intestinal juice.

The secretions of the intestines are alkaline in reaction. This enables them to neutralize acids coming from the stomach, those due to bacterial fermentation of sugars, and those formed by fat digestion.

Bile: A secretion of liver and temporarily stored in gall bladder.
Action:

- (a) Stimulate splitting of fats by pancreatic juice.
- (b) Enters into new formation of soaps with fatty acids.
- (c) Promotes peristalsis.
- (d) Helps to control bacteria.

Pancreatic juice: Amount, 1 pint daily. Action, on all three forms of foodstuffs. Enzymes: Amylopsin; Trypsin; and Steapsin (or amylase, protease, lipase).

Intestinal juice: Completes preparation of both proteins and carbohydrates for absorption.

Enzymes: (a) Invertase)
Maltase) bring about final changes in sugars.
Lactase)

(b) Erepsin) completes splitting of some proteins into amino acids.

e. Large Intestines

As the food passes through lower part of small intestines and beginning of large intestine water and absorbable materials are extracted from foods, at last leaving the waste products nearly solid and ready for discharge from the body. This is called the feces, and is made up of residue of diet (5%), excretions from the intestinal tract, and bacteria.

f. Absorption of Foodstuffs

The absorption of foodstuffs becomes the final and critical stage of digestion. The whole intestinal tract has some powers of absorption. The most important part is the small intestines.

(1) Mechanism of Absorption

The intestines are so arranged that the liquid or semi-liquid foodstuffs can come into intimate contact with as large a surface of intestines as possible. This is accomplished through the villi of the intestinal wall.

(2) Process of Absorption

- (a) Osmosis and dialysis
- (b) Action of epithelial cells

(3) Routes of Absorption

- (a) Blood stream through capillaries of villi into general blood stream.
- (b) Lacteals to the lymphatic system through the thoracic duct to blood stream.

(4) Form of Absorption of Foodstuffs

- (a) Carbohydrates absorbed mostly as simple sugars.
- (b) Fats are split into fatty acids and glycerin.
- (c) Proteins are split into amino acids.

E. HYGIENE OF NUTRITION

While a knowledge of the digestive system and a familiarity with the food composition and values is important, the factors included under the term "hygiene of nutrition" are of equal importance.

The levels of nutrition are markedly influenced by the following factors:

1. Environment. The environment in which food is taken may help or hinder its digestion.
 - (a) Character of service - cleanliness, etc.
 - (b) Preparation of food - appearance, taste, odor.
2. Emotional state: It has been proven that in both man and animals the emotions have a direct bearing upon the secretion of the digestive juices. (See Cannon: Bodily Changes in Pain, Fear, etc. - on Reserve Shelf).

3. Physical State: Fatigue, either acute or chronic, may be a determining factor in successful digestion.
4. Mastication: Thorough mastication of food is the first step in normal digestion. This requires normal teeth and proper habits of eating.
5. Rate of Eating: The gulping of partially masticated food is one of our most serious errors in the hygiene of nutrition. Why?
6. Amount and Character of Food: The selection of the proper amount and balance of foods for the individual is of vital importance.
7. Guide to Successful Nutrition: In attempting to judge whether his nutrition is normal, the individual can take certain factors as guides:

- a. Hunger: A general term by which we express the demands of the body for food to replace waste, supply energy and building materials. Sensation is referred to stomach. Taken alone it is not a safe guide.
- b. Appetite: Is psychic as well as physical. It expresses both a desire for and a relish of food.
- c. Height and weight tables

The height and weight tables graduated for age are one of our practical indices of nutrition. The "average" weights shown on these tables are not an absolute criterion. Due allowances must be made for race and family habit. For children the Sydenstricker and the Baldwin-Wood tables are best; for adults, the Insurance Company Tables. Life insurance experience suggests that the optimum weight for young adults (under 40 years of age) is 5-10% above the average weights of tables.

- d. Objective signs of successful nutrition

These are important guides for individual:

- (1) Color of skin and lips
- (2) Firmness of muscles
- (3) Posture
- (4) Regularity of excretions

- e. Subjective signs of successful nutrition

- (1) Feeling of well-being
- (2) Energy
- (3) Endurance
- (4) Prompt recovery from fatigue

f. Diet

Assurance of a balanced, adequate diet should be based upon actual body needs as adapted for age, weight, and intensity of activities.

This may be estimated for practical purposes by the following scale:

(1) Energy values

Light exercise: 40-50 calories)
Vigorous exercise: 45-50 calories) per kilogram of body weight
Very severe exercise: 50-60 calories)

(2) Balance

The total calories needed for each day should be distributed among the food groups approximately as follows:

Protein calories: 10-12%
Fat calories: 35% plus Vitamins
Carbohydrates calories: 55%

(3) Choice of Diet: The following outline may be used as a guide to selection of a well-balanced food intake. Each day's diet should contain the following:

Meat or fish, once daily.
Adult, 1 pint of milk.
Two servings of fruit--one fresh whenever possible.
Two vegetables, one leafy and one root.
Potatoes.
Butter (at least 2 pats).
Egg, alone or in combination.
Whole grain or cereal.

(4) Diet Project: The application of these facts should be made by the student in the Diet Project which forms an essential part of the course.

REQUIRED READING:

Storey--Principles of Hygiene, Book 1, Chap. 5, Discussion of Principles
Martin--Human Body, Chap. 26, Anatomy of Digestive System
Hough and Sedgwick--The Human Mechanism, Chaps. 8-13-19, Digestion and Nutrition
Kirkpatrick and Huettner--Fundamentals of Health, Chaps. 4 and 5
Meredith--Hygiene, Chap. 3, Hygiene of Eating
Williams--Personal Hygiene Applied, Chap. 7, Hygiene of Nutrition
Rose--Feeding the Family, Chaps. 1, 2, and 10.

COLLATERAL REFERENCES:

Martin--Human Body, Chaps. 25, 27 to 30 inc.
Bogert--Nutrition and Physical Fitness, Chaps. 1-14.

Meredith--Hygiene, Chaps. 32 and 34.
Sansum--The Normal Diet.
Cannon--Bodily Changes in Hunger, Fear
Sherman--Chemistry of Food and Nutrition
McCullum Simonds--The Newer Knowledge of Nutrition
Eddy--Nutrition
Emmerson--Diagnosis of Health

V. EXCRETION, the third determining force in Constructive Hygiene

The objective of the processes of excretion is to neutralize, dilute, and remove promptly and effectively the products of digestion and cell activities.

Excretion may be described as the chemical results of cell activities. These products are produced by:

- (a) Wear and tear on living structures of cells.
- (b) Residue from manufacture of cell products.
- (c) Wastes due to oxidation within cells.
- (d) Death of cells.
- (e) Waste products from foods.

Elimination is the series of processes by which the excretions are prepared and transported out of the body.

A. TYPES OF EXCRETIONS

1. Internal: Those excretions which are discharged directly by the cell into lymph or blood stream.
2. External: Those excretions discharged by cells upon surfaces that communicate with the outside of the body.

B. ORGANS OF EXCRETION

1. Kidneys: The most important organs of the body which are developed particularly for purposes of excretion.
 - a. Description: The kidneys are two organs situated on either side of the front of the spinal column in the region of the floating ribs behind the stomach, pancreas, and liver. They are oval or bean-shaped, about 4 or 5 inches long, and $1\frac{1}{2}$ inches thick. Color: They are dark in color on account of the large blood supply.
 - b. Structure macroscopically: The kidneys are observed to be covered with resistant capsule. On the side toward the spinal column is a depression (hilum) through which vessels, ducts, and nerves enter and leave. Inside of this depression is an open space called the pelvis of the kidney.
 - c. Microscopically: The kidneys have two layers, cortex and medulla. The cortex or outer layer is a special arrangement of tissue cells and tubules in a way to make possible the free passage of larger quantities of blood in intimate contact with the special cells and tubules.

d. Function: As the blood passes through the kidneys, the waste products are extracted in two ways:

- (1) Mechanical filtration
- (2) Selective action of cells

The urine thus excreted is gathered by series of tubules and emptied into the duct (ureter) of the kidney and is carried to the bladder.

e. Mechanism of excretion: The excreting unit of the kidney is made up of a microscopic collecting tubule connected with a tuft of capillaries.

f. Significant structural features

- (1) Arrangement of capillaries to secure higher capillary pressure than elsewhere in the body.
- (2) Exceptional thinness of membrane.
- (3) Cells capable of secretory function.

g. Significant function features

- (1) Mechanical filtration.
- (2) Re-absorption and secretion in tubules.

h. Amount of excretion: The amount of urine varies considerably under normal circumstances. Average amount 3 pints (1200 - 1500 cc or 40-50 ounces). Amounts less than 500 cc (1 pt.) or more than 3000 cc (3 qts.) if persistent should be considered as a departure from normal.

i. Composition: Color - yellowish or amber
Reaction - acid
Sp. Gravity - 1015 - 1025
Water - 96-97%
Solids - 4-3% -- Urea, creatinin, uric acid, inorganic salts.

2. Lungs are an important excretory organ, heat regulatory apparatus, and an organ of nutrition.

a. Area: Inner surface total area 90 sq. meters or 100 times as large as the total area of the skin surface. This inner surface of the lungs is in direct contact with the air in the spaces (alveoli) of the lungs. The membranous walls contain the blood vessels that bring blood from the heart. The entire blood supply is spread out in the pulmonary capillaries every few minutes.

b. Lung capacity

(1) Residual air	1000 cc	after extreme expiratory effects.
(2) Tidal air	500 cc	ordinary quiet inspiration.
(3) Complemental air	1600 cc	deep inspiration.
(4) Supplemental air	1600 cc	deep expiration
Total capacity	4700 cc	

Vital capacity = Tidal plus complemental plus supplemental air.

c. Lung functions

- (1) Absorption of oxygen
- (2) Removal of carbon dioxide
- (3) Heat regulation

3. Skin is secondarily an organ of excretion. Some of its other functions are:

- a. Protection of body structures
- b. Sensory surface
- c. Regulation of body temperature

Excretory function of skin is carried on by (a) sweat glands;
(b) sebaceous glands.

- a. Sweat glands: Over entire surface of body. Simple tubular glands coiled at the end. Amount of secretion varies with: (a) condition of atmosphere; (b) physical and psychical status. Usually acid in reaction contains urea, uric acid, creatinin, and sulphates.

Increased by:

- (a) Muscular activity
- (b) Heat
- (c) Emotion
- (d) Drugs

Decreased by:

- (a) Lower temperature
- (b) Emotion

- b. Sebaceous glands: Simple glands all over surface of skin, usually associated with hairs. Secretion (sebum) an oily semi-liquid material. Contains: fats, soaps, cholesterolin, cell debris, and inorganic salts.

4. Intestines are important organs of excretion as well as of nutrition. They carry off the useless remains of diet and also the waste products from cell physiology.

The semi-liquid chyme is passed along intestines by peristaltic action. As it progresses through the small intestines the portions acceptable to the body cells are absorbed into the blood lymph streams. When the large intestine (colon) is reached the movements favor free absorption of water leaving behind a pasty mass called feces.

Defecation is partly volitional and partly automatic due to stimuli arising from distention of the rectum. Defecation occurs by the volitional opening of the muscular sphincters controlling the anus.

C. HYGIENE OF EXCRETION

1. Kidneys: Susceptible to overstrain but are wonderfully effective mechanisms if given reasonable treatment.

Protections:

- (a) Ample water
- (b) Adequate diet
- (c) Exercise
- (d) Proper posture
- (e) Periodic health examination

2. Intestinal: The regularity and effectiveness of excretions by the bowels is influenced by:

- (a) Lack of proper habits of evacuation
- (b) Unsuitable diet
- (c) Weak abdominal muscles
- (d) Too little exercise
- (e) Low fluid intake

3. Lungs: Air needs of the body in character and amount.

- (a) Effective ventilation
- (b) Proper breathing

4. Skin: Its function and appearance are guides to successful nutrition. Its effectiveness as an excretory organ is influenced by:

- (a) Digestion--quality and quantity of diet
- (b) Cleanliness--bathing habits

REQUIRED READING

Storey--Principles of Hygiene, Book 1, Chap. 6
Martin--Human Body, Chap. 31
Kirkpatrick & Huettnner--Fundamentals of Health, Chap. 9
Meredith--Hygiene, Chap. 35
Williams--Personal Hygiene Applied, Chap. 10

COLLATERAL REFERENCES

Burton-Opitz--Textbook of Physiology, Section on Excretion
Stiles--Nutritional Physiology, Chap. 17

VI. EXERCISE, the fourth determining force in Constructive Hygiene

A. BRIEF DISCUSSION OF THE ANATOMY AND PHYSIOLOGY OF THE NEURO-MUSCULAR (MENTI-MOTOR) MECHANISM.

1. The Muscular System: Evolution of the system; relation to evolution of other systems and to development and conditioning of these systems. Forms 41% (\pm) of total body weight; most active of tissue cells in demand for nutrients and in transforming potential into kinetic energy; muscle activity produces most profound changes in environment of all tissue cells; some of the general effects of muscular activity on the muscles and on other systems: e.g., circulatory; respiratory; alimentary or digestive; excretory; heat regulatory; nervous.
2. Kinds of Muscle Tissue Cells, and where found in body.

a. Skeletal, Striated, or Voluntary Muscle.

Location: Attachment to bones; fasciae; tendons, structure of the voluntary muscle cell; sarcolemma fibrils; sarcoplasm; blood supply; connection with nervous system; sensory and motor nerve endings in muscles.

Functions of Skeletal Muscles: Connection with motion and locomotion; relation to posture; production of body temperature; storage and oxidation of glycogen; production of lactic acid and CO_2 during activity; relation to respiratory movements and to certain excretory functions.

b. Smooth, or Involuntary Muscles

Found in walls of alimentary canal; walls of blood vessels, bladder; ducts from glands, uterus, etc.; structure and characteristics; effects of voluntary muscular activity on these structures.

c. Cardiac, or Heart Muscle

Structure and characteristics of the cells; compare with cells of smooth and striated muscle; characteristic of rhythmic contractability; control of rate through nervous system; chemical factors which influence rhythm; "all or none" theory of contraction.

B. THE NERVOUS SYSTEM

Anatomical and physiological considerations.

1. The great coordinator of all bodily activities; relation to neuro-muscular (menti motor) mechanism: one unified system, but divided for purposes of discussion and understanding; the neurons, or nerve-tissue cells; characteristic forms of these cells; specialized to receive, transform, or transmit stimuli, affector, effector, and association neurons within the system.
2. Main Divisions of the Nervous System
 - a. Central (or Cerebro-Spinal) includes cerebrum, cerebellum, medulla, and spinal cord.

- b. Peripheral nervous system includes nerve trunks which leave or enter central system. The twelve pairs of cranial nerves, their general distribution and function; the thirty-one pairs of spinal nerves, their general distribution; the thirty-one pairs of spinal (sensory) ganglia; meaning of afferent (receptor) and efferent (effector) neuronis; association neuronis, etc.
- c. Autonomic or Sympathetic nervous system.

The ganglia; general distribution and functions of this part of nervous mechanism; connection with the central system; functions controlled by this division of nervous system.

C. EFFECTS OF MUSCULAR ACTIVITY (exercise) upon:

1. The Muscle Cell, and muscular system. (Refer back to earlier discussion). Its nutrition, size, production and elimination of wastes, endurance, nerve control developed through voluntary muscular exercise; immediate and remote (or ultimate) effects of exercise upon the various systems.
2. The Nervous Mechanism
Integration through exercise; how this is brought about. (Refer to discussion of nervous system above).
3. Circulatory Mechanism
Effect of sitting, standing, running in place on heart rate; on systolic, diastolic, and pulse pressures; effects of exercise of speed, of effort, and of endurance on these pressures; exercise as the chief means of strengthening and conditioning this mechanism; athletics and longevity; ("Do athletes die young?"); dangers from inadequate exercise; standard tests of cardiac efficiency; importance of physician's examination and advice if heart is abnormal in function or structure; local and general infections in relation to exercise and care of the heart; hygiene of exercise in relation to care of circulatory mechanism.
4. Respiratory Activity and the Respiratory Mechanism
 - a. The Normal Respiratory Rate: Before and during exercise of varying intensity and duration; effects of exercise on rate and depth of respiratory movements.
 - b. The chemical changes produced as represented in O₂ intake and CO₂ output.
 - c. The Respiratory Mechanism: Location of lungs; size; shape, aerating surface; ventilation of; vital capacity and exercise. (See back under nutrition and excretion for meaning of tidal, supplemental, complementary, and residual air). Exercise and respiratory efficiency; how muscular exercise develops and conditions this mechanism.

D. THE HYGIENE OF EXERCISE -- SUMMARY

1. Muscular activity does more than develop muscular strength, skill and endurance. It is the fundamental developer of all the organic systems and functions of the body: circulatory, respiratory, excretory, heat regulatory, nervous, mental motor, and even skeletal structures. Muscular action begins in the nervous system its influence on nutritive and all other functions relating to a healthy body.
2. Exercise should be adapted to: age, sex, strength, and vitality of the individual; to occupation, and to climatic conditions.
 - a. For Children: Play is best; play is the "driving urge" in childhood to insure organic development; a healthful environment and opportunity for wholesome play life should be maintained through social organization and leadership to secure normal physical, mental, and social health. Evidence of recognition of above in playgrounds since 1906, and in required physical education movements since 1916.
 - b. For Adolescents: A period of rapid growth and stormy mental life; needs and capacities at this stage of life should be reckoned with in the organization and leadership in activities at this period; big muscle-social activities represented by team games; athletics and rhythmic activities are best for this age; dangers where adolescents are stimulated by wrong standard of competition; high school and college programs of physical education; their organization and administration.
 - c. For Adults: Exercise should be enjoyable, moderate, satisfying; participated in primarily for recreation and conditioning values; variability in intensity and duration required to satisfy organic and other needs at ages from 25 to 50 years of age; types of activity suitable for different age levels.
 - d. For Later Years: Activity level should be lower; changes in organism which must be taken into account; deterioration of tissues; lessened elasticity of arterial walls etc. These changes are often hastened by unfavorable ways of living; types of activity for these age levels; golf, walking, gardening, horseback riding, etc.
 - e. Occupation: Sedentary occupations require definite planning for regular exercise; should be recreative and not too strenuous to maintain health; strenuous muscular occupations should be reflected in types of recreative activities selected by the individual; discriminating judgements essential; organizations and movements which attempt to meet these needs.
 - f. Other hygienic considerations in the regulation of exercise:
 - (1) Fatigue: Causes; effects of habituation to exercise; normal fatigue; chronic fatigue.
 - (2) Muscular soreness: Theories as to cause.

- (3) The heart and athletics: Importance of being "in condition" for competition in games; focal, and general infections in relation to exercise; periodic health examination in control of individual, school, and other programs of physical education. Evidence pro and con.
- (4) Exercise in relation to posture, "personality," nervous stability; applications of exercise as a corrective, remedial, or therapeutic agent.
- (5) Summary.

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VII. PLAY, the fifth determining force in Constructive Hygiene

A. INTRODUCTION:

"Play is a basic activity requisite for the acquisition and conservation of mental and physical growth and health."--Storey

Play may be said to be innate tendency (an "impulse," and "urge," a "drive") to activity, the purpose of which is development and education leading to adult adjustment to social and material environment; play is activity in which the whole personality is enlisted; chief business of childhood is play. Through play, the child's mental motor, organic, impulsive (or emotional), and interpretative (or intellectual) mechanisms are developed, strengthened, and integrated. This is why play is a "basic activity."

Above consideration has been given to various bodily systems and their functions as if each were an entity. Human life and health are products of the harmonious working together, or integration, of all of these systems and all of their activities brought about through the nervous system. The general structures and functions of the nervous system were

discussed above in a section of the chapter on Exercise. The student is referred to this discussion for details of anatomy and physiology of this system. A consideration of play involves problems related to the development, the integration, and the conditioning of the nervous system which have a connection with our concepts of "mind." Because this is so, this part of the discussion will involve considerations of the relationships of play to mental health and mental hygiene.

B. FORMS OF MIND

Stages in the evolution of "mind" may be indicated by certain terms used in our text (and other writings) as they relate to types of behavior at certain stages of development in the individual or in his tissue cells. These terms are:

1. "Tropic mind" -- mind of cells (germ cells, etc.)
2. "Reflex mind" -- mind of embryo (Storey)
3. "Unconscious or subconscious mind" -- inherited mental experiences (nerve patterns, etc.), perhaps early mental stimuli not gaining conscious expression.
4. Adult, or Conscious Mind: While the conscious mind begins to be evident in early stages of infancy and childhood, its adult form is reached in later adolescence, or early maturity. It is a product of the gradual development of psychic traits resulting from stimuli brought into the nervous system from the environment (or from other organs of the body) and from the responses made to these stimuli.

It is now believed that play is exceedingly important not only in the development of "mind" but as a factor in the hygiene of the mind (or mental hygiene). There are aspects of this problem which are of vital importance: e.g., relation to the social organization of the play life of children and adults, and in relation to certain abnormal or pathological conditions which may arise.

C. PLAY AND THE MIND

1. A most effective means of bringing proper stimuli to the nervous system is through normal, vigorous play in childhood and youth. The play life of a young person (child) is filled with:
 - a. Discoveries of pleasing and displeasing sensations and all sorts of motor and emotional responses. These have a profound influence upon the development and the quality of mind. Through a normal play life the young person rehearses activities which are race old and which train for participation in adult activities both physical and mental.
 - b. The principal play instincts have to do with: Curiosity; creation; nurture; rhythm; hunting; fighting; team play; sex. The play instincts are the primitive forms of instincts and interests of grown up life and tend to prepare for adult life. Through play the child rehearses racial activities and racial development.

D. MENTAL HYGIENE AND HYGIENE OF THE NERVOUS SYSTEM

1. If the above is true, then play has an important relationship to the health and well being of the nervous system and to mental health; within the limitations of heredity, one can determine the kind of nervous system he will have; a healthy mental state can be developed as surely as big muscles.
2. A healthy mental state can be developed by; Taking stock of one's mental resources and liabilities; instituting a plan of mental training.
3. Mental training means training in: Control; removal of unwholesome mental states; substitutions of wholesome plans, purposes and satisfying interests for their opposites, such as worries, long range fears, etc.
4. Outcomes of training through play are: Organic development, circulatory, respiratory, heat regulatory, nervous, and other systems; mental motor development in skills; coordinations of various kinds; impulsive (or emotional) development and control; interpretative, (or the development of intelligence) growing out of widening expanses. Specifically, some of these values are: Skills, honesty, diligence, sportsmanship, courage, self-control, faithfulness, loyalty to high ideals, love of play.

E. THE MEANING OF MENTAL HYGIENE

1. Physical hygiene has to do with the promotion of health and with fitness of the body, avoidance of disease and premature death, and therefore, the prolongation of life.
2. Mental hygiene has to do with the enrichment of life, mental normality, the joy of living.

F. CONCEPTIONS AND TESTS OF "NORMAL MIND."

1. Technical tests of normality
2. Practical tests of normality
 - a. Ability to adjust to ordinary situations of life (economic, domestic, social, civil, etc.)
 - b. Ability to perform some significant task
 - c. Ability to get on with people

G. THE ESSENCE OF NORMAL MIND

1. Integration of personality; the essential elements: Poise; self-control; serenity; "all's well with the world;" all symptoms of normality.
2. Opposites of integration: Lack of control; "flies off handle;" goes to pieces; hysteria; neurasthenia, etc.
3. Tests of integration.

H. DEVELOPMENT OF INTEGRATION

1. Attained by: Coordinated activity (physical and mental); doing some significant task; keeping one's self at a high level; the standard of "living best to serve most;" alternation of work, play, rest; meet situations squarely, self confidence; readiness to make adjustments; no inferiority complexes; normal sense of dependence; self control; scientific attitude--willingness to face realities, to test one's beliefs; readiness to learn.

I. RESULTS OF FAULTY MENTAL HYGIENE

No amount of hygienic training can compensate for marked nervous defects, but individuals can attain a higher level of control than either heredity or environment would have promised. Better mental tone can be developed as surely as better muscle tone. It can be done by mental training.

J. MEANING OF MENTAL TRAINING

1. Training in control in infancy and childhood. No tantrums, fits of silly laughter, temper, hates, etc.
2. Removal of unwholesome states. No place for the "black man," or other fears in the training of children. Vicious play is never wholesome.
3. Substitution of wholesome plans, purposes, and satisfying interests for their opposites.
4. The place of play, recreation; hobbies; vacations; and other means in mental hygiene.
5. Avoidance of vicious or unwholesome play, habits, etc. that may relate to this problem.
6. Other adjustments at higher age levels necessary for complete integration.

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VIII. REST, The sixth determining factor in Constructive Hygiene

A. INTRODUCTION

Two forms of activity have been discussed above: work and play. There are two important forms of inactivity; rest and sleep. Rest is nature's provision to satisfy a biological requisite to the production and maintenance of physical and mental health. Evidences of fatigue, of rest, balance, or equilibrium, between the "tearing down" and building-up processes, a phenomenon in living organisms; rest necessary to health; chronic fatigue the bane of civilized man.

B. THE PHYSIOLOGY OF REST

1. Absorption by osmosis and diffusion: changes during rest.
2. Anabolism, or building up by chemical synthesis: construction during rest.
3. Katabolism, or breaking down by chemical disassociation: reduction during rest.
4. Excretion, or removal of wastes by osmosis and diffusion: effects of rest.
5. Effects of accumulating metabolites (wastes) on the "irritability" of tissue cells during activity; restoration of "irritability" during rest.
6. Need for lowering cell activity through rest; the elimination of wastes; restoring irritability of cells through "building-up" process during rest.

C. FATIGUE: CAUSES = Activity; CURE = Rest.

1. Fatigue, The result of cell activity. This condition caused by:
 - a. Exhausting materials faster than supplied to tissue cell; when expenditure exceeds income result is bankruptcy.
 - b. Breaking down process through activity produces excretions faster than they can be removed; accumulated wastes lower working power.
 - c. Excretions from the cell have toxic, or depressing, effect upon cells.
2. Effects of fatigue upon tissue cells.
 - a. Upon structure - nerve; muscle, gland cells
 - b. Upon functions of these cells - nerve; muscle, gland.

3. Effects of rest upon structure and function of cells. (nerves etc.)
4. Effects of emotions upon onset of fatigue; recovery from fatigue.
The adrenal secretion and its effects.
5. Symptoms of fatigue: Feelings, lowered working power, disinclination to work, sleepiness.

D. TYPES OF REST

Cessation from activity; change in activity; sleep.

E. HOW REST MAY BE SECURED

1. Control of voluntary motor functions; mental functions; sensory functions.
2. Sleep. Physiology of sleep; causes; conditions which favor or discourage; control of these conditions; amount of sleep needed.

F. REST A PRODUCT OF:

Interesting work; pleasing exercise; happy play; peaceful sleep; balanced nutrition; effective excretion; satisfied mental states.

G. SYMPTOMS OF DEFICIENT REST

Lowered working capacity on physical side; lessened accuracy in motor movements and in mental processes, etc. Deficient mental rest often gives rise to: constant movements of fingers or other parts of body, exaggeration of unimportant details of life, groundless fears and anxieties, worry or excitement.

H. SUMMARY OF CONSTRUCTIVE HYGIENIC VALUES OF REST BY STOREY:

Promotes growth; promotes repair and replacement; restores mental, nervous and physical energy; promotes restoration of normal function; makes mental health possible; safeguards life.

I. PROGRAM OF REST

1. Balanced rest as important to health as balanced food rations.
2. Rhythmical character of various functions, or activities of life. Dangers in disturbing these normal rhythms of activity and rest, eating and fasting, sleeping and waking, and all others.
3. The essentials of a rest program are well summarized by Storey as follows: Rest-as-you-work adjustment, and avoidance of exhausting expenditures of energy; wholesome objective; sleep, adequate and in amount and quality; play and recreation in due proportion; exercise adapted to individual needs; vacations for complete change.

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IX. THE CONTRIBUTORY CAUSES OF HEALTH

A. INTRODUCTORY

This far discussion has been focussed on the biological and physiological factors concerned with the production of health. There are, however, important indirect or contributing factors which require consideration and understanding in order to have a reasonably complete picture of the problems of constructive hygiene.

While the six "determining factors," heredity, nutrition, excretion, exercise, play rest are of primary importance, the successful production of health by these is dependent upon other indirect, but essential, influences. These indirect influences or factors may be set down under the following general headings for consideration: (1) Responsibility for human welfare; (2) Favorable environment; (3) The prevention and care of health injury. These will be discussed in this order.

1. Responsibility for Human Welfare

- a. Relation of instinct of self-preservation and of minor defense instincts in their connection with certain emotions to this problem.
- b. The instincts, or nerve patterns, which influence man to care for, and protect, and seek the welfare of members of his family and community. Compare man with other animals in their responses in such matters.
- c. The "mothering," the gregarious (or "herd") instincts in relation to group and inter-group responsibility for health. Point out some of the applications of constructive hygiene based on them. (See Storey, Chapter XI on applications.) These contribute powerful influences connected with the applications of the determining causes of health.

2. Favorable Environment

- a. Compare primitive or savage peoples with those more enlightened in regard to their efforts and successes in control of environment.
- b. The control of environment and ability to make it favorable is dependent on:
 - (1) The power of scientific information. Show how information acquired through experience and research have been contributing factors in securing favorable environment; in securing food; in adjusting to climate and weather; in finding out facts about the nature of man's environment, and in the application of these facts.
- c. The Power of Balanced Education.
 - (1) In destroying superstitions
 - (2) In securing social action in applications of scientific information to various health problems; the reduction of famine and pestilences; in the control of communicable diseases; in raising standards of living, etc.