

V. CAUSES OF ILL-HEALTH

With the establishment of the correctness of the germ theory of disease and development of scientific knowledge has come an ever increasing accumulation of information about the exact causes of ill health.

For purposes of study these causes of ill health may be classified as to:

(a) Exciting Agents

1. Living or animate, as: micro-organisms.
2. Mechanical, as: automobile accidents, etc.
3. Chemical, as: lead poisoning, etc.
4. Physical, as: heat, cold, or electricity, etc.

or as to:

(b) Mode of Transmission

1. Communicable, as: diphtheria, etc.
2. Non-communicable, as: heart disease.

LIVING CAUSES OF ILL HEALTH

Our remarkable progress in the control of disease has come as a result of the proof that certain of our deadliest diseases are caused by living micro-organisms. For these contributions to the welfare of mankind we have to thank that remarkable group of scientific workers who founded the science of bacteriology.

The list of these benefactors is too long for us to any more than mention a few of the more prominent ones. Pasteur, Koch, Neisser, Laveran, Eberth, Klebs, Loeffler, Shandinn, Hoffman and Noguchi. We are prone to remember and honor the men of history who were great generals or admirals and were famous for destroying human life while we are apt to ignore or forget the men whose fame rests upon preserving human life. Review the lives of a few of this latter group.

Micro-organisms and Disease

Year after year we have seen a gradually lengthening list of micro-organisms that have been convicted of causing disease in man. These organisms may be classified in two great groups: (a) Bacteria; (b) Protozoa.

Bacteria--The group of bacteria includes a long list of members which may be considered from the standpoint of their action when taken into the human body, as:

- (a) Pathogenic or disease producing.
- (b) Non-pathogenic or non-disease producing.

Non-Pathogens. The importance of non-pathogenic bacteria to humans and plants is seldom fully realized. The carbon cycle and nitrogen cycle are necessary for life. They are dependent upon the action of non-pathogenic bacteria. Commercially these bacteria are essential for the production of butter, cheese, tanning hides, curing tobacco, etc.

Pathogens. The proof that specific bacteria were the cause of specific diseases marked the first great step in the rational, scientific control of communicable diseases. The more important members of this group will be considered in connection with the diseases which they cause.

Proof of Disease Production

In order to be certain that a given organism is the cause of a given disease, a very exact, scientific method was devised which is known as Koch's Postulates, after their originator:

- (a) Same bacteria always found with same disease.
- (b) Same bacteria isolated from diseased animal and grown in pure culture outside the body.
- (c) Pure culture must reproduce disease in animal.
- (d) Same organisms recovered from animal and grown in pure culture.

Growth and Reproduction of Micro-organisms

The growth and reproduction of bacteria are dependent upon favorable conditions adapted to their peculiar needs:

- (a) Temperature
- (b) Moisture
- (c) Food supply

Destruction of Micro-Organisms

Sterilization or disinfection is the name applied to the procedure of destruction of micro-organisms.

Methods: 1. Heat--dry or moist. 2. Sunlight. 3. Chemicals.

Spread of Micro-organisms

A knowledge of the ways by which micro-organisms spread from person to person is vital to any intelligent defensive hygiene plan against communicable diseases. Chapin classifies them as follows:

- (a) By contact
- (b) By fomites (inanimate objects)
- (c) By air
- (d) By food and drink
- (e) By insects

Sources of Infection

The chief source of infections is to be found in man and lower animals.

Modes of Infection

The micro-organisms which cause disease enter the body through one of the following channels:

- (a) Respiratory tract
- (b) Digestive tract
- (c) Genito-urinary tract
- (d) Skin and conjunctiva

Exits of Bacteria from Body

From the standpoint of defensive hygiene or prevention it is important to know the mode of exit of the disease producing bacteria from the body of the infected individual.

- (a) Nose and throat
- (b) Bowels or bladder
- (c) Mucous membranes (genital)
- (d) Blood (indirect by insects)

Fate of Bacteria in the Body

Every human being is constantly taking micro-organisms into his body. The fate of these organisms within the body has a vital relationship to defensive hygiene. They may:

- (a) Live, multiply and produce disease
- (b) Live, multiply without producing disease--"carriers"
- (c) Killed by defensive mechanisms of body.

Determiners of Infection

Whether an individual who takes micro-organisms into his body will develop disease or not depends upon a number of factors:

- (a) Type of organism
- (b) Virulence or strength of organism
- (c) Number of organisms
- (d) Degree of resistance or immunity possessed by the individual.

Course of Infection

A brief outline of a typical infection will serve as a basis for a better understanding of what is happening in disease caused by micro-organisms.

- (a) Cause--a specific bacteria or protozoa taken into the body.
- (b) Incubation period--a battle of resisting forces with infecting organism.
- (c) Symptoms:
 - 1. Premonitory
 - 2. Onset
 - 3. Fully developed
- (d) Results:
 - 1. Recovery
 - 2. Degeneration of organs
 - 3. Death

Mechanism of Infection

How do micro-organisms cause disease? We must remember that they, being living organisms, cannot survive unless conditions are favorable for them. They must carry out their fundamental cycles of life: (a) respiration, (b) nutrition, (c) excretion, (d) reproduction.

During the process of nourishing themselves, micro-organisms injure man. The manner in which this is brought about is:

- (a) By production of soluble toxins or poisons (diphtheria).
- (b) By production of insoluble toxins due to splitting up of proteins of body.
- (c) By mechanical action.

Infections may be: (a) Local--boils; (b) General--typhoid fever,

Infections may spread by (a) continuity, (b) blood stream, (c) lymph stream.

References: Storey--Defensive Hygiene, Book II, Chapters 17 and 22.
Rice, T. B.--Conquest of Disease, Chapter 2.
Bossard--Problems of Social Well-Being, Chapters 8, 9, 13.
Chapin, C. V.--Sources and Modes of Infection, Chapters 4-8.
DeKruif--Microbe Hunters.
Radot--Life of Pasteur.

DISCUSSION QUESTIONS:

1. Which one of the groups of exciting causes of ill health do you consider most important today?
2. Is there any change going on at the present time in the relative importance of these groups? What? Why?
3. What would happen if we destroyed all of the bacteria?
4. How do bacteriologists proceed when they wish to decide whether a disease is communicable or not?
5. In what way are disease producing bacteria most frequently spread from one person to another?
6. What information is it necessary to have about a given bacteria in order to provide defensive measures against it?
7. What conditions determine whether an individual who takes pathogenic organisms into his body will become ill?
8. Compare the process of fermentation with microbic disease?
9. How do bacteria harm the human body?

VI. RESISTANCE AND IMMUNITY

Certain persons who are exposed to communicable diseases do not come down with them; other persons recover from them. This raises two questions which are of great practical importance to every individual--resistance and immunity.

Resistance. We need to account for:

- (a) The already existing resistance to infection.
- (b) The resistance which develops during the infection.
- (c) The resistance which persists after infection.

These questions can best be answered by a study of the phenomena which are grouped under the title of immunity.

Immunity is the power which certain living organisms possess of resisting infection. It is a specific power.

Virulence or pathogenicity is the ability of a micro-organism to overcome the protective mechanisms of the host. The action of these organisms and reaction of the host results in what we call disease.

Susceptibility is due to the absence or suppression of the factors which underlie immunity.

Types of Immunity:

- (a) Natural--may be inherited by an individual or a whole species.
- (b) Acquired--through artificial means; may be either (a) active, or (b) passive.

1. Active:

- (1) Attack of disease
- (2) Introduction of virus or live organisms
- (3) Introduction of vaccine or dead organisms
- (4) Introduction of toxins

2. Passive:

- (1) Introduction of anti-bodies from another organism.

Theories of Immunity:

The science of immunology is only 30 years old. The explanation of it has been a subject of discussion for centuries. Even primitive peoples have tried to immunize themselves. There have been many theories.

- (a) Exhaustion (Pasteur)
- (b) Retention
- (c) Ehrlich's--Side-chain

Duration of Immunity

- (a) Transient--in a great many infections: diphtheria (from attack of disease); tonsillitis; common colds; influenza.
- (b) Permanent--appears to be for life of the individual: smallpox; measles; typhoid fever; mumps; poliomyelitis; chicken-pox; etc.

Tests for Immunity

Scientists have developed a number of tests which will determine whether an individual is susceptible to a specific disease.

- (a) Shick test--for diphtheria
- (b) Dick test--for scarlet fever
- (c) Skin test--for small-pox

Artificial Immunization

Some of our most valuable defensive hygiene measures are based upon methods of producing immunity artificially.

- (a) Virus--material containing live organisms
- (b) Vaccine or bacterin--contains dead organisms.

Some of the diseases for which we have immunizing methods:

- (a) Diphtheria--toxin-antitoxin and antitoxin
- (b) Tetanus--antitoxin
- (c) Rabies--attenuated virus
- (d) Epidemic Meningitis--immune serum
- (e) Typhoid fever--bacterin
- (f) Scarlet fever--toxin-antitoxin
- (g) Small pox--attenuated virus
- (h) Plague--bacterin
- (i) Cholera--bacterin
- (j) Measles--convalescent serum

VII. DEFENSIVE HYGIENE OF COMMUNICABLE DISEASES

In the study of the methods of controlling communicable diseases, the American Public Health Association has decided that in order to effectively control a disease we should have the following information about it:

- (a) Infectious agent
- (b) Source of infection
- (c) Mode of transmission
- (d) Incubation period
- (e) Period of communicability
- (f) Methods of control

1. The infected individual and his environment.

- (1) Recognition of disease
- (2) Isolation
- (3) Immunization
- (4) Disinfection

2. General Measures

Diseases by Sources of Infection

One of the most valuable classifications of communicable disease is the one made with reference to the source of the infecting organisms.

(a) Diseases Spread by Intestinal Discharges

- 1. Typhoid fever
- 2. Cholera
- 3. Dysentery
- 4. Food-poisoning
- 5. Hook-worm

(b) Saliva Borne Diseases

1. Scarlet fever
2. Diphtheria
3. Measles
4. Whooping Cough
5. Common Cold and Influenza
6. Pneumonia
7. Cerebro-spinal meningitis
8. Infantile Paralysis
9. Tuberculosis
10. Leprosy
11. Small-pox
12. Mumps

(c) Insect Borne Diseases

1. Malaria
2. Yellow Fever
3. Plague
4. Typhus Fever

(d) Diseases Transmitted to or through Skin or Mucous Membranes

1. Hydrophobia or Rabies
2. Tetanus or Lock-jaw
3. Anthrax
4. Syphilis
5. Gonorrhoea

References: Storey--Defensive Hygiene, Chapter 17.
McLaughlin--Communicable Diseases.
Rice--The Conquest of Disease.
Chapin--Sources and Modes of Infection.
Appleton--Bacterial Infection.
Rosenau--Preventive Medicine--Immunity.
Bossard--Problems of Social Well-Being, Chapters 7-13.
U. S. Public Health Reports--The Control of Communicable
Disease, (Reprint 436--Document Room).

DISCUSSION QUESTIONS:

1. Define immunity; susceptibility; resistance.
2. How may an individual acquire immunity to disease?
3. Is immunity a general or specific power?
4. Discuss the historical theories of immunity.
5. Of what practical importance is the knowledge of the duration of immunity?
6. How are the tests for immunity applied to the control of disease?
7. Outline the basic facts needed about a given disease for its effective control.
8. Name some of the principal diseases--according to source of infection.

VIII. PROTOZOA AS CAUSES OF DISEASE

Protozoa are classified as animal organisms. There is some uncertainty as to whether some organisms included in this group should not be considered as vegetable in nature. The more important point for our purposes is whether they produce disease and what defensive hygiene methods are necessary to combat their activities.

Protozoa are simple one-celled organisms. About 7,000 species have been described. Each of them has a characteristic "life cycle." Diseases caused by a few of the protozoa will be discussed.

Malaria--still an important public health problem.

- (a) Cause--Three distinct parasites (plasmodium).
- (b) Source of Infection--Blood of infected individuals.
- (c) Mode of Transmission--Anopheles mosquito--parasite undergoes life cycle in body of mosquito and infection is transmitted to another individual by bite of mosquito.
- (d) Carriers--Common in infected regions.
- (e) Prevention--Screening active cases--quinin prophylaxis and suppression of mosquitoes.

Dysentery--(Amebic)--Most frequent in Tropics but many cases demonstrated in United States.

- (a) Cause--Endamoeba histolytica.
- (b) Mode of Transmission--Intestinal discharges of infected individual. Transferred by drinking water, contact with fresh discharges, flies, etc.

Trypanosomiasis or Sleeping Sickness--(African)--Next to Malaria, the Trypanosomas are man's most deadly enemies among the protozoa.

- (a) Cause--Trypanosoma (two species).
- (b) Mode of Transmission--Tsetse fly--Life cycle of parasite in the body of the fly.

Syphilis--one of the major plagues of the world.

- (a) Cause--Spirochaeta pallida or treponema pallidum. A very small organism, but larger than the average bacteria. Discovered by Schandin and Hoffman, 1905.
- (b) Prevalence--Estimated 8% of population (Rosenau).
- (c) Organisms--Blood, tissue juices, secretions, and sores of infected persons.
- (d) Modes of Transmission--(a) Directly, most commonly by sexual intercourse, less frequently by kissing. (b) Indirectly, common drinking cups, instruments, pipes, etc. (c) Congenitally, organisms pass from mother to child.
- (e) Prevention and Cure and Social Control.

IX. METOZOA AS CAUSES OF ILL-HEALTH

Metozoa are the so-called higher animal parasites that often cause disease by means of their eggs, embryos, and larvae. The more important members of this group are: (a) Flukes, (b) Tapeworms, (c) Round worms, and (d) Hook worms.

Method of Injury. These organisms injure the individual by:

- (a) Taking nourishment from his body
- (b) Extraction of blood
- (c) Mechanical pressure or obstruction
- (d) Toxins
- (e) Injury to mucous or skin surfaces

Trichinosis

- (a) Cause--*Trichinella spiralis*--lives in upper part of intestines. Female bores into the walls of intestines and deposits ova. They wander through blood and lymph stream to striated muscles where they locate and become "encysted."
- (b) Carriers--Hogs, wild boars, rats, dogs, and cats. To humans by undercooked and infected pork.

Tape Worms

- (a) Cause--*Taenia solium* (pork), *taenia sagmata* (beef), fish.
- (b) Transmission--By means of larvae of parasites--taken into body by eating undercooked infected meat.
- (c) Prevention--Thoroughly cooked meats--meat inspection.

Hook Worms. An important public health problem.

- (a) Cause--One of many species--*Necator Americanus* (New World) from less virulent old world form.
- (b) Source of Infection--Feces of infected persons--Infected food and water. Polluted soil.
- (c) Mode of Transmission--Larval forms pierce skin--transported through circulatory system.
- (d) Prevention--(a) Education, (b) Prevention of soil pollution, (c) Personal hygiene including shoes.

X. CARRIERS OF DISEASE

The recognition and control of the so-called healthy carrier of disease is one of our most difficult public health problems.

Carrier may be defined as an individual who is not suffering from given DISEASE, BUT WHO HARBORS THE DISEASE PRODUCING ORGANISMS IN HIS BODY AND IS CAPABLE DIRECTLY OR INDIRECTLY OF INFECTING OTHERS.

Classification

- (a) Active--one who has had attack of disease and continues to harbor organisms.
- (b) Passive--one who has never had disease but harbors organisms.

Diseases--We have been gradually adding to the number of diseases in which healthy carriers have been demonstrated:

- (a) Cholera
- (b) Diphtheria
- (c) Plague
- (d) Typhoid
- (e) Epidemic meningitis

- (f) Bacillary dysentery
- (g) Poliomyelitis (?)
- (h) Pneumonia

Management of Carriers

- (a) Administration by health authorities
- (b) Medical and Surgical Treatment

References: Storey--Defensive Hygiene, Chapters 18, 19, 20.
Rosenau--Preventive Medicine, See articles on Malaria, Yellow Fever, Dysentery, Sleeping Sickness, Syphilis, Trichinosis, Tapeworms and Hook Worms. Also on Carriers.
Bossard--Problems of Social Well-Being, Chapters 10-13.
McLaughlin--Communicable Diseases.

DISCUSSION QUESTIONS:

1. How do protozoa and metozoa differ from bacteria?
2. Are they relatively more or less important to man as causes of ill-health?
3. What are the essential points in the life cycles of the malarial parasite?
4. Why is amebic dysentery of special importance to inhabitants of the Pacific Coast?
5. Discuss our knowledge of the presence of syphilis.
6. Which is the most common method of transmission of syphilis?
7. Should an infection with syphilis be a permanent bar to marriage?
8. Name the most important disease producing metozoa.
9. Discuss the defensive hygiene of metozoa.
10. Discuss the management of healthy disease carriers.

XI. MECHANICAL CAUSES OF ILL HEALTH AND DEATH

The importance of a defensive hygiene program against mechanical causes of ill health and death is evident when it is noted that approximately 6% to 8% of the deaths recorded in the Registration Area annually are caused by accidents of various kinds.

While we have no universal compulsory registration of accidents, the increasing number of states that require industrial and automobile accidents to be reported is furnishing a rapidly increasing basis for more accurate statistical study.

A considerable number of organizations and government agencies are engaged in accumulating evidence of the causes of the various mechanical injuries. Among these may be mentioned:

- (a) Bureau of Census--U. S. Department of Commerce
- (b) State Industrial Accident Boards
- (c) State Traffic Departments
- (d) Automobile Associations
- (e) Insurance Companies
- (f) Safety Organizations

Statistical Evidence

Mortality--In this field as in the field of disease our most complete returns are taken from the mortality records. For details as to number and exact causes of death see references at end of section.

Morbidity--While the deaths from accidents are sufficiently dramatic the results in non-fatal cases are of equal, if not greater social importance.

At present we have only partial statistics due to incomplete reporting. Sufficiently accurate estimates will be found in the references (Bossard) to indicate the degree of defensive hygiene problem.

Analysis of the Problem

For purposes of discussion, mechanical causes of ill health may be classified as to their place of occurrence:

- (a) Industrial
- (b) General--including automobile

Causes

Careful studies are being made to determine the causes responsible for accidents as a basis for preventive measures. These studies have revealed a great frequency of certain influences:

- (a) Carelessness of individuals or groups
- (b) Defects of individual (mental or physical)
- (c) Fatigue
- (d) Faulty machines

Character in Relation to Prevention--Accidents may be classified from the standpoint of responsibility, in order to plan an effective defensive hygiene program against them.

- (a) Personal--those in which the action or ability of the individual is largely responsible:
 - 1. Burns
 - 2. Accidental drowning
 - 3. Accidental shooting
 - 4. Accidental falls
- (b) Group--where major responsibility is caused by carelessness or neglect of the group:
 - 1. Machinery accidents due to lack of safety devices
 - 2. Mine accidents
 - 3. Railroad accidents
 - 4. Street car accidents

(c) Combination--or the accidents where there is a dual responsibility of the individual and group:

1. Automobile
2. Machinery
3. Streetcar
4. Railroad

Automobile Accidents--The rapid increase of motor propelled vehicles has led to an enormous number of fatal and non-fatal accidents with all of their personal and social consequences.

The importance of this problem justifies a little closer study of the causes and methods of prevention of this class of causes of ill health.

Study this problem as a typical example of the facts necessary and method to be employed in mechanical causes of ill health.

See references at end of section and be prepared to discuss analysis of automobile accidents by cause.

Defense against Accidents--A successful plan of defensive hygiene must include both education and regulation.

Education of Individual

- (a) Children--Modern conditions make it necessary that the education of the child to protect itself should be begun early. It should be made an important part of the health program of the schools.
- (b) Adults--Safety campaigns in both industry and the general community should be promoted with sufficient frequency and intensity to thoroughly inform every adult of the accident hazards.

Regulation--Notwithstanding the soundness of the educational efforts, a well-planned, adequately-enforced set of regulations are necessary.

- (a) Automobile Regulations--Adoption and enforcement of standard automobile code--regulation of pedestrian traffic.
- (b) Industrial Regulations--All but five states in the United States have compensation laws--enforcement of safeguarding.
- (c) Public Utilities--The regulation of public utilities such as railroads and steamships is an important part of control of accidents.

References: Storey--Defensive Hygiene, Chapter 14.
Rosenau--Preventive Medicine.
Bossard--Problems of Social Well-Being, Chapters 19-20.
(See further references at end of these chapters)

DISCUSSION QUESTIONS:

1. What is the estimated annual cost of accidents in the U. S.?
2. Discuss the social problems involved in accidents.

3. Do you agree with the statement that carelessness is the most important element in accidents? Why?
4. What has been the effect of the safety campaigns in industry? In communities (with reference to automobile accidents)?
5. What do you understand by the term "human engineering" in industry?
6. Outline a program of "accident hygiene" for the purpose of controlling the personal element in an industrial plant having dangerous machine processes.

XII. CHEMICAL AGENTS AS CAUSES OF ILL HEALTH

Chemical agents have been recognized as important causes of ill health as a result of the frequency of poisoning in industry. The attempt to understand and solve this problem has been one of the influences which has brought about the development of Industrial Hygiene. Proper consideration of this branch of preventive medicine is given in the course on Group Hygiene. Consideration will be given here to the more important chemical causes of ill health.

Statistics

Chemical agents as causes of death are relatively infrequent (1577 Registration Area 1924). As a cause of acute or chronic ill health, they are of considerable importance on account of the rapid development of new chemical processes in industry.

Classification

These chemical agents may be conveniently classified as to the nature of the substance:

- (a) Inorganic
- (b) Organic

Inorganic Chemicals

The list of inorganic substances capable of causing injury to human beings is a long one. Only a few of the more important ones will be given consideration.

Lead is one of the most frequent, serious, and insidious of occupational poisons.

Lead is a typical cumulative poison. Frequently a comparatively large single dose may be taken without noticeable effect; but small quantities inhaled or ingested, are stored in the body, resulting in chronic poisoning and sometimes death. Practically all forms of lead are poisonous.

Sources

There is a long list of possible sources both in and out of industry. Some of the principal ones are:

- (a) Pottery and earthenware processes
- (b) Lead mining, smelting, and refining
- (c) Gasoline--(Ethyl gas)
- (d) Printing trades
- (e) Miscellaneous: drinking water; beer made in lead lined vats; paint; face powder and cosmetics.

Absorption

Respiratory tract most frequent and serious. Dust or fumes is the carrier of the substance. Enters blood directly in lungs.

Intestinal tract--through liver into the circulation.

Skin--not as frequent--though it occurs from paints, cosmetics and hair dye.

Storage in Body

Lead is stored in the bones. Safely stored without ill effects as long as calcium balance of body is positive and a normal hydrogen concentration of the blood.

Excretion--through feces and urine.

Symptoms

Acute form--Intense colic, diarrhoea, rapidly developing anemia, convulsions, and mental symptoms.

Chronic form--Anemia, constipation, colic, paralysis (wrist drop), "blue line" on gums, muscular pain, and swelling of joints.

Maternal and Congenital--Lead is a race poison, causing:

- (a) Sterility
- (b) Prematurity and still births
- (c) Dwarfing

Prevention rests here, as in control of communicable diseases, upon a knowledge of the sources and modes of infection: (a) dust, (b) fumes, (c) by hands to gastro-intestinal tract.

- (a) Prevention of dust and removal of fumes
- (b) Cleanliness of body clothing and surroundings
- (c) Milk drinking

Arsenic is a source of a considerable amount of occupational poisoning.

The principal sources of arsenic poisoning are:

- (a) Lead smelting
- (b) Paris green manufacture
- (c) Sheep dip
- (d) Hides, feather, and fur processing
- (e) Criminal use

Mode of Entrance

Inhalation of fumes or dust or swallowing with food or drink.

Symptoms

- (a) Acute--conjunctivitis, eczema, ulcers.
- (b) Chronic--Anemia, neuritis, degeneration of liver and kidneys.

Mercury

Sources

- (a) Mercury mining and smelting
- (b) Manufacture of barometers and thermometers
- (c) Hat making (felt)

Mode of Entrance

- (a) Inhalation of vapor
- (b) Skin
- (c) Rarely by swallowing

Symptoms

- (a) Anemia
- (b) Headache and dizziness
- (c) Tremor
- (d) "Ptyalism" (fetid breath, soft, swollen, ulcerated gums, with loosening teeth)
- (e) Enlarged glands.

Prevention--Same as for lead.

Phosphorus

Sources--Chiefly match making with white phosphorus.

Mode of Entrance--Swallowing

Symptoms

- (a) Necrosis of bones of jaw
- (b) Foul odor of breath

Prevention

- (a) Prohibition of use of white phosphorus
- (b) Mouth hygiene

Carbon Monoxide--is the most important of all gas poisonings.

Sources

- (a) Illuminating gas
- (b) Exhaust from autos
- (c) Blast furnaces
- (d) Mine gas

Mode of Entrance--Inhalation

Action--Renders red corpuscles of blood incapable of uniting with oxygen.

Symptoms

- (a) Acute and sudden dizziness
- (b) Blurring vision
- (c) Nausea
- (d) Stupor and loss of consciousness

Organic Chemicals

Only a few of the more important organic chemicals that injure health can be considered. The ones selected are: alcohol; opium; cocaine; and tobacco.

Alcohol may be considered as a food, a medicine, or a habit forming drug.

Varieties:

- (a) Methyl (wood alcohol)--very dangerous, used commercially and to adulterate cheap whiskies.
- (b) Ethyl--main component in alcoholic beverages.

Properties--In large amounts a poison. Dispute is about "small" amounts.

- (a) Food--Burned body 1 gram produced 7 calories.
- (b) Nervous depressant--Acts by removing inhibition. It is not a true stimulant.
- (c) Habit-forming drug.

Effects

- (a) Health
- (b) Longevity

Opium and its Derivatives

The problem of the habit forming drugs is one of our major public health problems. The opium group includes opium, morphine, codein, and heroin.

Use--number of addicts not accurately known. Estimated in 1924 to be 110,000.

Physical Effects

- (a) Lowers ability to withstand pain or distress
- (b) Causes gastro-intestinal disturbances
- (c) Destroys self-control, will, memory.
- (d) Effects reproductive system

Social Effects

- (a) Contributes to crimes of violence, poverty, disease, and disorganization of homes.

Control

- (a) Federal: Laws--Food & Drug Act, Harrison Law.
1. Organization: U. S. Public Health Service, Anti-Narcotic League.
(b) International: League of Nations, Health Section
(c) State: Departments of Health, Hospitals and Clinics.

Tobacco

The use of tobacco should be considered from the standpoint of its effects as:

- (a) Habit forming substance
(b) An injurious substance
(c) In its relation to efficiency

Composition of Tobacco

While tobacco as used is the leaves of the plant nicotiana tabacum, our interest from the standpoint of defensive hygiene is in the active principles in the plant which are possible chemical poisons.

Nicotin is the most important of these. In its pure form, it is one of our most powerful, fatal, and rapidly acting poisons. The nicotin content of the various kinds of tobacco vary considerably from 1.3% to 4% for Havana and Maryland, to 6% to 8% for Virginia or Kentucky tobacco.

Tobacco contains many other substances which give it a characteristic flavor. One of them, pyridin, on heating gives rise to substances that are of importance in estimating the physiological effects of tobacco. Two of them are carbon monoxide and furfural.

Combustion of Tobacco

Our interest lies in understanding what is responsible for its charm and its ill effects. There can be no debate about the serious effects of such a powerful poison as nicotin if used in any but the most minute quantity. It is its effects when taken into the body in such amounts and forms as are present in smoking and chewing tobacco that causes much controversy.

The amount of nicotin in the smoke of burning tobacco depends upon the kind and form of tobacco, and the amount of moisture present. This varies from 14% to 33% in cigarettes, to a much higher percentage in cigars and pipes.

It is claimed by some investigators that nicotin is practically destroyed in the process of smoking and that the effects of tobacco are limited to the decomposition products resulting from the pyridin. This does not explain the fact that the same physiological effects are produced by chewing tobacco.

Effects of Tobacco

The important point is what amount of these substances are absorbed by the body and what are their effects when taken in regularly over long periods of time. This will vary with whether the user inhales, swallows the saliva, uses a holder, as well as upon the kind and forms of tobacco used.

Nicotin causes a brief stimulation of the brain and spinal cord followed by depression. The salivary flow is increased temporarily followed by a decrease. The heart action is at first slowed and blood pressure increased followed by rapid heart action and lowered blood pressure. Its final effects are not that of a stimulant but of a narcotic.

Habit Formation

The use of any narcotic is always accompanied by the danger of habit formation with its consequent dependence upon the substance. This applies with peculiar force to tobacco. The individual who is miserable unless he has his given amount of tobacco at a given time comes in the same category, psychologically, as the morphine habitue.

Tobacco and Efficiency

A large number of experiments have been made to determine the relationship of the use of tobacco to mental and physical efficiency.

In the field of mental accomplishments, the evidence seems to show a higher accomplishment among non-smokers, though many of the experiments were not conducted with adequate controls and standard conditions.

From the physical standpoint, the evidence is clearer both from practical and experimental experience. The athletic coach does not permit his teams to smoke. The mortality experience of the insurance companies show more favorable death rates among non-users of tobacco.

- References: Storey--Defensive Hygiene, Chapter 16.
Rosenau--Preventive Medicine (1927). (Industrial Poisons, page 1232); Alcohol page 515).
U. S. Public Health Service--Bulletin 116 (1921)
(Document Room)
Pearl--Alcohol and Longevity
Fisher & Fiske--How to Live, (Alcohol and Tobacco)
Earp--The Student Who Smokes
O'Shea--Tobacco and Mental Efficiency
Eddy, C.--One Million Drug Addicts in U. S. Current History, July, 1923.
Waring, J. J.--The Hygiene of Smoking, Hygeia, June, 1925
California Narcotic Commission--Narcotic Habit, (363.99 C153)

DISCUSSION QUESTIONS:

1. Is it true that chemical causes of ill health are relatively unimportant in the United States? Why?

2. What are the five fundamentals for the prevention of occupational diseases and poisons? (Rosenau)
3. Outline a plan for the prevention of lead poisoning in a pottery using lead.
4. Explain the preventive action of milk drinking in lead workers.
5. Discuss alcohol as a food.
6. Is alcohol a true stimulant? Why not?
7. Explain the function of Pure Food and Drug and the Harrison law in controlling drug addiction.
8. What are the important active principles contained in the tobacco plant? Explain the way in which pyridin is said to produce its ill effects on the body.
9. What is the relation of the use of tobacco to habit formation? Efficiency?
10. Explain physiologically why the athletic coach prohibits smoking for men in training.

XIII. PHYSICAL AGENTS AS CAUSES OF ILL HEALTH

Certain physical agents are capable either directly or indirectly of causing ill health. A few of the more important will be discussed. Attention will be called to the health influences of certain other ones.

Atmospheric Pressure

While changes in atmospheric pressure are not usually of much importance to the average individual, a knowledge of them is essential under special conditions of work, recreation, or transportation.

Diminished

Due to the rapid growth of aviation, diminished air pressure is becoming more and more important.

Occurrence

- (a) Mountain Climbing
- (b) Aeroplaning and ballooning

Effects

The effects of living at very high altitudes with their low pressure can only be mentioned.

The acute effects express themselves in headache, lassitude, and sometimes nausea. The extremities are cold, the pulse is weakened, and the respirations are deeper and more frequent. The face becomes pallid and lips and nails blue. Readjustment sometimes is made.

In more severe cases there may be vomiting, fever, fainting, and persistence of the other symptoms.

The physiological effects of low pressure are due to the low partial tension of oxygen. This causes a deficiency of oxygen in the blood (anoxemia). The body tries to compensate for this condition by:

- (a) Increases respiration
- (b) Chemical alterations in blood (lowering alkaline reserve)
- (c) Increased hemoglobin (increase in red blood cells)

Increased Pressure

Increased pressure is of importance chiefly in the industrial field as:

- (a) Tunnel workers
- (b) Deep sea divers

The subjecting of the individual to high pressures results in a condition called Caisson disease or "bends," the latter name given by workmen from the excruciating pains causing the individual to double up his body.

Symptoms

- (a) Slow respiration
- (b) Slow pulse
- (c) Pains in ears
- (d) Headache and dizziness
- (e) Excruciating pains
- (f) Vomiting

Death may occur from internal hemorrhage or there may be paralysis (diver's palsy).

Physiological effects are most marked and dangerous after decompression. Effects are due to:

- (a) Increase in amount of gases in blood (nitrogen)
- (b) Increase in chemical absorption of oxygen
- (c) Air emboli

Prevention

- (a) Gradually increasing pressure
- (b) Gradual decompression
- (c) Careful medical supervision

Temperature

The relation of temperature and light to health as two of the important elements in climate can only be mentioned. The influence of climate on the vigor and vitality of races is an interesting field of study. At this time, we will only consider the acute, extreme variations in temperature.

Low temperatures

- (a) Chilblains

- (b) Frost bites
- (c) Freezing

High temperatures

High temperatures are of more immediate interest.

Heat Stroke--the cause of 300 to 400 deaths in the United States annually. It is the result of hot moist atmosphere marked by headache, rapid pulse and respiration, loss of consciousness, and sometimes death.

Burns--may vary in effect from simple redness to cremation. In 1924, 6895 persons were accidentally burned to death and in addition 1625 lost their lives in conflagrations.

Cost: (a) Economic, (b) Vital.

Defensive hygiene of increased temperatures

Light is an important source of both health and ill health.

The effects of light may be summed up under the following heads:

- (a) Insufficient light may affect eyes or have relation to rickets in children.
- (b) Excessive light--"sun stroke," sunburn.
- (c) X-Rays or Radium may injure as well as aid health.

Electricity may be an important cause of ill health and death unless proper defensive hygiene measures are taken.

- (a) Lightning
- (b) Commercial electricity

Defenses

- (a) Safeguarding
- (b) Education

References: Storey--Defensive Hygiene, Chapter 15.
Rosenau--Preventive Medicine--Articles on Pressure, Temperature, and Light.
Huntington--Civilization and Climate.
Sunset Magazine--What Price California Climate, June, 1928.
Luckiesh and Pacini--Light and Health

DISCUSSION QUESTIONS:

1. Discuss the relation of aviation to health.
2. Why are the respirations quickened when the atmospheric pressure is diminished?
3. Explain the increased number of red cells produced under same conditions.
4. Outline a defensive hygiene program against Caisson's disease.

5. Discuss relation of high temperature to health.
6. Why are burns of so much importance as a problem of defensive hygiene?
7. Discuss relation of insufficient sunlight to rickets?
8. What defensive hygiene measures are particularly indicated in the University to meet the hazards of insufficient light?

XIV. DEFENSIVE HYGIENE OF HEREDITY

Our knowledge of heredity has been transferred from the realm of speculation to the realm of experiment. The rediscovery in 1900 of the work of Mendel furnished the foundation for the rapid growth of the science of genetics.

Normality and Abnormality

As a result of the statistical and experimental study of heredity, we have had revealed to us with great vividness the mechanisms by which both normal and abnormal characters can be transmitted from generation to generation. The knowledge of these mechanisms has uncovered for us some of the most pressing problems of Defensive Hygiene.

Problems

The principal problems of heredity for which we should adopt a more intelligent and aggressive defensive program are:

- (a) Hereditary mental diseases
- (b) Feeblemindedness
- (c) Nervous and mental instability.

Extent of Problem

While there is some controversy over whether the large increase in mental deficiencies of various kinds is an absolute or relative one, there is no doubt of the immensity and importance of the problem. An intelligent opinion upon control measures should be based upon a working knowledge of the basic and exciting causes of:

- (a) Mental diseases
- (b) Feeblemindedness.

Control of Human Heredity

Even though we have accumulated considerable knowledge of the mechanisms of both normal and abnormal heredity, it is a difficult and complex problem to apply in the human field.

Any program of applied eugenics to be successful must be practical and not visionary. In this course we are concerned directly with the prevention side and only indirectly with the constructive side.

- (a) Positive Eugenics (Discussed Course 150)
- (b) Negative Eugenics

- (1) Laws restricting marriage
- (2) Selective mating (with idea of dilution of defects)
- (3) Segregation
- (4) Sterilization
- (5) Undesirable immigration

Program of Defensive Hygiene of Heredity

Every well informed person should have sufficient knowledge of what science has shown us about heredity to enable him to act intelligently himself and to participate wisely in the community's attempts to meet the problems arising from heredity.

A working program includes many things that can be done at once and some that are only possible with increased intelligent public opinion.

(a) Community program

- (1) Control of procreation of mentally deficient
- (2) Institutions and colonies
- (3) Exclusion of abnormal immigrants
- (4) Restriction of marriage

(b) Personal program

- (1) Knowledge of heredity
- (2) Pre-nuptial examination
- (3) Ideals of responsibility for reproduction of healthy germ plasm.

References: Storey---Defensive Hygiene, chaps. 2-6.
Guyer----Being Well-Born, chaps. 8-13-19-20-23.
Conklin--Heredity and Environment, pages 116-120 and 287 (5th ed)
Bossard--Problems of Well-Being, chaps. 21-25.

DISCUSSION QUESTIONS:

1. If the statements of modern biologists and physicians as to the transmission of feeble-mindedness and insanity are true, how do you account for the great opposition to their social application?
2. Are the present day laws restricting marriage likely to influence markedly the reproduction of the unfit? Why?
3. If the upper grades of feeble-minded now segregated are sterilized and released, what other problem does it affect? How?
4. What would you include in a personal program of defensive hygiene of heredity and constructive program that would make for race improvement?

XV. DEFENSES AGAINST ENVIRONMENTAL DEFICIENCIES AND EXCESSES

The earlier part of this course has concerned itself with a consideration of the mechanical, physical, chemical, and micro-organismal causes of ill health. Science has also demonstrated that we have another great group of causes: sickness, inefficiency, and death. They may be broadly classified as environmental excesses and deficiencies.

These excesses and deficiencies play an important part in our levels of health. One might consider them from a chronological point of view on account of their peculiar effects on every age group.

- | | |
|----------------------------|--------------|
| (a) Pre-natal | (d) Maturity |
| (b) Infancy and pre-school | (e) Old age |
| (c) School or college | |

The time at our disposal will permit only a consideration of the principles involved in the health effects of excesses and deficiencies.

Food Excesses and Deficiencies

No argument is needed to establish the fact that food is one of the prime essentials of life. The difficulty is to convince the average individual that we have sufficient scientific knowledge to prove that more than instinct, taste and the subjective sensation of satisfaction of hunger are necessary to insure the individual an adequate diet and to protect him against food excesses and insure him against food deficiencies.

Food Deficiencies

From our studies of normal nutrition, we learned that the amount of food taken in by the individual should be adapted to his age, body weight, and degree of activity. Further, that this intake should be distributed properly among proteins, fats, and carbohydrates with an insurance of securing sufficient vitamins and inorganic salts.

If we are to plan successful defensive hygiene of foods, we must know the correct amounts and distribution of food elements and understand the signs of deficiency of each group.

- | | | |
|-------------|-------------------|---------------------|
| (a) Protein | (c) Carbohydrates | (e) Water |
| (b) Fats | (d) Vitamins | (f) Inorganic salts |

Food Excesses

It is impossible to judge exactly whether an individual is taking food in excess without a careful study and expert examination. It is doubtful wisdom to take the unreliable testimony of the feelings and the scales. It seems almost unnecessary to mention that we should be able to recognize the signs of excesses of:

- | | | |
|--------------|-------------------|---------------------|
| (a) Water | (c) Fats | (e) Inorganic salts |
| (b) Proteins | (d) Carbohydrates | |

Excretory Excesses and Deficiencies

The excesses or deficiencies of the excretory organs are of vital importance in health maintenance. The lack of knowledge of normal amounts of various excretions lead to much permanent physical damage.

Deficiencies

- (a) Deficiencies of intestinal excretions. Constipation is one of our major health problems. Relation to diseases.
- (b) Deficiencies of urinary excretions. Knowledge of normal amounts and character of urinary excretions is fundamental to health.
- (c) Deficiencies of skin excretions. Not relatively important.

Excesses

The excesses of excretions are more likely to attract attention but are none the less important. They include the same organs:

- (a) Urine
- (b) Intestinal
- (c) Perspiration
- (d) Menstruation

Excesses and Deficiencies of Exercise

Exercise is fundamental to good function. Both deficiency and excess need to be guarded against.

Deficiency of Exercise

A deficiency of exercise has a serious effect on:

- (a) Metabolism
- (b) Organic growth
- (c) Functional growth

The signs of deficient exercise may be summarized:

- (a) Weakness and lack of endurance to voluntary muscles
- (b) Weakness and lack of endurance of heart and circulation
- (c) Weakness and lack of endurance of muscles of respiration

Excesses of Exercise

Excessive exercise may be a serious matter. The understanding of the signs of over exertion are among the most important hygienic facts. To interpret fatigue properly is difficult but possible. Fatigue may be either local or general. The degree of fatigue and the rate and completeness of recovery are of vital importance.

- (a) Normal muscular fatigue
- (b) Acute muscular fatigue
- (c) Exhaustion