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COMPENDIUM OF THE PARASITES OF MOSQUITOES CULICIDAE

Up to the time of Sir Patrick Manson's discovery that mosquitoes transmit *Filaria* to man, these insects were generally considered as of little importance medically, but of more importance as pests and because of their interference with sleep. That mosquitoes are directly responsible for the transmission of disease was an epoch-making discovery, and was followed by many experiments in this field of research. An especially noteworthy result was the work of Ross and of Grassi, in the problem of the transmission of malaria to man by mosquitoes—an hypothesis previously advanced especially by King.

Later, the experiments of Carroll, Lazear, Reed, and Agramonte proved conclusively that yellow fever is transmitted directly by the bite of a mosquito—a view which had previously been advanced by several authors, especially Finlay.

The placing of the responsibility for transmission of certain diseases of man and other animals upon the mosquito has given this insect an economic status of increased importance and has resulted in closer observation of the parasites of mosquitoes.

Because of the medical importance of mosquitoes in the transmission of disease, it seemed opportune to collate and present a catalogue of all the parasites reported for mosquitoes, and this has been done by Alma J. Speer in Hygienic Laboratory Bulletin No. 146, Compendium of the Parasites of Mosquitoes Culicidae, now in the hands of the printer. Among the parasites reported from this widespread study are many that are more or less pathogenic for the mosquitoes themselves. A notable example is *Agamomermis*, now recognized as fatal to mosquitoes in many cases; and the problem suggests itself whether parasites can be used in the control of mosquitoes.

AN ADVANCED SCHOOL OF MALARIOLOGY TO BE ESTABLISHED IN ROME

Through the Department of State, the Royal Italian Government has brought to the attention of the Government of the United States the plan of the former Government to establish in Rome an advanced school of malariology, with the suggestion that, as the establishment of such a school will be of great interest to all malaria students, the matter be brought to the attention of malaria workers in this country.

Following is a statement of the Italian ambassador:

Studies on malaria which have been carried on in Italy with continuous success have, during the last 50 years, been perfected, as a result of several happy coincidences and thanks to the labors and initiatives of illustrious personalities.

Italy, better than any other country, offers a suitable field for direct and clinical observations, and for objective conclusions on the results obtained with the use of preventive means employed both alone and in connection with other measures.

The Royal Italian Government, therefore, has come to the decision of instituting in Rome an advanced school of malariology.

This school will first of all concern itself with the study of climatic factors, including the flora and fauna of infected zones, and will especially apply itself to the study of the germ producing the malady and of *Anopheles* mosquitoes. It will then devote itself to the genesis of the illness, its symptoms, its clinical forms, its consequences, and its treatment, on the one side, and, on the other side, the school will consider the various means to prevent the spread of infection and to redeem the infected zones by reclaiming the soil and fostering cultivation.

The instruction given in the school, which will be as much as possible, of the character of an object lesson, will consist, in its fundamental lines, of practical experiments on the part of the students. Besides the ordinary lessons, there will be lectures by eminent persons, both Italian and foreign, considered as authorities on the matter.

During the course, which will last from May to October, there will be excursions and trips on reclaimed lands or in the zones under process of reclamation and in the infected areas. The school will be divided into two sections: One technical and scientific, which will be reserved mostly for physicians; the other economic, reserved to engineers, agriculturists, administrative personnel, and persons interested in social work. These two sections will have several teachers in common, but each section will have its own subjects. Each section will grant, after examinations, a diploma to its graduates.

The Italian ambassador has received instructions to bring the foregoing information to the knowledge of the Government of the United States, with the request to have the competent departments, institutes, universities, and persons interested in malariologic studies informed of the existence of the school, signifying at the same time that the Royal Italian Government would be gratified if citizens of the United States, physicians, engineers, agriculturists, and other persons interested in the subject, would register as students in the advanced school of malariology.

THREE YEARS WITHOUT A DEATH FROM DIPHTHERIA IN AUBURN, N. Y.

Three years without a death from diphtheria is the enviable record that has been achieved by Auburn, N. Y., a city of over 35,000 population, which had from 4 to 17 deaths annually from diphtheria during the years 1915 to 1920, and averaged 9 deaths annually from the disease from 1915 to 1923. The following is taken from the Health News, published by the New York State department of health, issue of March 21, 1927:

March 8 marked the end of three years since a death from diphtheria has occurred in the city of Auburn.

During 1926, but 7 cases of diphtheria occurred as compared with 18 during 1925. In January and February of the present year 7 cases developed. Of these, 4 occurred in one family, 3 being in children who had received toxin-antitoxin only six weeks previously and who therefore had not had sufficient time to develop an immunity. These cases were all very mild. One case occurred in a boy who had not had the protective treatment, one was in a baby in a family where all other members had been immunized. Another case had received but one dose of toxin-antitoxin three years previously.

The entire record shows the remarkable results which follow when a large part of the child population has been immunized against diphtheria.

COURT DECISIONS RELATING TO PUBLIC HEALTH

Abattoir ordinance held to create a monopoly.—(Georgia Supreme Court; City of Waycross et al. *v.* Caulley, 136 S. E. 139; decided December 20, 1926.) An ordinance of the city of Waycross purported to grant an exclusive franchise to certain private individuals for a term of years, authorizing them to establish and maintain an abattoir. The ordinance also provided that all meat slaughtered in the city, exclusive of Federal Government inspected meat, should be slaughtered in the said abattoir and that all killing of animals for food to be used in the city should be done therein. A scale of prices to be charged for the killing of animals was given, and inspection provided for. The ordinance, however, contained no provision authorizing persons other than the grantees of the franchise to slaughter animals at the abattoir. The supreme court held that the ordinance denied "a skilled butcher having an established business the right to slaughter at the abattoir or elsewhere his own animals for food to be used in the city"; that the ordinance, to the extent that it denied such right, created a monopoly; that the city charter gave no express or implied power to the mayor and aldermen to grant such a monopoly; and that the ordinance was void in so far as it interfered with the right to slaughter animals as above set forth.

License ordinance held invalid because discriminatory.—(Kansas Supreme Court; Ex parte Irish, 250 P. 1056; decided December 11, 1926.) An ordinance of the city of Holton imposed a license fee of $150 per year on each person, firm or corporation, not a resident of the city, who sold any bread or bakery products in the city. This ordinance was upheld by the supreme court in a decision rendered May 8, 1926, but on December 11, 1926, on a rehearing, the court declared the ordinance to be invalid, because violative of the Federal Constitution in that it discriminated between residents of the city and nonresidents.

Compensation granted under workmen's compensation act for death from typhoid fever.—(Illinois Supreme Court; John Rissman and Son *v.* Industrial Commission et al., 154 N. E. 203; decided October 28, 1926.) An employee died from typhoid fever contracted from the drinking of contaminated water furnished by the employer. In a proceeding under the workmen's compensation act, the supreme court, in granting compensation, stated as follows:

> The real question in this case is whether or not the death of the deceased can be said to be the result of an accidental injury. This question has really, from the evidence in this record, been practically decided by the decision of this court in Christ *v.* Pacific Mutual Life Ins. Co., 312 Ill. 525, 144 N. E. 161, 35 A. L. R. 730, in which case this court decided that typhoid fever may be regarded as accidental if the disease is contracted by accidental means. * * *
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> * * * In this case the deceased intended to drink the water furnished by the defendant in error, but she did not intend to drink polluted water or water contaminated with typhoid germs. The contraction of typhoid fever by the deceased from the drinking of such water was unexpected and not foreseen by her, and may therefore be said to be accidental. The evidence in the record is to the effect that it was the water that was contaminated with typhoid germs. * * *

Typhoid fever held not compensable under workmen's compensation act.—(Texas Commission of Appeals, Section B; Buchanan et al. *v.* Maryland Casualty Co., 288 S. W. 116; decided November 24, 1926.) In an opinion of the commission of appeals, which opinion was adopted by the supreme court, answers were given to certain questions certified to the supreme court. These answers were that, under the Texas workmen's compensation act, typhoid fever, contracted by an employee as a result of impure water or food furnished by an employer, was neither an accidental injury nor a compensable injury. The compensation act contained a provision that "The terms 'injury' or 'personal injury' shall be construed to mean damage or harm to the physical structure of the body and such diseases or infection as naturally result therefrom."

Order of city health commissioner to abate nuisance upheld.—(Massachusetts Supreme Judicial Court; Commonwealth *v.* Collins, 154 N. E. 266; decided November 29, 1926.) In a proceeding against the defendant for a violation of a notice or order of the health commissioner of the city of Boston to abate a nuisance on certain premises, the action and order of the commissioner were upheld by the supreme court. The opinion in the case considers in detail the various technical exceptions taken by the defendant.

Act authorizing construction and operation of public water supply system and proceedings thereunder upheld.—(Virginia Supreme Court of Appeals; Kirkpatrick et al. *v.* Board of Supervisors of Arlington County et al., 136 S. E. 186; decided November 26, 1926.) An act of the Virginia Legislature passed in 1926 authorized any county of the State, having more than 300 inhabitants per square mile as shown by the last preceding United States census, to issue bonds "for the purpose of constructing and operating a public water-supply system in any magisterial district or districts in the said county." In 1922 the legislature had passed an act creating out of Arlington County a sanitary district and subdividing it into various zones and districts for the purpose, among other things, of providing a publicly owned water-supply system or systems within the county. An election was held in Arlington County under the 1926 act and the issuance of bonds for a public water supply authorized. In a suit to enjoin the issuance of the bonds it was contended that the 1926 act was a general law and was not applicable to Arlington County, because the prior special act of 1922, covering the same matter, was in force in that county. However, the court took judicial notice of the fact that Arlington County was the only county in Virginia which had a population of more than 300 per square mile, and held that both acts were applicable to Arlington County, a choice of two means of financing a publicly owned water system being left to the people. It was also contended that the 1926 act was unconstitutional and that the election held thereunder was void, but the court's holding was adverse to these contentions and an injunction was refused.

PUBLIC HEALTH ENGINEERING ABSTRACTS

Measuring Quality of Water now a Standardized Practice. Jack J. Hinman, jr., associate professor of sanitation, State University of Iowa. Water Works Engineering, vol. 80, No. 4, February 16, 1927, pp. 232 and 235. (Abstract by William L. Havens.)

The standardization of methods of water examination has made remarkable progress since the early studies of the American Association for the Advancement of Science in the eighties. In 1897 the American Public Health Association began a study of the problem which resulted in the 1905 edition and subsequent editions of the Standard Methods of Examination of Water and Sewage. The publication of this book has proved of considerable value in unifying laboratory practices and in allowing a comparison of results from different plants and laboratories. Attention has recently been given not only to the necessity for frequent examinations, mass data, and reliability of operation, but also to such more recent developments as the hydrogen ion concentration, fecal and nonfecal types of colon organisms, nonconfirming spore-forming, lactose-fermenting bacteria, and the orthotolidine test for free chlorine. The writer believes that, at the present time, however, there is an unwise tendency to scrap some of the older chemical methods tending to add testimony of value to the indications of the bacteriological investigation and the sanitary survey. Considerable attention will undoubtedly be given in the future to improvements of mineral characteristics, as, for example, the treatment of hard waters and those having high iron contents. It is practically certain also that requirements will be more rigid than they are now and that full advantage will have to be taken of all developments in water purification and control.

Wells and Guinea-Worm Disease in Bombay City. Anon. The All India Local and Municipal Self-Government Gazette, vol. 13, No. 5, November, 1926, pp. 236–237. (Abstract by R. E. Tarbett.)

The adult guinea worm appears under the skin of the lower extremities of the infected person. It discharges its embryos in contact with water, and these enter *Cyclops* which may be in the water. When water containing infected *Cyclops* is ingested, the embryos are liberated and burrow in the tissue and develop, and after some months the female makes its appearance at the skin surface. The water of the municipal lakes very rarely showed *Cyclops*, and it was assumed that the infection was from wells. Several wells were examined and *Cyclops* were found although none were infected. Water from wells is obtained through water carriers, some of whom were found to be infected, and these carriers were considered as the chief source of the disease. Wells found to have cyclops were treated with potash permanganate. It was recommended that all wells have tight tops and pumps. Other measures were the control over the water carriers and the periodic treatment of all wells with permanganate.

A Survey of Connecticut Rural School Water Supplies. Warren G. Scott. Nation's Health, vol. 8, No. 12, December 15, 1926, pp. 825–826 and 870. (Abstract by F. C. Dugan.)

A survey of the water supply of schools in various sections of the State showed many conditions that should be corrected. Out of 680 supplies, less than 10 per cent might be classed as satisfactory. About 20 per cent were found to be fairly satisfactory, and the remaining 70 per cent ranged from unsatisfactory to unsafe.

In a number of schools it was found that more care was needed in the method of distributing the water in the school. The most striking point brought out by this survey was the large number of wells and springs poorly constructed. Such a survey as this would be of the greatest benefit to every State in the Union.

Housing and the Regional Plan. John Ihlder. American City, vol. 35, No. 5, November, 1926, pp. 636–638. (Abstract by A. L. Dopmeyer.)

A definition of "metropolitan region" is given and some of the problems are discussed which enter into regional planning.

The author believes it important to keep the various urban units in a region separate, but at the same time provide for accessibility and communication, the communities keeping their individuality by surrounding open areas.

Several assumptions as to housing for the regional area are outlined, principally, the desirability of decreasing the speculative element and increasing the investment element. Stabilizing the character of a neighborhood is believed essential. Among the major items of regional planning briefly discussed are the following: (1) Open spaces; (2) transit; (3) water; (4) sewage disposal; and (5) police and fire protection. The methods used in Germany and England for preserving open spaces are discussed in some detail. The question as to what our policy in this respect will be is left unanswered.

City Planning and Zoning Aided by the Florida Hurricane. Robert M. Kerr, American City, vol. 35, No. 5, November, 1926, p. 693–696. (Abstract by A. L. Dopmeyer.)

In June, 1926, Fort Lauderdale accepted a comprehensive city plan by special election, and shortly thereafter the city council passed a zoning ordinance. There were five separate questions on the ballot, which are discussed briefly in this article. The questions concerned—(1) Proposed street widenings and extensions in the old main sections of the city; (2) beautification of river drives in the central part of the city; (3) main arterial thoroughfares and secondary streets; (4) a proposed civic center; and (5) a park, parkway, and recreational plan.

The recent storm is said to have emphasized to the people the need of building wisely for permanency and in accordance with modern standards. Incidentally, buildings damaged in the storm, that project beyond the new setback lines, if rebuilt, must recognize the new lines.

The map of the city showing improvements in the street plan is reproduced, and a plan for the new river parkway is shown. There is also a drawing showing a probable view of the river front after proposed changes have been made.

The Housing Conditions of Copenhagen. Povl Heiberg, M. D., deputy city medical officer of health of Copenhagen. League of

Nations Health Organization in Denmark. Doc. C. H./E. P. S./49. pp. 322–332. (Abstract by H. B. Hommon.)

A brief history of housing conditions in Copenhagen is given as far back as the year 1500 and the operation of the Copenhagen building societies, which build and control, to a large extent, the dwellings occupied by workmen, is described in detail.

A housing commission, consisting of a mayor, the chief city medical officer of health, a municipal architect, the vice director of the city police, the chief of the fire brigade, and a member of the town council, carry out the provisions of the present building act.

Why Property Zoning is a Necessary Public Health Measure. Geo. M. Kober, Nation's Health, vol. 8, No. 10, October 15, 1926, pp. 668–670. (Abstract by F. C. Dugan.)

This article is an abstract of the testimony given by Doctor Kober in defense of the constitutionality of the zoning law enacted for the District of Columbia. It brings out the various objectionable features which business houses bring to a residential community and points out that having specified areas set aside for resident, business, and industrial purposes accomplishes the greatest amount of good for the greatest number of people.

Stream Pollution and Its Effects. N. T. Veatch, jr., consulting engineer, Kansas City, Mo. Journal American Water Works Association, vol. 17, No. 1, January, 1927, pp. 58–63. (Abstract by J. K. Hoskins.)

The increasing urban population and the demand for sewerage facilities in the smaller communities are resulting in more general and intensive pollution of streams, thereby endangering one of our most valuable natural resources—the public water supply derived from surface sources. To reduce the burden placed on water-purification plants treating such waters, proper methods of sewage treatment must be adopted. Data from Public Health Bulletin No. 143 are quoted giving the equivalent population in terms of polluting constituents of various industrial wastes. The amount of oxygen required for satisfaction of the organic constituents of sewage is also briefly discussed, as well as the extent of dilution required to prevent nuisance in the receiving stream. Support of Federal and State research studies on these subjects is emphasized.

The Prevention of River Pollution. F. B. Preston. Surveyor, vol. 71, No. 1828, February 4, 1927, pp. 177–180. (Abstract by H. W. Streeter.)

The author discusses the administrative and technical aspects of stream pollution in Great Britain, especially pollution by trade wastes and its prevention. He notes certain weaknesses in past regulatory legislation, mentioning particularly the exemptions permitted by a faulty definition of "solid matter."

In discussing the relation between river pollution and fish life, he stresses the importance of biological studies of the effects which wastes of various kinds and concentrations may exert on the small water animals and plants on which depend the ultimate survival of fish. He also notes the toxic effect which tar wastes have on fish, stating that trout succumb in concentrations of 1 to 80,000 parts in 18 or 20 hours. Water which has taken up tar poisons retains its toxicity for a long time.

Methods for treating wastes from paper mills, creameries, beet-sugar factories, and gas plants are described.

Stream Pollution in Michigan. Edward D. Rich, State sanitary engineer. Proceedings, third annual meeting Lake Michigan Sanitation Congress, vol. 3, No. 1, January, 1927, pp. 20–22. (Abstract by I. W. Mendelsohn.)

In the fall of 1925, a new policy regarding stream pollution in Michigan was inaugurated by joint cooperation of the department of health and the department of conservation. Representatives of municipalities having sewer systems were called to Lansing by groups according to river drainage basins, and the problem was considered as affecting each municipality. Then groups of industries according to their nature were called.

The State departments recommended the following: (1) A thorough engineering study of local conditions and an estimate of the cost and time required to install satisfactory treatment works; (2) an orderly program by municipalities to obtain the necessary funds annually for construction of the treatment works in sections. In the case of industries, committees composed of their own members have been appointed by them to cooperate with the State in making studies to determine the most satisfactory and economical methods of treatment for their wastes. Satisfactory action has resulted already from these conferences.

Disposal of Canning Factory Waste. E. F. Eldridge. The Canner, vol. 62, No. 20, May 8, 1926, pp. 23–26. (Abstract by L. M. Fisher.)

Pressure of public opinion requires officials to take action to keep trade wastes out of streams. Polluting material is divided into three classes—(1) poisonous wastes, such as acids, alkalies, phenols, insecticides, and other toxic substances; (2) wastes carrying pathogenic bacteria, such as sewage, raw garbage; (3) wastes containing unstable organic and, sometimes, inorganic material, such as tannery, paper, milk, and cannery wastes. Cannery wastes are very unstable and soon reduce the oxygen content of streams. A decrease of 40 per cent of the normal oxygen content will have a detrimental effect on the life in the stream. Complete removal of oxygen becomes a hindrance to the self-purification of the stream.

Screenings and burial of screenings, settling of the screened liquid in Dorr tanks or clarifiers, and burial of sludge with the screenings are discussed.

Because cannery wastes are sometime alkaline and sometimes acid, chemical precipitation, using lime and ferrous sulphate, or alum, give promising results. The liquid must be further stabilized by slow sand contact or sprinkling filter treatment.

The efficiency of any method will be determined by the oxygen demand of the final effluent. The whole idea is to lower the oxygen demand of the wastes to such a point that it will have no effect on the plant and animal life in the stream.

POPULATION OF HOSPITALS FOR THE INSANE

Data for August, 1926

Reports for the month of August, 1926, were received from 139 institutions.

The total number of patients increased 0.28 per cent during the month. The number in hospitals increased 0.26 per cent and the number on parole increased 0.49 per cent.

First admissions constituted 80.58 per cent of the total admitted; readmissions 15.33 per cent, and 4.09 per cent of the admissions were by transfer or not accounted for.

Of the patients discharged 27.86 per cent were recorded as recovered, 50.39 per cent as improved, 15.11 per cent as unimproved, 4.33 per cent as without psychosis, and 2.31 per cent were "otherwise discharged" or not accounted for.

There were 1,067 male patients per 1,000 females at the end of the month.

On August 31, 7.80 per cent of the total number of patients were on parole or otherwise absent from the institutions.

The deaths for the month numbered 1,277, which gives an annual death rate of 73.28 per thousand patients under treatment.

Movement of patient population in 139 hospitals for the care of the insane during August, 1926

Number of institutions included:	
Public	118
Private	21
Total	139
Patients on books Aug. 1, 1926:	
In hospitals	185, 054
On parole or otherwise absent but still on books	15, 613
Total	200, 667

Admitted during August:	
First admissions	3, 605
Readmissions	686
Admitted by transfer	182
Not accounted for	1
Total received during month	4, 474
Total on books during month	205, 141
Discharged during August:	
As recovered	688
As improved	1, 244
As unimproved	373
As without psychosis	107
Otherwise discharged	54
Not accounted for	3
Total discharged during August	2, 469
Transferred	163
Died	1, 277
Total discharged, transferred, and died during August	3, 909
Patients on books Aug. 31, 1926:	
In hospitals	185, 543
On parole or otherwise absent but still on books	15, 689
Total	201, 232
Male patients	103, 859
Female patients	97, 373

REVIEW OF LITERATURE ON THE PHYSIOLOGICAL EFFECTS OF ABNORMAL TEMPERATURES AND HUMIDITIES[1]

By R. R. Sayers, *Surgeon, United States Public Health Service, Chief Surgeon, Department of Commerce, Bureau of Mines*, and Sara J. Davenport, *Principal Translator, Department of Commerce, Bureau of Mines.*

Introduction

Atmospheric conditions under which people live and work have a marked effect upon their health and efficiency (1).[2] Two of the most important conditions are temperature and humidity. The general connection between temperature and humidity and human health and efficiency, of course, has been discussed in the literature in relation to the climate and seasonal variation in different parts of the world, but their influence within doors, as in the home, in places of amusement, and in the industries, has not been sufficiently considered until more recently. Emphasis usually has been placed on the gaseous constituents of the air in such places.

[1] Published with the approval of the Director of the Bureau of Mines.

[2] The numbers in the text refer to the bibliography at the end of the article.

With the discovery by Black (2) in 1757 that the expired air differed from the inspired air by the addition of what he called "fixed air," in which he observed that animals died of suffocation, and with the belief expressed in 1777 by Lavoisier (3) that the gas, which he named oxygen, taken into the body combined with carbon to form "fixed air," or carbon dioxide, the idea originated that the ill effects experienced by people crowded together in small inclosed and poorly ventilated spaces were due to the lack of oxygen and the accumulation of carbon dioxide. This idea still prevails rather generally, although it has been proved by careful experimentation to be erroneous. As early as 1862 Pettenkofer (4) had questioned the carbon-dioxide theory by calling attention to the fact that the air of a room filled with human beings is disagreeable and offensive and appears foul and nauseous long before it is too greatly deprived of oxygen or laden with more than 1 per cent of carbon dioxide.

It was observed by many investigators that it was not until the oxygen content of the respiratory air fell below 10 per cent that animals began to breathe with difficulty. Friedländer and Herter (5) concluded from the results of their experiments that inhaling 20 per cent carbon dioxide for several hours had no poisonous effect, but that only a stimulation of respiration and an increase in the work of the heart were produced. Not until a mixture of gas containing 30 per cent or more of carbon dioxide was breathed did they find an appearance of depression. Leblanc (6) pointed out that under conditions in which the carbon dioxide content of the air increases considerably, for example, in lecture rooms, theaters, etc., the reduction of oxygen content is inconsiderable and very seldom falls below 20 per cent, while the carbon dioxide content very seldom exceeds 1 per cent.

When it appeared evident that the quantitative changes in the normal air are not great enough to explain the bad effects of the air in dwellings and other poorly ventilated buildings, the question arose as to whether the supposed harmfulness of air rebreathed many times might not be ascribed to the presence in room air of somewhat volatile organic material produced through the respiration and perspiration of human beings. To determine whether such gas-forming organic material is produced by people through normal respiration and perspiration, the rebreathing of which would injure health, Hermans (7) conducted experiments on animals and men for one year, from August, 1881, to August, 1882. He found that dyspnea resulted only when there was at least 3 per cent by volume of carbon dioxide present, and a content of 10 per cent of oxygen caused no disagreeable symptoms as long as the carbon dioxide content did not reach 3 per cent. He observed that the disagreeable sensation experienced by anyone on reentering the test chamber after being in fresh air for a short time soon disappeared unless the air was humid and hot and, therefore, concluded that fainting and the like which occur in unventilated rooms is not due, except in very definite cases, to the expiration of harmful gases, but to insufficient cooling.

Brown-Sequard and d'Arsonval (8), from a series of experiments conducted in 1888, concluded that the lungs of man, dog, and rabbit in a state of health produce continuously with the expired air an extremely energetic poison and that it is extremely probable, if not certain, that it is this toxic agent which renders confined air so dangerous; but the experiments of Beu (9), Rauer (10), Lübbert (11), Lehmann and Jessen (12), and others proved that Brown-Sequard's results were entirely incorrect.

Krieger (13) considered that the hygienic value of ventilation with the object of restoring pure air in dwellings, schools, and sick rooms is not so great as is usually supposed. Much more important is ventilation in the interest of the heat economy of the body, for the production of a proper temperature and agitation of the air, as well as for the regulation of the humidity.

In 1903, W. Mehl, an engineer (14), emphasized the fact that a "breath poison" does not exist, that the carbon-dioxide content of the air is not a correct measure of the necessity for ventilation, that injury to health proceeds from excessive heat and humidity, and that the cooling and drying power of the atmosphere is of more value than the control of impurities, or of gases as carbon dioxide.

Paul and Ercklenz (15) had different persons remain for several hours in a glass chamber of 3 cubic meters' capacity so that the carbon dioxide content of the air rose to 10 or 15 parts per thousand. As long as the temperature of the chamber was kept down, there were no bad symptoms. A trial of mental weariness by means of the aesthesiometer and ergograph or by problems in arithmetic gave negative results. Sick people suffering from emphysema, heart disease, kidney trouble, anemia, scrofula, etc., showed no bodily or mental injury from being confined in the experiment chamber in very impure air. The results of the experiments were entirely different as soon as the temperature and humidity were raised. At 78.8° F. with moderate humidity, or at 70° to 73° F. with high humidity, almost all the subjects began to experience discomfort, congestion in the head, anguish, dizziness, and nausea. The sensitiveness was not the same in all persons; the reaction of school children was relatively slight, also that of the emphysematous; the most sensitive were those suffering from heart disease. Paul and Ercklenz then conducted a series of experiments by setting in motion the impure air in the chamber without admitting any fresh air. The brisk circulation of the air laden with gas-forming excretions decreased the heat of the body, evaporated the moisture, and thereupon the ill effects of the still hot air disappeared. In another experiment Paul introduced from the outside, pure air of the same temperature and humidity as that of the experiment chamber, with the same disturbances resulting to the subjects as those caused by the hot, damp, impure air of the chamber.

In one case reported by Flügge (15) a man was placed in the chamber, the temperature of the chamber air being 30.2° C., the relative humidity 87 per cent, and the carbon dioxide content 1.1 per cent. He was not relieved of his discomfort by breathing through a tube the cool outside air, but his symptoms were allayed by a fan inside the chamber.

From the work of Paul and Ercklenz and other investigators, with which he was familiar, Flügge (15) concluded that it is not the chemical composition of the air but the overheating of rooms that has the chief evil influence on health, and it is the latter that must be combated; the objection to an evil-smelling atmosphere is to be supported, not on account of its poisonous properties, which have never been proved to exist, but on account of the resulting feeling of nausea; and fresh air is desirable for men, not because they then breathe chemically purer air, but because the continual movement of the fresh air facilitates the loss of heat from their bodies, and exercises besides a very beneficial stimulus on their skins.

Dr. B. R. Hoobler, in a paper (16) before the International Congress on Hygiene and Demography, 1912, called attention to Dr. W. Gilman Thompson's proposition that a physiological method be substituted for the physical or engineers' method of determining the fitness of air for breathing. Doctor Hoobler stated that the carbon-dioxide standard, so long in vogue, took into account only the air in its function as oxygen and carbon-dioxide carrier, leaving out entirely its function as moisture and heat carrier, as well as its effect on the vasomotor and other reflex nervous apparatus. He considered that most of the discomforts of poor ventilation are due to the effect of the air on the body other than the respiratory exchange. Air heavily laden with moisture may be breathed well and feel soothing to the mucous membrane, but such air, already saturated with moisture, will take up no more, so that the whole body becomes bathed in perspiration and the vasomotor and heat centers are worked overtime to accommodate the body to such an environment.

In an experiment described by Sewall (17), with a person confined in an air-tight box 3 by 5 by 7 feet, the percentage of carbon dioxide rose to 50 parts or more in 10,000 and, although the odor was overpowering when the observer opened the door, the subject of the experiment was unconscious of the odor and suffered no discomfort as long as the water vapor was absorbed and the temperature of the box kept low. He gives a similar experiment in which a subject was kept for 24 hours in a chamber, the air of which held an average carbon dioxide content of 220 parts per 10,000, or over seventy times the normal, together with a reduction of oxygen to less than 19 per cent. The humidity was kept down and the temperature held uniform. The subject of the experiment suffered no discomfort and his body metabolism, as determined by the number of calories of heat given off and the weight of oxygen consumed and of carbon dioxide exhaled, did not differ from that of a control experiment made in pure air.

The appointment of the New York State Commission on Ventilation was announced on June 25, 1913. In 1915 two of the members of this commission, D. D. Kimball and G. T. Palmer, published some of the results of the first year's studies, from which it was concluded (18) that the discomfort in badly ventilated rooms is due mainly to temperature and humidity, and that ventilation is necessary to remove odors as well as to keep down the temperature. It was considered that the same arguments would apply to keeping the air clean as to the personal bathing of the body.

However, Kitchen, in an article (19) published in the Heating and Ventilating Magazine in 1915, stated that while there is no question as to the influence of heat, humidity, and air stagnation as being, in part at least, the cause of the evil influences of poor ventilation, it is not clear that deficiency in oxygen content and the presence of bacteria and volatile organic toxic matters are not also causative. He asked why it is that one feels immediately the influence of air surcharged with the respiration of many human beings, such as is experienced when one enters the subway cars and before any mere influence of heat or moisture on the body can be exercised.

In another article, published in 1915, on the results of the investigations by the New York State Commission on Ventilation, C.-E. A. Winslow and G. T. Palmer (20) found that the experiments seemed to warrant the conclusion that there are substances in the air of an unventilated occupied room (even when temperature and humidity are controlled) which, in some way and without producing conscious discomfort or detectable physiological symptoms, diminish the appetite for food, and that the observed beneficial effects of fresh air may to some extent be connected with this phenomenon.

In a summary of the present state of opinion on the subject of confined air in living rooms and in workshops, Price (21) has the following to say:

1. Ordinary decrease of oxygen as found in inhabitated rooms and shops probably does not exert any deleterious influence on the persons within them.

2. An increase in the content of carbon dioxide from 4 parts to 15 and up to 100 parts in 10,000 volumes is not dangerous to health.

3. It has not yet been proven that the presence of organic matter in confined air has an important bearing upon the health of the persons therein, although

a prolonged breathing of a large quantity of volatile malodorous products may be followed by nausea, loss of appetite, and general malaise.

4. The ill effects commonly ascribed to impure confined air of ill-ventilated rooms and shops are due not so much to the chemical impurities in the air, as to the physical properties such as increased temperature, higher rate of humidity, and stagnation of the air surrounding the body.

5. An increase of the temperature of confined air in workshops above 70° F., and particularly an increase in the wet-bulb reading of the therometer above the same degree, is probably injurious to health if maintained for too prolonged periods, and may cause fatigue, lassitude, decreased metabolism, anemia, and loss of resistance, predisposing the workers to acute and chronic diseases.

Places of Occurrence of Abnormal Temperatures and Humidities

NATURAL ENVIRONMENT

The first contact of human beings with high and low temperatures and humidities no doubt has taken place in the natural environment, as through seasonal changes in the temperate zones or with changing elevation in a tropical climate. Hoffman (22), in a discussion of the report of the Committee on Public Health Climatology, stated that the large degree of conformity in the mortality curve of the cities and States throughout the world during different periods of time would seem clearly to prove that there is some definite relation of weather to disease. He also stated that, unquestionably, heat and humidity, when prevailing in excess of the normal, are direct causes or factors in the development of disease. Doctor Pierce (23), in discussing the same committee report, thought that climate is an extremely complex subject and that the relationship to the incidence of disease of all the elements of climate, such as the diurnal and seasonal variation of temperature, humidity, altitude, air, light, and static, should be considered.

EFFECTS OF SEASONAL VARIATION IN THE TEMPERATE CLIMATES

In the seasonal variation which takes place in temperate zones the effects of high temperatures encountered might be considered as acute. Every summer, in the cities especially, in different parts of the United States many sudden deaths occur during certain periods when the weather becomes excessively hot (24). During the year 1920, in the registration area of the United States (exclusive of Hawaii) there were 270 deaths reported from the effects of heat (25). Persons affected by the atmospheric heat usually suffer from what is known as heat exhaustion. According to Sir Patrick Manson (26), heat exhaustion is "sunstroke" when due to exposure to direct rays of the sun and "heat stroke" when the patient happens to be under cover at the time. In nine times out of ten this simply means syncope—syncope caused by solar or atmospheric heat, or a combination of these, acting on a body whose resistance has been impaired by disease, or by trying conditions and unphysiologic manner of living. This form of heat stroke has no geographical distribution and no special morbid anatomy or pathology.

The effects of sudden increases in atmospheric temperature in the temperate latitudes is very interestingly described by Dr. John Huxham in a report of the extremely hot weather experienced at Plymouth, England, during July, 1757, which was published in Philosophical Transactions (27) for that year. He found many people suffering very severely from these excessive heats; putrid, bilious, petechial, nervous fevers were exceedingly common everywhere, and dysenteries, hemorrhages, and most profuse sweats affected not only those in fevers but a large number of others.

In the same volume of philosophical transactions (27) there is an article "On the heat of the weather in Georgia," by H. Ellis, the governor of that State in 1758. He described conditions as follows:

> One can not here sit down to anything that requires much application but with extreme reluctance; for such is the debilitating quality of our violent heats at this season (July) that an inexpressible languor enervates every faculty, and renders even the thought of exercising them painful. * * * Yet but few people die here out of the ordinary course; though indeed one can scarcely call it living, merely to breathe, and trail about a vigorless body; yet such is generally our condition from the middle of June to the middle of September.

Numerous experiments and studies have been made by different investigators as to the effects of meteorological conditions on the different daily activities of people, such as their relation to scholarship of children in school, the incidence of crime, number of deaths, suicides, clerical errors in banks, etc. Dexter, from a study of statistics in New York and Denver as to the effects of such conditions on behavior, concluded (28) that the hot, humid, cloudy wet days, although making us feel out of sorts and likely to be troublesome, show the least number of misdemeanors, owing to the fact that the energy required to carry out the emotion is lacking because of the depleting effect of the weather. Stecher (28), however, in commenting upon the above, said that we should be very cautious about accepting Dexter's conception of the underlying physiological causes, as his theory was sheer assumption resulting from the necessity of interpreting the data.

The effects on people of seasonal variation, as described by Huntington (1), indicate that in the temperate zone there are two periods in which health and efficiency are greatly decreased in comparison with the other seasons of the year and even many deaths result. In the Northern Hemisphere these periods are during the coldest months of the year, January, February, and March, and during the hottest months, from the middle of July to the middle of September, the other months of the year being the most favorable from the stand-point of health and energy. While the diseases incident to the two periods are different, the net result to health and efficiency is about the same. Farther to the north, however, there is only one unfavorable period, the long extremely cold winter; while farther south the long summer is the unfavorable period, the loss of health and strength due to continued warm weather becoming more pronounced the farther one goes toward the Equator.

EFFECTS OF TROPICAL CLIMATE

Persons accustomed to a temperate climate who go to the Tropics at first may suffer acute effects from the excessive heat and humidity. According to an editorial which appeared in The Lancet (29) in 1916, the European in the Tropics, especially if newly arrived there, is likely to suffer in two ways from the climatic conditions of the hot season—in the one case from heat stroke, in the other from heat exhaustion.

As to the chronic or permanent effects of exposure to tropical conditions, Ellsworth Huntington (30) has made some very interesting assumptions in regard to the relation between civilization and climate. In a discussion of "Environment and Racial Character" he has the following to say:

> Thousands or even tens of thousands of years in the heat of Africa do not seem to have fully acclimatized the Negro to a temperature averaging above 80° F. The same is true among northern races in respect to cold, although they protect themselves by means of clothing, fire, and houses so that they are not really exposed to such low temperatures as might be supposed. All this seems to mean that an adaptation to a climate averaging between 60° and 70° F. is a very primitive trait and presumably belongs to the earliest type of humanity. Therefore we conclude that man probably did not originate in the tropical region extending from Persia or Mesopotamia eastward to southwestern China. This accords with the region from which the most numerous migrations are known to have come. * * * Moreover, these southern migrants would go into a climate less stimulating than that where they became of human form. They would find that great exertion heated them there much more than in their old habitat. Whenever they became thus heated they would unconsciously have a mild and perhaps harmless fever, for the temperature of the body rises under such conditions. The inevitable result is a feeling of lassitude and a tendency to be idle for a long time before making further exertion. In fact, those who were not thus idle would be at a disadvantage, for they would give themselves so much fever that probably their health would suffer and in the course of hundreds of generations their type would be eliminated.

EFFECTS OF COLD CLIMATE

The literature in regard to the action of cold on animals is very meager. Extreme cold seems to be better borne by the human organism than extreme heat. This may be partly due to the fact that the effects of cold can be mitigated by artificial control and, therefore, people are not really exposed to its rigors, even though living comparatively near the poles. The wonderful adaptability of the human body to different climatic conditions is well illustrated by the rapidity with which explorers become inured to the extreme cold in the polar regions. Hartwig (31), in his book on "The Polar World," published in 1869, mentions the "mysterious compensations" by which Kane and Belcher were able to stand the "lowest temperatures ever felt by man."

During their stay through the first Antarctic night Doctor Cook and his companions found (32) that with temperatures ranging from −34° to −37° with a strong wind it was impossible to exist outside the ship, as the extremities were frozen so quickly that it was positively dangerous to be out. But they also found that in still weather no temperature was too low to prevent outdoor work.

In the report of Scott's last Antarctic expedition (33) an account is given of the loss of one of the members of the party in a blizzard at −25° to −28°, with the wind blowing around 40 to 45 miles per hour. Scott had on comparatively light clothing and was out in this temperature wandering around in the Antarctic night for six hours. The only ill effects suffered by him were a badly frostbitten hand, less serious frostbites on the face, and considerable mental confusion when first found by the searching party. The report stated that there can be no doubt that in a blizzard a man has not only to safeguard the circulation in his limbs but must struggle with a sluggishness of brain and an absence of reasoning power which is far more likely to undo him. These Antarctic explorers found −25° under some conditions to be quite mild, as the sensation of cold did not conform to the thermometer, depending rather on the wind, the humidity of the air, and the ice crystals floating in it.

Henry Arctowski made the following statement (32) in regard to the physiological effects of living in the polar regions:

> Some further points must be referred to in describing the climatic conditions we experienced. The temperature of the air is doubtless the most important element in the study of climate; but it seems to me that its importance is relatively less in polar regions than in other parts of the globe. In polar latitudes the human organism is chiefly influenced by the absence of the sun during the night of winter. In the summer, on the other hand, the radiant heat of the sun is so strongly concentrated that the temperature of the air scarcely measures the warmth we feel. Further, the action of the solar rays is directly beneficial—the sun strenghtens and reanimates. And besides direct insolation, the diffused daylight itself must be considered. One feels quite different under a cloudless vault and under a sky overcast and somber. The presence or absence of the sun is a much more important matter to us than the state of the thermometer.
>
> The wind is another extremely important factor from the physiological point of view. In calm weather a temperature of −20° C. (−4° F.) is quite tolerable, even agreeable if the sun is shining; but with a light breeze one feels the cold at once, and in strong wind it is impossible to remain long in the open air with so low a temperature. It appears to me that humidity plays a quite secondary

part in the physiology of the polar climate—at least, at low temperatures; in any case, the humidity of the atmosphere rarely makes itself felt.

The last statement above in regard to the unimportance of humidity at low temperatures is corroborated by the experiments conducted by the Public Health Service in cooperation with the Bureau of Mines and the American Society of Heating and Ventilating Engineers in which it was found (34) that for subjects working at a rate of 90,000 foot-pounds per hour, when thinly clad, a temperature of 43° F. was too cold with and without air movement, regardless of humidity.

PERSONAL REACTION—SEX AND AGE

The relation of sex to susceptibility to abnormal atmospheric conditions seems not to have been given much consideration, although statements are frequently made that women react more readily than men to variations in temperature, humidity, and other changes in the surrounding air. Observations made of operatives in cotton weaving sheds (35) would seem to indicate that women are more likely than men to suffer ill effects from the unhealthful conditions prevailing in this work with air temperatures of 100.1° F. and over and relative humidity of 71.1 per cent. The disproportion of raised mouth temperature between male and female was the most striking fact elicited in the course of the inquiry. At the end of the day's work the weavers complained of having no energy, no great desire for food, and needed only drink and rest. Owing to less power of accommodation and less loss of heat due to clothing worn, the women were affected more than the men.

In a study of the effect of changes in the weather on factory workers, Huntington (24) found, from curves illustrating the data obtained on 120 men at Bridgeport in 1910 and 1911, on 180 men at New Britian in 1911, 1912, and 1913, on 196 girls at New Britain in 1911, 1912, and 1913, and on 60 girls at New Haven in 1913 and 1914, that higher wages were made on days succeeding a change in temperature than when there was no change for several successive days, but the curve for the girls varied more than that for the men.

What little material there is in regard to the effect of atmospheric conditions in relation to the age of those exposed seems to indicate that the heat regulating mechanism of young people and of old people is not able to operate so rapidly and successfully in adapting the body to severe changes in temperature.

Eröss (36) made a study of 297 infants to determine the practical use of artificial heat in rearing them, especially the sick and delicate ones. The experiments were carried out on healthy, well-developed infants and on weaker, premature, and atrophic infants. He found, in the case of healthy infants, that the increase in body temperature was not so remarkable with the older and more developed infants as it was with the younger, although in some instances the surrounding temperature was higher in the case of the older ones, the increase being around 0.1° C., while with the younger the increase was 1.0° C. Results of these experiments indicate that the conditions for the conduction of heat with infants are much more favorable than with adults and that by this means the absorption as well as the giving off of heat is considerably influenced. The strongly developed and fairly well-developed children showed greater capacity for conduction of heat, and hyperemia and perspiration of the skin appeared especially in the well-developed infants, while this happened less frequently and in a decidedly less degree in the case of the premature children.

As stated previously, the information in regard to the effects due to cold is limited, and is especially so in relation to age. However, from the experience of the men in Scott's last expedition (33), the men around 26 and younger did not stand the conditions as well as older men; between 30 and 40 seemed to be the best "all around" age.

INDUSTRIES

There are numerous occupations involving exposure to extremes of heat and cold, dampness, and sudden changes. About 300 of these are listed in a table prepared by Doctor Robertson, of the Division of Industrial Hygiene of the Commonwealth of Australia (37). Among the more common are artificial-ice makers, brick makers, caisson workers, cement workers, coke-oven workers, cold-storage plant workers, dry cleaners, dye makers, electroplaters, foundry workers, furnace workers, glass makers, hothouse workers, ice-cream makers, illuminating-gas workers, iron and steel workers, laundry workers, match-factory workers, miners, packing-house employees, petroleum refiners, pottery workers, sailors, smelters, soap makers, tannery workers, telephone linemen, vulcanizers, wall-paper printers, and welders.

Bodily Reactions to Abnormal Atmospheric Conditions

HEAT-REGULATING MECHANISM

The source or cause of animal heat was an unsolved mystery to the ancients. From observation they were aware that there was within their bodies some source of heat and some mechanism to regulate the production and loss of heat, since in the heat of summer and the cold of winter their temperatures remained fairly constant. According to Schäfer (38) their knowldege of this fact was imperfect, they had no thermometers and could only judge from their sensations, and observations dependent upon the sensations of heat and cold are necessarily imperfect and often fallacious. The ancients considered animal heat to be beyond the reach of physical and chemical laws. They could assign no cause for it, and therefore looked upon it as some innate quality, something essentially "vital." This "vital" heat was supposed to be concentrated in the heart (Plato, Aristotle, Galen), and to be distributed to the body by the blood in the veins. It was prevented from accumulating by respiration, the chief function of which was to cool and temper the blood.

Lefèvre, in his extensive work on animal and bioenergetic heat (39), refers to the ideas of the ancients as follows:

> In fact, from antiquity, the doctrine of *innate heat* has been accepted; but while some, with Aristotle, would have it that heat appertained to the right heart, others, with Galen, thought that it was developed in the left ventricle. No one, otherwise, yet occupied himself with the cause of this calorification.

Lefèvre (39) considered that the history of animal heat followed an evolution parallel to that of general scientific knowledge, and that up to the time of Lavoisier the most absolute empiricism reigned on this subject. A scientific attitude toward the subject developed with the addition, from time to time, of knowledge contributed by scientists like Lavoisier (3) and Crawford (40), who showed that the heat of an animal might be accounted for by the processes of combustion; of Dulong (41) and Desprez (42), whose results, when critically examined and explained by Liebig (43), formed an important support for the law of the conservation of energy; of Helmholz, Ludwig, Pflüger, and others (38), who, by their investigations upon the production of heat in muscle, glands, and other tissues and their determinations of the respiratory exchange of animals, have indicated where and how heat is produced; and, finally, of Rubner (44), whose exact determinations upon heat production and metabolism have proved that the sole cause of animal heat is a chemical process, a combustion of food substances by the oxygen taken in by the animal.

LIMITATIONS OF HEAT-REGULATING MECHANISM OF THE BODY

With the invention, about 1600, of the thermometer more exact data upon the temperature of animals could be obtained and it became possible to carry out experiments to determine the point at which the heat-regulating mechanism of the body ceases to function in contact with heat or cold in excess of usual body temperature. Most of the experimental study seems to have been devoted to the physiological effects of high temperatures, very little having been done on the effects of cold. This is probably due to the fact that there are very few industries which require exposure to excessive cold and that methods of protection from atmospheric cold are well developed.

According to Sir Patrick Manson (26), the healthy human body, when untrammeled by unsuitable clothing, when not exhausted by fatigue or excesses, when not clogged by surfeit of food, by alcoholic drinks, or by drugs, can support with impunity very high temperatures. When, however, the physiological activities have become impaired by disease, by excesses of any kind, by fatigue, or by living in overcrowded rooms, or by a combination of some of these, then high atmospheric temperatures are badly supported, the enervation of the heart may fail, and syncope may ensue.

Dr. William Cullen (45), who was a lecturer in medicine and chemistry at the University of Glasgow about 1775, suggested many arguments to show that life itself had a power of generating heat independent of any common chemical or mechanical means; before his time the received opinions were that the heat of animals arose either from friction or fermentation.

The Philosophical Transactions for the year 1775 (45) describe a series of experiments and observations made in a heated room by Dr. George Fordyce, who with others observed the effects of air heated to a much higher degree than it was formerly thought that any living creature could bear, and convinced them by their own experience of the wonderful power with which the animal body is endued of resisting a heat vastly greater than its own temperature. According to this article Doctor Fordyce had proved the mistake of Doctor Boerhaave and most other authors by supporting many times very high degrees of heat in the course of a long train of important experiments.

In the experiments mentioned above, different persons, sometimes several at a time, remained for a number of minutes in rooms heated to as high as 211° without any symptoms excepting that the air felt unpleasantly hot; their most uneasy feeling was a sense of scorching on the face and legs, which were bare. When the heat of the air began to approach the highest degree which the apparatus was capable of producing, their bodies in the room prevented it from rising any higher; and when it had been previously raised above that point, they inevitably sunk it. The results of these experiments were given as follows:

> These experiments therefore prove, in the clearest manner, that the body has a power of destroying heat. To speak justly on this subject, it must be called a power of destroying a certain degree of heat communicated with a certain quickness. Therefore, in estimating the heat which we are capable of resisting, it is necessary to take into consideration not only what degree of heat would be communicated to our bodies, if they possessed no resisting power, by the heated body, before the equilibrium of heat was effected; but also what time the heat would take in passing from the heated body into our bodies. In consequence of this compound limitation of our resisting power, we bear very different degrees of heat in different mediums. The same person who felt no inconvenience from air heated to 211° could not bear quicksilver at 120°, and could just bear rectified spirit of wine at 130°; that is, quicksilver heated to 120° furnished, in a given time, more heat for the living powers to destroy, than spirits heated to 130°, or air to 211°.

* * * As animals can destroy only a certain quantity of heat in a given time, so the time they can continue the full exertion of this destroying power seems to be also limited; which may be one reason why we can bear for a certain time, and much longer than can be necessary to fully heat the cuticle, a degree of heat which will at length prove intolerable. Probably both the power of destroying heat, and the time for which it can be exerted, may be increased, like most other faculties of the body, by frequent exercise.

In some "Further Experiments and Observations in a Heated Room," carried out in April of the same year by nearly the same personnel as were the above-mentioned experiments, heat from 240° to 261° or 262° was entered. They found that the air felt very hot, but still by no means to such a degree as to give pain; on the contrary, Doctor Blagden had no doubt of being able to support a much greater heat; and all the gentlemen present, who went into the room, were of the same opinion. However, after seven minutes, Doctor Blagden began to feel an oppression in his lungs, attended with a feeling of anxiety which gradually increasing for the space of a minute, led him to think it most prudent to put an end to the experiment, and he immediately left the room. His pulse, which he was unable to examine in the room, was counted as soon as he got into the cool air and found to be 144 per minute.

Experiments by Doctor Dobson (45) showed that air temperatures up to 224° could be borne for from 10 to 20 minutes by different persons without a great rise in body temperature. His conclusions were that the human body keeps nearly its own temperature in a stove heated to 224°, or may even pass without injury into air heated to a much greater degree.

In 1842 Claude Bernard (46) began experiments to determine the mechanism of death under the action of heat. These experiments were not written up until 1878, when he published the results of later studies. The first result he observed from his experiments was that animals can not live indefinitely in a temperature higher than that of their body. They all die but not in the same length of time; in general the larger the mass of the animal, the quicker the death. On the other hand, the class of animal has an influence; birds are more sensitive to the toxic influence of heat than are mammalia.

OTHER FACTORS MODIFYING THE ACTION OF VARIOUS TEMPERATURES ON THE BODY

The effects of abnormal air temperatures on the human body are modified by other factors, such as humidity, air motion, exercise, physical condition of persons exposed, food eaten, clothing worn, and individual idiosyncrasy.

The fact that much higher temperatures can be borne when the air is dry than when it is humid is, of course, common knowledge. Fordyce (45), in 1775, assigned two reasons for this—that dry air does not communicate its heat like air saturated with moisture, and that the evaporation from the body, which takes place when the air is dry, assists its living powers in producing cold. Bernard (46) found that in humid temperature death follows in a much shorter time and at a lower temperature than in dry air, provided that the temperature is higher than that of the body of the animal. However, he claimed that death results because the animal is in the physical condition most favorable for heating, but not from the fact of evaporation from the surface of the body.

In regard to the effects of heat on workmen in sugar refineries in the summer of 1892, Coplin, Bevan, and Sommer (47) found that the humidity seemed to be a most important factor. The great majority of the cases occurred in the boiler room, the air of which contained escaped steam, and in the "mixer," where the raw sugar was emptied into the melting reservoir, over which the men worked and where there was constantly present a large quantity of aqueous vapor. From the temperature records it would appear that temperatures of several degrees higher can be borne if the atmosphere is dry than if it is moist. In the boiler house the temperature varied from 120° to 124° F. with no great percentage of cases, while on the machine floor, with temperatures between 112° and 120° F., averaging 115° to 117°, with a high degree of humidity, 60 cases developed.

From some observations on the influence of high air temperatures, made in the Levant mine by Doctor Haldane in 1905 (48), it was found that in saturated air at about 80° to 93° F. the men accustomed to the mine appeared to bear the heat well and did not suffer in health, although they could do only a limited amount of work. However, visitors to the bottom parts of the mine were greatly affected by the heat. In the Dolcoath mine the subject of the experiments was unable to maintain a normal body temperature in still and saturated air at 94°, and a second experiment, at an air temperature which remained at 89° by both wet and dry bulb, was made in the same level. From this experiment it appeared that 89° F. in motionless and saturated air was slightly above the limit at which a normal regulation of body temperature occurred. A state of equilibrium was not reached, as the body temperature was still rising after two and three-quarters hours. The rectal temperature did not show any abnormal increase during rest in still air until the temperature by the wet-bulb thermometer reached about 88° F. (31° C.), provided the subjects were stripped to the waist or clad in light flannel. If, however, the wet-bulb temperature exceeded this temperature by even 1° a very marked rise in rectal temperature occurred. This was observed in each of the subjects investigated, and took place whether the air temperature was the same as the wet-bulb temperature, or 50° F. (28° C.) above it, or only 10° F. above it. It was also remarkable that the rectal temperature continued to rise, hour after hour, instead of becoming steady after a short time, as might have been expected.

Le Neve Foster, according to Young (49), observed that in still and saturated air it is hardly possible for men to do continuous work above 90° or 95° F., even when stripped to the waist. At high temperatures in saturated air the amount of work becomes less and less, though men accustomed to the heat can bear it better than others. At above 90° F. it becomes difficult to remain even without working. At 93° F. in still saturated air, although stripped to the waist and doing no work, the temperature rose 5° in two hours and was still rising rapidly when it was found necessary to come out.

Pembrey and Collis, in Appendix III of the Second Report of the Departmental Committee on Humidity and Ventilation in Cotton Weaving Sheds (35), stated that the exact temperature of wet bulb causing undue stress depends on duration and amount of work done and probably varies in individuals as some become inured to warm moist atmospheres, but that the powers of accommodation of all workers must be taxed when the wet bulb rises above 70° F.

In some studies made in the coal mines of the Saar district and Upper Silesia (50) it was found that, while subjective and objective sicknesses could not be determined and the capacity for work was not lowered, the total incapacity of the workers in coal mines, where the humidity is greater than in other mines, begins at 45 years of age, nine years earlier than with other miners.

Cadman (51) made some investigations on the effect of temperature in the mines of Great Britain. He felt quite comfortable at a temperature of 83° F. dry bulb and 66° F. wet bulb, and the men worked with shirts and vests on; but at 86° F. dry bulb and 86° wet bulb Cadman was unable to exert himself much and the men appeared to be doing little work. He concluded from his observations that the capacity of a man for work becomes seriously impaired when the wet bulb temperature exceeds 82° F., although this figure may be exceeded if a strong breeze is made to blow over the exposed skin surface of the miner, but 85° F. wet bulb may be taken as the limit. At 72° F. wet bulb, inconvenience is experienced, unless heavy clothing is removed and only light clothing is worn.

Many cases of heat prostration have occurred on board the vessels of the United States Navy, as reported by Surg. Charles N. Fiske. He reviewed the reports of the surgeons attached to the different vessels in a paper published in the Transactions of the Fifteenth International Congress on Hygiene and Demography in 1913 (52).

He stated that, on the U. S. S. *Texas*, the surgeon reported steering engine room temperatures of 110° to 115° F., and humidity so great that there was no evaporation from the body, and those of the crew who were stationed there at sea were exhausted at the end of two hours.

Higgins (53) found, in 1914, in the Comstock mines of Nevada, that at wet-bulb temperatures of from 80° to 90° F., relative humidity 100 per cent, the average miner worked only one-half to one-third of his time. In one mine four miners produced the same tonnage of ore as was produced by nine miners in a similar place in the same mine where the temperature was 10° hotter.

In some preliminary studies (54) made in the hot deep metal mines of Montana, Sayers and Harrington found in one of the mines in which the average of about 30 readings, taken at all working faces, gave a wet-bulb temperature of 93.3° F. and a dry bulb of 94.4° F., that the efficiency of the workers, although somewhat difficult to gauge, was certainly much less than 50 per cent of that of similar workers in other mines. For instance, two men at the face of a drift in this mine in still air, with 96° F. dry bulb and 94 per cent relative humidity, muck about 12 tons per shift; whereas in a drift in an adjoining mine, less than 1,000 feet away, in moving air, with 82° F. wet bulb and 92 per cent relative humidity, two men muck 30 tons or over per shift.

The following quotation from an article by Briggs on "Physical work and the human machine" (55) may be of interest in comparison with the finding by Bernard (46) that, in humid heat, death does not result entirely from lack of evaporation:

> The great reduction in efficiency of the human machine which results from a high wet-bulb temperature is accountable, then, in the first place to the difficulty of keeping down the body temperature. I wish to suggest a possible second cause, namely, that the hot, damp air may impair the passage of oxygen from the air in the lungs to the blood. A recent experience lends color to that view. A rescue brigade were exercising with breathing apparatus in a road in the Niddrie colliery. A steam pipe ran along the road; some steam was escaping, bringing the air to saturation point at a temperature of 85° F. After more than an hour's light work a halt was called and the instructor advised the men to take out their mouthpieces and rest. They did so, but very soon slipped them back again, one by one. They preferred to breathe air from the apparatus—which by that time would also be saturated and of at least as high a temperature as the outer atmosphere—rather than fresh air from the road. The air of the apparatus would contain 70 or 80 per cent of oxygen; it would, therefore, be more comfortable to inhale than normal saturated air at this high temperature if there were any difficulty in getting a proper oxygen supply from the latter. This seems to be a point calling for investigation.

In the Monthly Weather Review for December, 1920, Leonard Hill (56) stated that wet-bulb temperatures in factories and mines are physiologically much more important than dry-bulb temperatures; also, the vapor-pressure reading is much more important than the relative humidity, and the velocity of movement of the air is most important of all, for on this chiefly depends cooling by convection and evaporation.

In 1916, Bruce (57), considering moisture and temperature in relation to comfort and health, concluded that any attempts to judge conditions by means of the wet bulb alone are certainly misleading; under some conditions a wet-bulb temperature of 82° is far more endurable than one of 75°; and in any case, dew points of 70° and over give rise to most oppressive conditions.

Orenstein and Ireland (58) conducted numerous experiments in the mines of South Africa and found the kata thermometer a very much better way of investigating actual atmospheric conditions in their relation to practical problems than could possibly be obtained with the anemometer or thermometer. They found that when the cooling power of the atmosphere is below 6 units of dry kata and 16 by wet kata, the working efficiency of a native (stripped to the waist) falls off. In bad places where the cooling power is only 1.5 units (dry) and 5 (wet) or under, the average efficiency is only about 55 per cent, the body temperature rises to an undesirable degree and extreme fatigue may be produced by work.

According to Clifford (59), 15 millicalories of wet kata cooling power per square centimeter of wet surface per second may be considered as the lower limit of satisfactory conditions unless no physical work is being done, and 30 millicalories the upper limit of satisfactory conditions; the latter induces a feeling of cold and danger of chill unless the body is well clothed or physical work is being done. The best conditions are experienced at 20 to 25 millicalories, the higher figure necessitating a fair amount of clothing or the performance of physical work. At 5 millicalories the condition is extremely oppressive, inducing profuse perspiration and a severe strain on the heat regulating mechanism.

In a preliminary study made in 1922 by the United States Bureau of Mines to determine the adaptability of the kata thermometer as a measure of the comfort of working places in mines, Harrington and McElroy (60) found the indications to be that the instrument would probably be useful for making routine determinations of comfort conditions in the mines and that it might also prove an important accessory for investigative work on problems in ventilation and kindred subjects in both coal and metal mines, although it should probably be altered somewhat for maximum utility under the varied conditions in the mines of the United States. As in its present form, however, the instrument is awkward, owing to frailness and because it requires an external method of heating the fluid and the use of mixed units such as Fahrenheit scale on the instrument with the results and formulae expressed in metric units, it seems probable that a similar instrument, but measuring cooling powers at a higher temperature, can be developed for investigating temperatures above the range of the present instrument, and the results obtained by both correlated.

From a further experimental study of the use of the kata thermometer, made by the Bureau of Mines and the United States Public Health Service in cooperation with the American Society of Heating and Ventilating Engineers, McConnell and Yagloglou (61) arrived at the opinion that there is no single index of human comfort in atmospheric conditions and questioned whether any single instrument can be designed that will answer this purpose. While the wet bulb takes account of the temperature, humidity, and air motion, the main difficulty lies in estimating the relative degree of importance to be attached to these various measurements. Their final conclusion was that the kata thermometer stands in need of much more experimentation.

On account of the many factors influencing the heat production and heat loss in man, and the realization that only by a study of the relative importance and correct correlation of these factors could intelligent effort be directed toward preventing their ill effects, an investigation was started some years ago by the United States Public Health Service in cooperation with the Bureau of Mines and the American Society of Heating and Ventilating Engineers. In order to carry out the proposed investigations under carefully controlled conditions, a psychrometric chamber was constructed at the Bureau of Mines experiment station at Pittsburgh, Pa. A description of this chamber by Sayers and McConnell was published in The Nation's Health in 1923 (62).

As the temperature of the air and surrounding objects rises, the loss of heat by convection and radiation decreases. When the temperature reaches that of the body, the loss by radiation and convection ceases. Finally, as the air temperature exceeds that of the body, heat passes from the air to the body. If, on the other hand, the relative humidity is increased, the heat loss by evaporation decreases. If while the dry-bulb temperature increases, the wet-bulb temperature decreases sufficiently, the increase in loss of heat by evaporation may be made equal to the decrease in loss of heat by radiation and convection, resulting in no change in body temperature or comfort. From these premises it was concluded (63) that there must necessarily exist certain combinations of temperatures, humidities, and air motion which will produce the same total body heat loss by radiation, convection, and evaporation, and therefore the same feeling of comfort or discomfort. Any such combinations are equivalent and have been plotted as curves known as effective temperature curves.

The effect on pulse rate, body temperature, body metabolism, and feeling of comfort or discomfort at various temperatures (100 per cent humidity), with subjects at rest and at moderate work, is shown in the following table (64):

Temperature of air; relative humidity 100 per cent	Effects when at rest				Effects when at moderate work		
	Pulse rate	Body temperature	Metabolism	Remarks	Pulse rate	Body temperature	Remarks
° *F.* 98	Greatly increased.	Marked increase.	Marked increase.	Very hot, even with little clothing.	Very rapid	Marked increase.	Very hot.
95	Marked increase.	Increased	Increased	Hot, even when little clothing worn.	do	do	Do.
90	Increased	do	do	Very warm	Rapid	Increased	Hot.
85	No change	No change	Slight increase.	Warm	Increased	Slight increase.	Very warm.
75-80	Slight decrease.	Slight decrease.	Minimum metabolism.	Comfortable	Slight increase.	do	Comfortable or warm.
65-70	Decrease	do	Slight increase.	Slightly cool to comfortable.	do	do	Comfortable.
55-60	do	do	do	Cool, clothing needed for comfort.	do	do	Comfortable to cool.
45-50	do	do	Increased	do	do	do	Cool.

The following general conclusions summarize the results of this phase of the investigation:

1. Comfort, as determined by both sense and physiological reactions, depends solely upon effective temperature. At 32° the effective-temperature line coincides with the dry-bulb temperature line; hence, in this particular case, dry-bulb temperature is the only factor in determining comfort.
2. In the comfort zone, comfort depends equally upon wet-bulb and dry-bulb temperatures.
3. At about 132° the effective temperature coincides with the wet-bulb temperature, and for this case the wet-bulb temperature is the only factor.
4. Below 32° the effect of humidity is reversed—that is, the lower the humidity the greater the feeling of warmth.

In a study of ventilation problems in the United States Army, Maj. Charles Le Baron, jr., found (65) that the optimum temperature for barracks is in the neighborhood of 56° F., wet bulb, and 70° F., dry bulb, with a relative humidity of about 40 per cent.

AIR MOVEMENT

The effect of moving air in alleviating the discomfort experienced when exposed to atmospheric heat has apparently always been common knowledge. According to the Encyclopaedia Britannica

(66), fans for cooling the face have been in use in hot climates from remote ages. A bas-relief in the British Museum represents Sennacherib (King of Assyria 705–681 B. C.) with female figures carrying feather fans. Examples may be seen in the plates of the Egyptian sculptures at Thebes and other places and also in the ruins of Persepolis. In the Museum of Boulak, near Cairo, a wooden fan handle, showing holes for feathers, is still preserved. Large punkahs, or screens, moved by a servant who does nothing else, are in common use in hot countries, particularly in India. Men and women of every rank, both in China and Japan, carry fans, even artisans using them with one hand while working with the other.

Blagden (67) found that with air heated to about 260° air movement made the heat feel most intense and a blast of the heated air from a pair of bellows was scarcely to be borne.

In a summary of their studies made in metal mines, Sayers and Harrington (68) compared the effects, produced on men, of working at various temperatures with air movement and without air movement. They found that—

Remaining at rest in saturated air at 91½° for one hour,

With no air movement caused—

1. An increase in body temperature;
2. A moderate increase in pulse rate;
3. Profuse sweating;
4. After effects of dizziness and weakness.

With air movement caused—

1. Slight or no increase in body temperature;
2. Slight increase in pulse rate;
3. Slight perspiration;
4. No after effects;
5. No ill effects at any time; but the noise of the fan was annoying.

Remaining at rest in saturated air at 95° for one hour,

With no air movement caused—

1. An increase in body temperature;
2. A marked increase in pulse rate;
3. Very profuse sweating, clothing being saturated with perspiration and sweat in shoes of all subjects;
4. Dizziness on movement, and increase in depth and rate of respiration (puffing somewhat on slight movement); chilly sensations in some subjects.

With air movement (250 to 600 linear feet per minute) caused—

1. Slight or no rise in body temperature;
2. Slight or no rise in pulse rate;
3. Profuse sweating, but not sufficient to wet all clothing;
4. No untoward symptoms in subjects other than profuse sweating.

Remaining at rest in saturated air at 96°, still and moving, caused the subjects to experience symptoms practically the same as those felt in still or moving saturated air, respectively, at 95° F.

Remaining at rest in saturated air at 98½° F. for one hour,

With air movement caused—

1. An increase in body temperature;
2. An increase in pulse rate (in one case to 183);
3. Very profuse sweating, clothing being saturated (sweat could be poured from shoes);
4. Dizziness on movement. All felt that little work could be done at this temperature and that the conditions were much worse than in moving saturated air at 95°, but not as bad as moving saturated air at 100° F.

Remaining at rest in saturated air at 100° F.

With no air movement caused—

1. A marked rise in body temperature, which reached 102.3° F.;
2. A marked rise in pulse rate, varying in different subjects from 152 to more than 175;
3. Profuse sweating, the shoes being partly filled with perspiration;
4. Early appearance of dizziness, weakness, and persistence of symptoms for about one hour after test. The test was very trying.

With air movement (200 to 800 linear feet per minute) caused—All the above symptoms, and no subject remained a full hour.

The untoward effects upon man of almost saturated air with temperature above 90° F. and below 98° F. are much less when the air is moving than when it is still. Further, the output or work that can be done is greater when the air is moving than when it is still, with the above temperature and humidity.

No beneficial effects were found by moving saturated air at 98.6° or 100° F., even at high velocities; and there was apparently some disadvantage.

In continuation of the cooperative investigations carried on with the American Society of Heating and Ventilating Engineers by the Bureau of Mines and the Public Health Service on the effects of different atmospheric conditions with still air, a similar study of the reactions of human beings to air motion was made and the results were reported as follows (69):

It has been pointed out that the experiments conducted in still air indicated that the upper limit of man's ability to compensate for atmospheric conditions lies around 90° F. saturated (90° effective temperature.) Under similar conditions, but with an air velocity of 200 feet per minute, this limit is shifted to about 95° as a result of the cooling effect of the wind.

At 105° with saturated air moving at a velocity of 200 feet per minute, the average rise in body temperature is approximately 1° (or to be exact, 0.95°) higher than in still air.

The physiological reactions resulting from air moving at the rate of 400 feet per minute are much more pronounced, especially at low temperatures. It is significant to note, however, that by doubling the velocity of the air, the physiological reactions do not double in rate of change. As stated above, the rise in body temperature was 0.95° in air moving at 200 feet per minute at a temperature of 105° with a relative humidity of 100 per cent, while under the same conditions, but with the air moving at 400 feet per minute, the rise in body temperature is only 1.3°, the increase of 200 feet in velocity producing only 0.35° additional rise in temperature.

Air motion exerts a cooling effect on the human body in atmospheres where the temperature is less than that of the body; in temperatures above that of the body, air motion increases the discomfort, but the rate of change in reactions can not be doubled by doubling the velocity of the air.

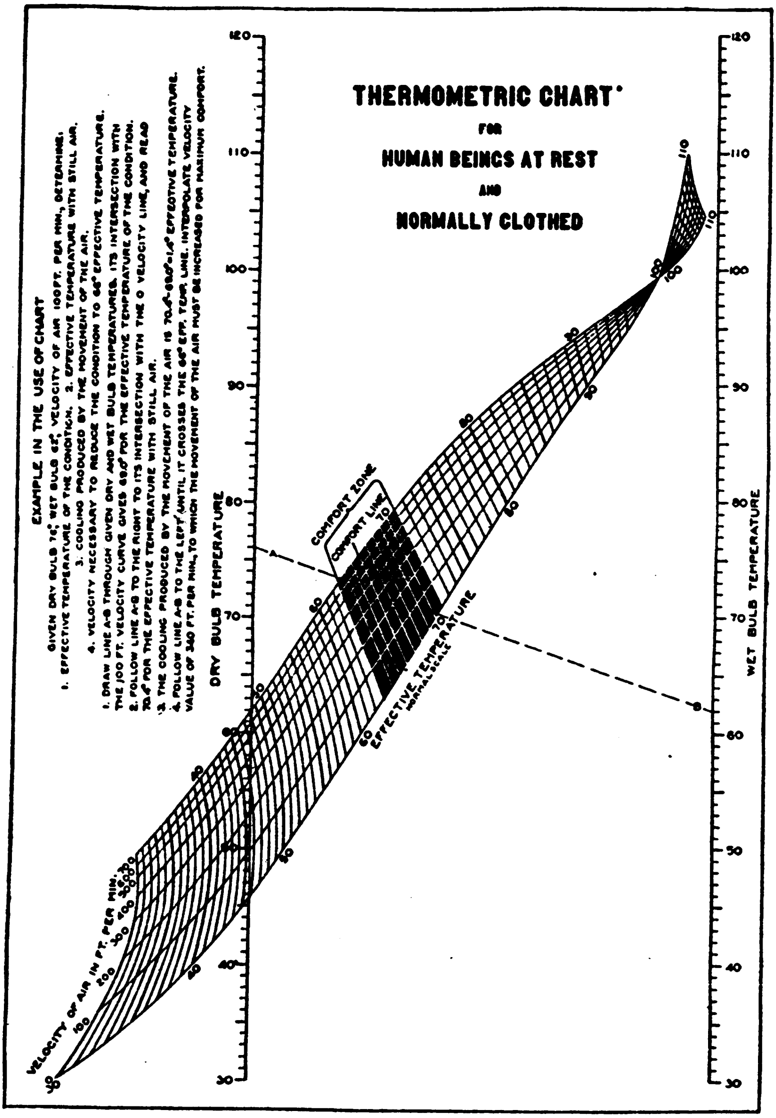

FIG. 1.—Thermometric chart

As a result of the cooperative work mentioned above, charts were prepared showing effective temperatures for different air velocities at different temperatures and humidities, as well as for still air conditions, for comparative purposes. The accompanying interpretation of one of these charts (fig. 1) is given by the authors (70):

The proximity of any point to the dry and wet bulb temperature axes indicates the superiority of one temperature over the other in determining human comfort. For ordinary temperatures the points are nearer to the dry-bulb temperature axis, while for high temperatures, when sensible evaporation comes into play, the upper part of the diagram approaches the wet bulb axis. A vertical line drawn halfway between the two temperature scales will intersect the various velocity curves at points where dry and wet bulb temperatures are of equal importance. For instance, with still air this occurs at an effective temperature of about 77°, while with a velocity of 500 feet per minute it occurs at a saturated temperature of 86.0° or at an effective temperature of 80.7°.

It will be observed that, in the lower part of the diagram the various velocity lines intersect the dry-bulb axis at temperatures at which the effect of wet bulb, or humidity of the air, is eliminated completely. Below these temperatures the divergence of the velocity lines away from the dry-bulb axis and the change in their curvature indicate a reversal in the effect of humidity; the higher the humidity the cooler the condition, and vice versa.

At high temperatures the velocity curves converge toward each other, until at body temperature they all meet at a common point called the "neutral point" in atmospheric conditions. Above this point the reversal in the order of the velocity curves with reference to the still-air curve shows the heating effect of wind upon the human body, and its increase with velocity. For temperatures higher than 120° dry bulb, but not exceeding 170°, the scale may be extended beyond the limit of the chart and the value determined in the usual manner as long as the effective temperature is below 110°.

Considering next the efficiency of air movement in cooling the human body, it will be noted that low velocities are more efficient than high. The distance between any two consecutive velocity lines is a function of the amount of cooling produced by an increase of 100 feet per minute in the velocity of the air. Therefore above 300 feet per minute the efficiency of air movement falls off considerably, and it will be inefficient in practice to use velocities greater than 300 feet per minute.

In the application of effective temperature to practical problems, where air of high temperature and comparatively low humidity is cooled, and at the same time saturated with moisture by passing it through a humidifier, Figure 1 affords a simple means of studying in detail the cooling that will result from saturation and movement of the air. In problems involving cooling or heating of the air at constant dew point, when a detailed study is contemplated, it will be desirable to introduce in the chart a scale of moisture content of the air. For clearness in reproduction this scale is not shown here, because with the chosen distance between the two vertical axes it falls outside the limits of the chart.

In some experiments made by Flinn (71), with air movement of 224 feet per minute at a temperature of 50° C., the body temperature of dogs showed very little rise the first hour (only 0.4° C.), but by the end of the four-hour exposure it had increased 2.6° C. Flinn concludes that this increase in body temperature in spite of the increased air movement is interesting in view of the fact that so much emphasis has been placed lately on air movement. There appears to him to be no doubt, if the results are interpreted correctly, that air movement must be studied from a viewpoint of evaporation. Air movement may delay the discomfort of the organism exposed to high environmental temperatures by keeping the body cool temporarily because of the increased rate of evaporation, but at the expense of the organism itself by lowering the water reserve.

EFFECT OF ABNORMAL TEMPERATURES AND HUMIDITIES ON WORKING CAPACITY AND ACCIDENT RATE

The optimum temperature of the environment most conducive to human comfort, and at which the body works most efficiently, depends upon the work performed. The greater the muscular activity, the greater the heat produced; therefore to effect the loss of this increased heat, the cooling power of the air must be correspondingly increased.

In studying conditions in the Julia mine of the Comstock Lode, Nevada, in 1880, Raymond (72) found that three men had died on account of the excessive heat, the air temperature being from 108° to 110°, and that some men wilted under the work, and were said to have "no pluck." Unaccustomed men were often unable at first even to reach the end of the drift where they were to work.

In a most interesting monograph (73), published in 1883, Lord called attention to the danger encountered by the miners who were tempted by the silver of the Comstock mines to explore their depths until they dropped dead at the stopes. Death alone had the power to say to miners: "Thus far shall ye go and no farther"! For no endurable suffering would bar their progress; nor would the loss of life even make them pause, unless the scourge of heat struck them down like a pestilence. If power drills had not been in use in the hottest working of the California and Consolidated Virginia mines during the summer of 1878, the work of exploration would probably have come to a close. To penetrate hard rock while breathing such an atmosphere would have taxed human endurance too greatly; even to cut out the decomposed feldspar with light steel picks was a painful labor. At some stopes in the great ore-body four miners could scarcely do the ordinary work of one man in a moderately cool drift; yet no mines were more carefully ventilated than these.

According to Patrizi (74) the raising of the temperature is unfavorable to muscular work in human beings, the normal heat of the blood being the most satisfactory for it. As certain poisons act more readily on heated organisms, it is to be supposed that the toxic power of the products of fatigue are also augmented in the muscles with an increased temperature.

According to the annual report of the Surgeon General of the Navy for 1909 (52), heat exhaustion was less prevalent then than it was two and three years previously, for the reason that the small cruisers with poorly ventilated firerooms had either been withdrawn from tropical service or placed out of commission. It is thought that the slight amount of physical exertion required to regulate the oil burners, as compared to that used in passing coal, enables the fireroom watch to withstand a greater elevation of temperature.

In this connection it is interesting to note that of 158 cases described by several different authors as suffering from heat exhaustion (75), there were 85 laborers, 12 teamsters, 8 carpenters, 4 firemen, 3 laundry workers, 3 housewives, 3 cooks, and 3 clerks. There were 152 males and 6 females; 116 were in the third fourth, and fifth decades, the majority of them being in the fourth; 102 were foreigners and only 45 were Americans.

In regard to the best temperatures for working efficiency, Vernon (76) concluded from a study of different occupations that probably a temperature of 60° to 65° is the most suitable for ordinary machine work. As this temperature would raise accident frequency only 6 per cent above that at 65° to 69°, it may provisionally be accepted as the practical ideal.

The question as to whether the commonly experienced disinclination to perform muscular work in a hot and humid atmosphere is accompanied by actual diminution of working power was studied by the New York State Commission on Ventilation. Also the effects of various air conditions upon mental work were considered. From this study it was found that even when men were urged to work they accomplished 28 per cent less total work in a day in an atmosphere of 86° F., 80 per cent relative humidity, than at 68° F., 50 per cent relative humidity. When left to themselves but stimulated by a bonus, they performed per man per hour in the four atmospheric conditions of 68° F., fresh air, 68° F., stagnant air, 75° F., fresh air, and 75° F., stagnant air, the decreasing series of 100, 91.1, 85.2, and 76.6 percentages of work. With mental work an individual, when urged to do his best, does as much, and does it as well, and improves as rapidly, in a hot, humid, stale, and stagnant air condition at 86° F., 80 per cent relative humidity, with no air or only recirculated air as under an optimum condition of 68° F., 50 per cent relative humidity, 45 cubic feet per person per minute of outside air introduced (77).

The Industrial Fatigue Board, in a report of an investigation (78) of the effects of external temperatures in two factories, one badly and one well ventilated, made the following comparison of the hourly outputs of an eight-hour shift for a 55-week period. For external temperatures under 40° F. the hourly output was 10 per cent above normal; it fell without interruption for each rise of 5° F. until for external temperatures of 65° and over it was 10 per cent below normal. A seasonal fluctuation of output from 9 per cent below normal in August to 9 per cent above normal in January was noticed. In a factory with good ventilation the limits of variation were from 3 per cent above to 3 per cent below normal. On the very hottest days the variation was probably as much as 30 per cent below the output of the coldest days in the ill-ventilated factory.

In the studies carried out by the Bureau of Mines and the Public Health Service in cooperation with the American Society of Heating and Ventilating Engineers, it was observed (79) that the subjects were capable of performing four times more work in a temperature of 100° with a relative humidity of 30 per cent than in a saturated condition of 100°. For the ordinary humidity of 60 per cent the subjects performed about five times more work in a temperature of 90° than in one of 120°. The rate at which the output decreases with increase in the external temperature is practically the same for all three humidities at the higher temperatures; and in the light of the experimental results, the upper limit in atmospheric conditions at which work can be performed efficiently corresponds to a dry-bulb temperature of 100° and a relative humidity of 30 per cent. As an indication of the effect of air movement upon the ability of individuals to perform work in comparatively high temperatures, it was observed that an air movement of 350 feet per minute, 60 per cent relative humidity, increased the output from 70 per cent at 90° dry bulb to 55 per cent at 110°, when the work was based on equal increase in the pulse rate, and from 26 per cent at 90° to 20 per cent at 110° when based upon equal rise in rectal temperature. In so far as the pulse rate is a better index of bodily reactions, the first estimate represents more nearly the actual benefit derived from the movement of the air. A conservative estimate may be arrived at by taking the average of the two values—namely, an increase in the output of from 50 per cent at 90° dry-bulb temperature to 40 per cent at 110°. Above 110° dry bulb the effect of air movement is rather small, because the effective temperature approaches the temperature of the body.

In tests (34) conducted in atmospheres of low temperature in still and moving air, it was found that during work at a given rate of 90,000 foot-pounds per hour, with intermittent rest periods, a temperature of 43° F., with the subjects thinly clad, was pronounced as too cold with and without air movement, regardless of humidity. On the other hand, conditions above 85° F. were found to be too warm for comfort, regardless of humidity if the air were still; but with air moving at 350 linear feet a minute, a temperature of 85° F. was found to be comfortable, even with 100 per cent relative humidity.

In connection with the above investigations, observations were made regarding the extent to which clothing decreases the cooling power of the air in such temperatures as are frequently met with in actual practice. At the ordinary dry-bulb temperature of 70°, a velocity of 300 feet per minute produces a cooling effect of about 5°

on the human body when clothed, and 10.5° when stripped to the waist. Therefore, clothing under these conditions reduces the cooling effect by 52 per cent. Approximately the same percentage reduction holds true for velocities higher than 300 feet. For lower velocities the decrease in cooling effect due to clothing is still greater. For example, with a velocity of 100 feet per minute, at 70° F., the corresponding decrease in cooling is 66 per cent. As the temperature of the air increases, the percentage reduction in cooling decreases slightly, varying from a maximum of 50 per cent to a minimum of 40 per cent.

In general, it can be stated that normal clothing at ordinary humidity halves the cooling effect of wind as compared with that obtained when only light work trousers, socks, and shoes are worn. The importance of stripping to the waist is therefore apparent when high cooling power of the air is desired, provided that the temperature conditions do not exceed certain prescribed limits. On the other hand, clothing in a number of instances is advantageous in increasing loss of heat by evaporation and decreasing heat gain by radiation and convection. This is particularly true when very high dry-bulb temperatures are accompanied by humidities below 20 per cent, and when the wet-bulb temperature is well below 99°. In fact, man is capable in such cases of increasing evaporation materially by suitable clothing. An elastic cotton union suit which will cover tightly as much of the body's surface as possible constitutes an ideal outfit for exposure to dry, hot atmospheres. The excessive perspiration, most of which runs down and off the body in the case of a man stripped to the waist, and thus is rendered unavailable for evaporation, is absorbed by the cotton garment and distributed uniformly over the entire surface by capillary action. This method of exposure eliminates the burning effect upon the areas of the body which otherwise become dry, while other parts of the body's surface are cooled adequately by the evaporation of abundant perspiration.

The effects of exposure to low temperatures are qualified by clothing worn and by exercise. As stated above (79), normal clothing at ordinary humidity halves the cooling effect of wind as compared with that obtained with the subject stripped to the waist. It is too well known to need verification that, due to increased heat production, the greater the exercise, the lower the temperature that can be borne. According to the experience of the Antarctic explorers, as recorded by Doctor Cook (32), no temperature was too low to prevent outside work as long as the air was still.

At rest in still air with a temperature of 65° to 70° and with 100 per cent relative humidity, subjects stripped to the waist felt from "slightly cool" to "comfortable"; under these same conditions with moderately hard work, they felt "comfortable." At rest in still air with temperatures from 55° to 60°, 100 per cent relative humidity, clothing was required for comfort, while at moderately hard work under these conditions the subjects were "comfortable" to "cool" stripped to the waist, and at 45° to 50° subjects working moderately hard felt cool stripped to the waist (64).

The high and low extremes of temperature at which death takes place vary according to individual idiosyncrasy and also according to whether the heat or cold is dry or moist. Exposure of a rabbit for 55 minutes to moist air at 101.66° F. raised its body temperature to 109.4° F. (38). The ordinary human being can exist for only a few hours in a temperature of 110° F. and 100 per cent relative humidity (80). No direct statement was found in the literature as to the air conditions and the length of exposure required to raise the body temperature to the fatal point. In experimenting to determine the temperature at which death takes place by refrigeration, Lefèvre (39) found that a rabbit died when the rectal temperature had fallen to between 60° and 65° F. The rectal temperature of 60° F. was reached after exposure of the rabbit to a bath of 50° F. for 61 minutes. Schäfer (38) mentioned cases in which exposure to cold, especially of drunken persons, had reduced the body temperature to 75° F. Although unconscious when found, the victims recovered. In other cases, with body temperatures (rectal) of 83°, 80.6°, and 79.5° F. death followed in about 24 hours. Storm Van Leewuen (81) showed that cooling tends to reduce the reflex irritability of the spinal cord. This reduction becomes very marked at a body temperature of 78.8° F.; which may explain why this temperature approximates the lowest compatible with life.

According to Hope (78), accidents in factories show a seasonal fluctuation similar to that shown in percentage of output, as they are more frequent in summer and under bad conditions of ventilation than in winter and under good conditions of ventilation. An exception occurs, however, in very cold weather if the temperature falls too low, more accidents occurring from slipping of tools, etc., if the hands become too cold. He mentioned that in a fuse factory the accidents were at a minimum at temperatures between 60° and 69° F. Above these temperatures there was a slight and progressive increase with rise of temperature, but with lower temperatures there was a well-marked increase, so that, in the case of women, there were two and a half times as many accidents when the external temperature was at or below freezing than when it was 47° F. or over, and the accidents among the men were twice as numerous. This result is largely due to the numbing effect of cold on the hands, especially when cold metal tools have to be held in them; but there is also a numbing effect on the brain.

From data collected in two munitions factories and a projectile factory on industrial accidents in relation to temperature, Vernon (76) observed that in both men and women the minimum accident frequency was at 65° to 69°. At lower temperatures it gradually increased to a similar extent in men and women, till at 50° to 54° it was 35 per cent greater than at 65° to 69°. At temperatures below 49° the frequency fell off slightly. This fall may have been due to the fact that the workers were too cold to keep up their usual rate of production. In such a case they would expose themselves to less risk of accident. At temperatures above 65° to 69° the accident frequency showed only a slight rise in the women, but in the men it increased rapidly; and at temperatures above 75° it was 39 per cent greater than at 65° to 69°. Probably this difference was due to the fact that the work of the men was often of a heavier character than that of the women, and the greater the exertion required the more trying must be the effect of exposure to high temperatures.

One of the most striking results of the installation of a cooling plant in the Morro Velho Mine (82) was the fall in the accident rate. In the 16 months (August, 1919, to November, 1920, inclusive) previous to the starting up of the plant there occurred 20 deaths through underground accidents and 4 cases of disablement, the total liability for compensation involved in connection with these accidents being 80,675 milreis. In the following 16 months (December, 1920, to March, 1922, inclusive) there were six fatal accidents underground and four cases of disablement, the amount of compensation involved being 35,820 milreis.

Raymond (72) was of the opinion that sometimes accidental deaths might be the indirect result of the faintness caused by the effect of the heat on the circulation, giving as an example the case of a man who fell down an upcast shaft, probably because he was overcome by the heat while putting in timbers.

While the deleterious physiological effects of increased moisture and temperature are of themselves sufficient argument for improvement of such conditions, there are many other points that must be considered (83). According to Lauder Brunton (84), one of the most important conditions influencing both chemical and pharmacological reactions is temperature.

Reed (83) considered that a moderate increase of temperature—within physiological limits—would augment the action of drugs, whether harmful or not.

In a study on the effects of exposure to low concentrations of carbon monoxide, Sayers and his coworkers (85) found that high temperature and humidity, with a given concentration of carbon monoxide, caused more rapid combination of carbon monoxide with hemoglobin than did normal conditions of temperature and humidity.

Murray (86) found, during his investigation of the mining of lead in Utah, conducted over a number of years, that heat and humidity may also predispose to lead poisoning, as the men work with little clothing and even stripped to the waist. In such cases a large part of the body surface is exposed to lead-laden dust. Men working under the conditions cited are usually perspiring profusely, which exposes them to possible absorption of soluble salts of lead through the skin. Then, too, unless care is exercised in bathing after each shift lead dust accumulated on the body becomes dry and further exposure to inhaled and ingested lead dust is afforded in changing clothes and in sleeping quarters.

Physiological Action of Abnormal Temperatures and Humidities

HIGH TEMPERATURES

The results of exposure to high atmospheric temperatures and humidities may be considered as acute and chronic. The acute condition is referred to as sunstroke when it results from exposure to the direct rays of the sun and heat stroke or heat exhaustion when the heat is from some other source or only indirectly due to the sun. In the case of heat stroke, the temperature of the body rises and there are signs of congestion and nervous irritation; in heat exhaustion, there are pallor, fainting, and collapse. Heat stroke is the commoner form. Although sometimes caused by the direct rays of the sun, it is much more frequently produced by the combination of high temperature and excessive moisture in a confined space (87).

According to Fiske (52) the etiology and incipiency of heat exhaustion need not be at variance with those of sunstroke, except in intensity; the assumption is tenable that in sunstroke the factors are so fulminating and of such an overwhelming character that heat production and loss are promptly deranged, whereas the symptoms of heat exhaustion represent the sustaining and finally failing efforts upon the part of the human body to overcome its adverse environment.

SUBJECTIVE SYMPTOMS

Doctor Coplin, who in 1892 was requested by the management of a sugar refinery to attend professionally the workmen therein who were suffering from the high temperatures, aggravated by the extreme heat outside, reported (47) that the most constant symptom and the one of which the patients complained most was "cramp," usually referred to the region immediately below the ensiform appendix, not infrequently associated with similar pains in the calves of the legs, occasionally in the back, sometimes also in the hypogastrium, less commonly in the thighs and upper extremities. There was also difficulty of respiration and a feeling as of a weight on the chest. Occasionally there was pain in the splenic or hepatic region and in nearly all cases sharp and throbbing headache, temporal or supra-orbital, rarely occipital. In some cases nausea was present, but vomiting rarely occurred. In a few cases diarrhea was present, but in the majority constipation preceded the attack. As a rule the patients felt cool, not infrequently chilly, when brought out of the intense heat. In a number of cases in which the temperature ranged about 105° F. a blanket felt comfortable. Consciousness began to waver at 106° F., the patients felt sick at the stomach and attempted to vomit. There was a feeling of fatigue. The desire to urinate was constant, although often no urine was voided. Great thirst was experienced. Removal from the extreme heat was often followed by a gradual return of the temperature to the normal, and only weakness, entirely disproportionate to the other symptoms, remained.

Dizziness, physical weakness, or exhaustion to a marked degree, inability to think quickly or accurately, and nausea and headache were observed by Sayers and Harrington (54) in still air in metal mines, with a wet-bulb temperature over 90° F. and under 100° F., and with a relative humidity of 89 per cent or higher, even when little or no exercise was taken.

According to Johnson's experience (75) the onset of heat exhaustion is almost always sudden, but frequently there are prodromal symptoms for a few hours or a few days before an attack. These consist in general depression, headache, malaise, dizziness, anorexia, nausea and vomiting, diarrhea, epigastric distress, restlessness, insomnia, and great thirst (polydipsia). Convulsions may be present and the temperature may be normal, subnormal, or greatly elevated.

Watkins claimed (88) that the ill effects of disturbance of heat equilibrium do not become manifest solely in acute illness, such as heat stroke or heat exhaustion, but also in chronic affections, such as diminished resistance to fatigue and disease and lowered physical efficiency. Workers exposed to heat hazard eventually drop out because of decreased working powers, poor health, or some degenerative disease for which predisposition has been created by reason of the working conditions. The effects of long-continued exposure to this hazard are slow and insidious and are evidenced in degenerative changes, such as arthritic and muscular rheumatism, chronic skin disorders, and arteriosclerosis. In addition, long-continued exposure to excessive heat will gradually but surely lower the general physical tone, even if no disease conditions become evident.

The acute manifestations of exposure to excessive heat, as given by Kober and Hayhurst (89), are colic, concentrated urine, and muscular cramps, which symptoms are more or less influenced by toxins generated within the body; cases of "colds"; and anemia and general debility are also quite common in this class of workers. Any abrupt change in temperature is likely to cause congestion of internal organs; hence the undue frequency of catarrhal, neuralgic, and rheumatic affections among imprudent workers. These congestions not infrequently also result in gastrointestinal and vesical catarrh, and pave the way for pneumonia, pleurisy, and Bright's disease. Nervous affections, such as headache, dizziness, and general irritability, are also observed.

In the studies by the Bureau of Mines and the Public Health Service, in cooperation with the American Society of Heating and Ventilating Engineers (90), the subjects who frequently on entering the chamber were in a happy mood and of a joking disposition soon became restless and irritable. They complained of headache and palpitation of the heart. The headache soon became throbbing in nature, and the palpitation distressing. Great thirst was experienced. The eyes became inflamed and sore. A feeling as of a weight on the chest was noticed. The voice suffered somewhat in that it became an effort to speak. Dizziness and confusion followed. After leaving the chamber it was necessary to sit down and rest for 5 or 10 minutes before taking a shower. Weakness and a "dragged out" feeling continued for some time, depending upon the severity of the test. A metallic taste was a noticeable symptom, and persisted for one or two hours following the high temperature experiments.

OBJECTIVE SYMPTOMS

Bernard (46) found in his animal experiments that exposure to the "toxic effects of heat" produced a series of constant and characteristic symptoms. The animal was at first slightly agitated, soon the respiration and circulation were accelerated, the animal opened its mouth and panted, and it soon became impossible to count the respiratory movements; finally it fell in convulsions and died, more often suddenly, uttering cries. If the temperature was elevated enough, death followed so suddenly that the animal seemed struck by lightning.

Coplin (47) observed the following objective symptoms in patients suffering from the effects of exposure to high temperatures: Agitation, jerky muscular movements, skin pale, usually cold and clammy with the temperature below 102° or 103° F., surface temperature rarely high, in a fatal case the axilla temperature being only 105° while the rectal was 108°; sluggish response of pupils to light, but not in accommodation, eyes vacantly fixed, lids moving slowly and infrequently; the voice often sepulchral. This condition passes into delirium, occasionally active and sometimes fierce and uncontrollable, during which convulsive movements may occur, usually in the extremities but later may involve the muscles of the trunk, more particularly those of the back, and occasionally those of the respiration, giving rise to interference with breathing and to cyanosis. The patient swallows with difficulty if at all. Speech is jerky, skin and lips are pale, conjunctiva brilliant, ears cold, finger nails blue or of an ashen whiteness. The cardiac impulse is diffused as though the ventricles were distended and the organ laboring. The pulse is "floody," a term coined to express the condition; to the finger it is like a sudden flood of blood coursing in the channel of the vessel and disappearing upon the slightest pressure. Irregularity in the pulse and in the cardiac rhythm is a constant feature. Ordinarily there is no increase in the intensity of the heart's sounds, certainly no accentuation. The urine is scanty and high-colored, and when the pyrexia becomes excessive, albumin may be present temporarily in small quantities.

The objective symptoms observed by Sayers and Harrington (54) were a rise in body temperature, in one case reaching 102° F. after less than two hours spent in hot, humid air; an increase in pulse rate, which seemed more sensitive to exercise than normally; very profuse perspiration; loss of weight, especially marked in men who had been employed under conditions of high temperatures and humidities over a period of years but occurring even after exposure only for a few days.

Johnson (75) considered that the physical findings depended upon the degree of trauma, a patient suffering from collapse, without a tremendous initial rise of temperature, greatly resembling a person in a state of shock. He quoted Edsall as saying that the spasms and twitchings of the muscles were due to faulty metabolism within the muscles themselves, and not to central irritation.

Sir Thomas Oliver, who went to Hungary to study the question of ancylostomiasis, incidentally noticed the high temperatures to which the workers were subjected in the Sopron-Brennberg mines (91). The men work practically without any clothing. The day's work was eight hours, but the men could work only four hours. Owing to the high temperature the men were obliged to rest and to come out of the working into the main ways for air. As a consequence of working in high temperatures the Sopron miners seemed prematurely old, and the men were all thin and of spare body. A large number of them suffered from functional and organic disease of the heart. The effects of working in high-temperature mines were throbbing of the head, increased frequency of the pulse, discomfort in breathing, and physical exhaustion.

Body temperature.—The average temperature of a normal man is around 98.4° F. While the range in normal temperature is less than 2°, a much wider range has been observed in certain pathological conditions. According to Schäfer (38), even in those warm-blooded animals that possess a perfect power of heat regulation there are limits to this power. If the animal be exposed to excessive cold, the loss of heat is great, and only within certain limits can compensation be effected by an increased production of heat. When compensation fails, then the animal's temperature falls, its bodily and mental activities are diminished, and it passes into a sleepy, unconscious condition which ends in death. Such a condition is observed in men or animals before they are "frozen to death." On the other hand, extreme heat can be resisted only within a certain range; the production of heat in the body can be diminished, but not suspended; the loss of heat can be greatly increased by sweating and by a greater exposure of blood in the vessels of the skin, but if the air be of a temperature equal to, or nearly equal to, that of the body, and greatly laden with moisture, then the loss of heat is slight or even suspended. Under such circumstances the internal temperature of the animal rises rapidly to a point incompatible with life.

Thompson (92) mentioned cases of recovery from insolation in which the body temperature was 111° F., 112° F., and 115° F.; but a case which sustained for some time a temperature of 117.8° had a fatal issue. He observed that in favorable cases under treatment the maximum temperature was sustained for only a few moments and the rate might fall 2° or 3° F. every 15 minutes. However, after very high temperatures—above 106° or 107° F.—there was a return of the rise of temperature later in the day or on the following day to 102° or 103° F., and a mild remittent fever might last for a few days or a week.

Haldane (48), as a result of 24 experiments on the effects of high temperatures and humidities on body temperature, found that in proportion as the temperature rose beyond 88° F. by wet bulb the rise of the rectal temperature became more and more rapid. Thus, at 89° to 90° F. wet bulb the rise was about 1° to 1.4° F. per hour; at about 94° F. the rise was about 2° F. per hour; and at 98° F. the rise was about 4° F. per hour. In moving air (with the wet bulb still below the body temperature) a higher wet-bulb temperature could be borne without abnormal rise of rectal temperature. Thus, in an air current of about 170 linear feet (51 meters) per minute a wet-bulb temperature up to about 93° F. could be borne without abnormal rise of body temperature. During muscular work in still air the limit of wet-bulb temperature which could be borne without abnormal rise of body temperature was much lower. Thus, during leisurely climbing work (13 feet per minute) the limit for a person stripped to the waist was about 78° F., or 10° F. lower than that during rest; and with harder work this limit would certainly be lower. At a wet-bulb temperature of about 87° the rectal temperature rose about 3.5° F. in an hour. In an air current of about 135 linear feet per minute a wet-bulb temperature of about 85° could be borne without abnormal rise of body temperature, but 87° was beyond the limit.

In their investigations conducted in the hot mines of Montana, Sayers and Harrington (68) found that the temperature of a fairly typical subject showed increases above normal after an hour spent in still saturated air as follows: At 95° there was an increase of 1.4° in body temperature; at 96° an increase of 2.3°; and at 100° an increase of 3.4°. With saturated air moving 300 to 700 feet per minute, the temperature of the same subject rose 0.6° at 95°, 1.1° at 96°, 1.9° at 98½°, and 1.8° at 100°. The temperature of the subject in the 100° air temperature apparently did not have time to go to the higher limits as he was able to remain in this atmosphere for only 49 minutes instead of an hour as in the other tests.

Flinn (71) found, in experiments with dogs, that during a six-hour period of exposure to a temperature of 104° F., 80° F. wet bulb, there was a rise of 1° in body temperature, the rise being confined to the first and last two-hour periods. When the temperature was raised to 113° F. or 122° F.,[3] a very marked rise in rectal temperature was noted, and apparently this rise began at once. In fact it was so sharp that the body temperature rose within an hour, in some cases to such a height that it was not deemed safe to let the dog remain in the heat for a longer period. When air movement at the rate of 224 feet per minute was introduced at an air temperature of 122° F. the body temperature showed very little rise the first hour, amounting only to 0.4° C. By the end of the four-hour exposure it had increased by 2.6° C.[3]

Pulse rate and blood pressure.—The following data on the increase in pulse rate experienced in high temperatures are mentioned by Raymond (72) as having been obtained by Professor Whitney and Professor Church in the 1,800-foot level of the Julia mine of the Comstock Lode, Nev., in an air temperature of 108° to 110°: A carman, after bringing out a car about 1,200 feet had a pulse rate of 140 per minute, which fell to 64 after a rest at the station. Professor Whitney's pulse rose from 60, his normal rate, to 120 after walking through the drift.

Sonntag (93) found that there seemed to be a definite relation between the pulse rate and the area of the skin available for cooling, that is, if a part of the body was immersed in water at a temperature above that of the skin zero, a certain amount of heat loss was prevented, so that more loss must take place through the rest of the skin. The heart beat quickened so as to drive the blood more rapidly through the available skin area, and these actions were

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[3] While the humidity is not given, it is presumed to be the same as that mentioned in the first sentence of this paragraph.

correlated by the nervous system, resulting in the increased pulse rate.

Judging from the various observations recorded by him, Haldane (48) concluded that the increase in pulse rate was usually about 20 beats per minute for each 1° F. of increase in rectal temperature, or 36 beats for each 1° C. while the subject was standing in the warm air, the increase being about a fourth less in the sitting posture. On return to cool air there was, however, an immediate drop in the pulse rate, so that the increase in the pulse rate was only about 10 per minute per 1° F. of increased rectal temperature in the standing position, and 8 beats sitting. The increase in pulse rate thus depended not merely on the rectal temperature but also on the external (wet bulb) temperature.

Palmer (94) found that a change even as little as from 68° to 75° produced in a very short time a visible reaction in the body mechanism. In a 75° atmosphere the pulse in one series of experiments rose from 79 in the morning to 89 in the late afternoon, an increase of 10 beats per minute. At 68° the pulse rate of the same subjects fell from 83 to 70 in the course of the day, a drop of 13 beats. The warmer room thus placed upon the heart the added strain of 23 beats per minute.

According to Johnson (75) the pulse rate corresponds roughly to the temperature; with a temperature of 110° F. or over, the pulse rate is from 150 to 180, and with continued hyperpyrexia it becomes imperceptible.

In the cooperative study conducted by the Bureau of Mines, the Public Health Service, and the American Society of Heating and Ventilating Engineers (95) the importance of the circulatory system was emphasized by experiments in which subjects were exposed to abnormal atmospheric conditions. These investigations led to the conclusion that the pulse rate would be selected as probably the best index of discomfort due to high temperature, if a single physiological measure were the basis of consideration. Investigators have long recognized that the body temperature alone is not the cause of the discomfort and their conclusions as a whole correspond with those of Haldane, who stated that the discomforts produced by high temperatures undoubtedly depend to some extent on other causes than the rise of body temperature, as indicated by the rectal temperature. It frequently happened in these experiments that the rectal temperature rose slightly after leaving the chamber, but the subject, nevertheless, felt more comfortable with the fall in pulse rate. Though no arbitrary rate at which certain symptoms occur has been determined, the consensus of opinion indicates that very uncomfortable sensations are felt after the pulse rate exceeds 135 per minute, and the atmospheric condition becomes unbearable and the subject desires to leave the chamber immediately when the rate exceeds 160 per minute. Several experiments revealed the fact that some subjects attained a high pulse rate much sooner than others who were exposed to the same conditions, and therefore were compelled to leave the chamber sooner. In one instance a man attained a pulse rate of 160 in 10 minutes, while another remained in the chamber 35 minutes before the pulse reached 180. In the next experiment one attained a pulse rate of 160 per minute in 55 minutes, while another remained 1½ hours and the pulse reached only 156 pulsations per minute. In a third experiment the pulse of one reached 142 in 25 minutes, while the pulse of another reached 156 in 45 minutes. The pulse rate rapidly diminished after the subject left the test chamber.

In a study (96) on the effect of exposure of the nude human body to a current of hot desiccated air having a temperature of approximately 80° to 85° C. (176° to 185° F.) five subjects, three men and two women, all showed a definite increase in pulse rate, but the greatest increase took place in the case of the two women who were very fat; the rate in one case increased 23 beats after 22 minutes' exposure and in the other 34 beats after an exposure of 73 minutes.

The rise in blood pressure no doubt contributes to the discomfort. At 30 per cent relative humidity the change begins around 120° F.; at 60 per cent, around 104° F.; and at 100 per cent, around 92° F. Subjects describe (93) the sensation felt on reaching the unbearable condition as follows: First, a slight palpitation of the heart occurs, which increases in severity until a feeling of floating in the air is experienced. This is accompanied by dizziness, and frequently with a numbness or soreness of the face, and with nausea.

The New York State Ventilation Commission (77), as a result of their studies on the effect of various temperatures and humidities on the heart rate, pulse rate, and blood pressure, found that exposure of subjects to an atmosphere of 20° C. (68° F.) and a relative humidity of 50 per cent for a period of from four to eight hours was accompanied by a decrease in the rate of the heart, averaging 11 beats per minute when the body was in the reclining position and 18 beats when in the standing position. At a temperature of 24° C. (75° F.), 50 per cent relative humidity, there was only a negligible change in the heart rate; at 30° C. (86° F.), 80 per cent relative humidity, there was an increase in the rate of the heart in the standing position, and in the reclining position a negligible average decrease. Exposure to a temperature of 38° C. (100.5° F.), average humidity of 86 per cent, for a period of 2.43 hours was accompanied by an average increase in the rate of the heart of 28 beats per minute, or 43 per cent, the average maximum increase being 41 beats, or 63 per cent. When the experimental subjects increased the rate of the heart beat by performing physical work in the two atmospheres of 20° C. (68° F.) and 24° C. (75° F.), the humidities being the same, the return of the heart to the original rate was slightly earlier in the cooler air. The systolic and diastolic blood pressures of the experimental subjects in the three moderate atmospheric conditions studied exhibited no marked changes; but subjection of an individual to the more extreme condition of 38.3° C. (101° F.), 87 per cent humidity, for 2.5 hours was accompanied by an average increase of systolic pressure, amounting to 12.6 mm., or 12 per cent, and of diastolic pressure of 1.4 mm., or 2 per cent, the respective average maxima being 22 and 16 per cent.

According to Martin (97), it is not necessary to look beyond the mammalian heart itself to account for the quick pulse of fever; no theoretical assumption of any paralysis of inhibitory or any excitation of accelerator cardio-extrinsic nerve centers is required. The experiments show that, in spite of its highly developed extrinsic nervous apparatuses, the heart of the mammal does, so far as its rhythm is concerned, in its own nervo-muscular tissues, respond to temperature variations within wide limits (42°–27° C.—80°–108° F.), just as the frog's heart or the heart of the embryo chick does.

Sedgwick (98) mentioned the fact that, while physiologists were not agreed as to the effects upon reflex actions of changes in temperature, it was generally known that protoplasm, from almost complete inactivity at a low temperature, passes with a gradual rise of temperature little by little into a phase of greatest activity beyond which under excessive heat its functions fall rather quickly back to zero, or if the temperature be raised still higher, pass beyond and disappear with the occurrence of coagulation and death. He found from experiments that the heart, obeying the laws of protoplasm, always beats faster when fed with heated blood. An increase in heart rate due to increased accelerator tone, caused by increased temperature of the carotid blood, was noted by Moorhouse (99) in experiments on dogs.

The vasomotor response to high temperatures seems to be more delicate than that of the heart or respiratory mechanism, judging from the increase of blood in the periphery (99).

In the efforts of the body to defend itself against overheating, evaporation of water from the lungs and skin as well as direct radiation and conduction of heat from the surface of the body is involved (100). Both evaporation and radiation are favored by an increased blood flow through the skin. According to the older views, vasomotor shifts of blood to the surface at the expense of the interior were chiefly responsible for the increased surface blood flow, but it now appears that the value of these shifts may be much enhanced by augmented blood volume, brought about by rapid dilution (101).

The water thus made available serves in the evaporation and radiation processes.

Light upon the heat-regulating mechanism from this angle is shed by the recent work of Kestner and his collaborators upon the effects of exercise. They have shown that marked exertion with sweating dilutes the blood, as indicated by diminished hemoglobin content and red blood cell count. Gross and Kestner (102) showed further that this stream of fluid into the blood is associated with an increased rather than a decreased protein content.

Before leaving the question of increased blood flow in warm environments it may be pointed out that with very high environmental temperatures it would be of advantage to have a diminished blood flow through the skin rather than an increased blood flow, thus protecting the body to a certain extent in a manner precisely similar to that in which it is protected against excessive cold. Put in another way, increased surface blood flow promotes poikilothermia, because it facilitates the conduction of heat either to or from the body. In this connection Berti (103) has shown that very high temperature may produce vasoconstriction. Under conditions of extremely high temperature there is also a tendency to increase the coagulability of the blood, the greater viscosity probably hindering the flow through the surface (104).

Exposure to high temperatures increases the loss of carbon dioxide from the blood through the skin and lungs. This lowering of the carbon dioxide tension increases the hydrogen ion concentration of the blood and ultimately leads to an excretion of alkali from the blood. The carbon dioxide dissociation curve of the blood is not significantly altered. The peripheral blood vessels are greatly dilated during exposure to high temperatures, and this dilatation continues indefinitely. The lack of high resistance in the peripheral blood vessels prevents blood from returning to the heart. The heart rate increases steadily and rapidly, and is even able to increase the systolic blood pressure. In spite of this compensating activity on the part of the heart, the blood flow back to the heart finally becomes inadequate. At this point circulatory failure or shock is complete, with faintness. The rise in skin temperature seems to play the initiatory part in the control of the respiratory and circulatory reactions (105).

In addition to the effects on the circulation of the blood, high temperatures also seem to react on the blood itself. In response to the heat stimulation, the blood apparently is diluted by a protein-salt solution flowing from the tissues into the blood (106, 107). Young and his coworkers (108) found that a small concentration of the blood plasma takes place when considerable loss of water is suffered by the body; the estimation of the refractive index gave such constant results as to warrant the conclusion that a definite concentration of the blood takes place as the result of copious sweating. Sayers and McConnell (95) found that the hemoglobin concentration increased proportionately with the amount of weight lost.

The results of studies of Barbour and Hamilton (109) on heat regulation are of interest in connection with the question of blood concentration in persons exposed to heat. They concluded that increased blood concentration was clearly established by previous investigations (109, 110) as one of the constant protective responses of the body to environmental cold, that this concentration is quick and reversible and is, therefore, not due to hematopoiesis, and that the evidence that fluid is shifted in and out of the blood stream in heat regulation is strengthened by the result that the serum became diluted in the hot room part of the experiment, thus confirming their numerous experiments on man which indicated that the phase of blood dilution in response to warm environment, the solids, nitrogen, and specific gravity of the serum, dimishes. After determining that cold anhydremia is not merely relative but due to actual loss of fluid from the blood, they sought for the reservoirs where this fluid might be stored. From experiments on dogs (111) they found that the skin, subcutaneous tissue, and muscles formed such reservoirs, and they concluded that this accumulation of water in and under the skin in the regulation against cold may be of considerable value. The significance of loss of fluid from the actively-circulating blood has been repeatedly emphasized as a means of facilitating the reduction of the peripheral blood flow to save heat. This fluid which leaves the blood serves the additional function of increasing the thickness of the insulating tissues. Contained undoubtedly in small cutaneous and subcutaneous vesicles, it can not carry heat by convection and is, hence, as good an emergency insulator as could be found within the body. The "suit of clothes" which protects those regions in which blood now actively circulates is thus further padded by water.

Moss's investigations (112) among miners lead him to conclude that during work in high temperatures some of the men suffered from a great shortage of chlorides in the blood, caused by a combination of excessive sweating and drinking of water, with attacks of "cramps" resulting. He did not feel that the sweating alone could be responsible for the shortage, since the tendency would be toward a concentration of chloride in the blood, but thought that the excessive drinking of water by miners, due probably to the dryness of the mouth and throat, tended to dilute the blood until in some of the men examined the excretion of chlorides by the kidneys showed a very marked decrease from normal despite the enormous excess of urine passed. In order to relieve "cramps" and also fatigue, Moss recommended the addition of salt to the water drunk by the miners.

He found from experiments that 10 grams of sodium chloride to a gallon of water helped some of the miners while others did not seem to get any benefit. Further experiments conducted by him point to the efficacy of using in the drinking water a mixture of sodium and potassium chloride in the proportion of 60 per cent of the former to 40 per cent of the latter, instead of pure sodium chloride. It appears that a number of miners working in the hottest district in Pendleton Pit take a small amount of cream of tartar (potassium bitartrate) in the drinking water as a cramp preventive, which indicates the value of potassium salt in keeping the body properly balanced physiologically.

According to Pemberton (113), who studied for some years the changes accruing from the exposure of the body to external heat in the form of radiation from electric lamps, exposure of the body to the therapeutic application of external heat results in a heightened blood flow, an increased metabolism, and in the elimination of acids, chiefly carbon dioxide, which escapes through the lungs, urine, and sweat, in amount in the order of means of escape named. This leaves an excess of alkali in the blood, which then changes its reaction, becoming more alkaline. In the compensatory effort to meet this situation, the excess of alkali is eliminated through the sweat and urine. The profound nature of the changes introduced by these measures is clearly indicated, and explanation is afforded of some of the painful consequences which follow their uncritical use. If carried to extremes, tetany may result. The available evidence indicates that part of the benefit of the sweat process in some forms of nephritis is due to loss of acid substances from the body, with consequent benefit to the acidosis frequently accompanying renal disease.

The total concentration of sweat is less than the total concentration of blood (114). The chloride concentration is less than that of blood, and the acidity is always greater than that of the blood. Nevertheless, the chloride and acidity are probably influenced by the composition of the blood, for the sweat is more concentrated in chloride and in alkali after the blood has become concentrated and more alkaline. McConnell and Sayers (90) report that the rate of secretion of sweat mounts rapidly with increased wet-bulb temperature, and is proportional to the number of degrees of temperature above 91° F. The sweat becomes less acid as its secretion continues. The secretions from the chest and arms are more acid than those from the face. The range of acidity found does not depart greatly from neutrality. It is usually between neutrality and the slight alkalinity characteristic of the blood. The most dilute sweat occurred at the beginning of a test. The most dilute sweat contained 0.03 M. chloride, equivalent to 0.17 per cent sodium chloride. The most concentrated, approximately the same for all subjects, was about

0.08 M. Reliable results could be obtained only from samples collected in conditions of 100 per cent relative humidity, for otherwise the sweat was concentrated by evaporation. The salinity and alkalinity are roughly proportional to each other. Sweat from the chest is of higher concentration than that from the arms and face.

An individual in whom the absence of sweat glands had been demonstrated by microscopic examination was studied with reference to the elimination of heat and water vapor (115). At rest a normal quantity of water vapor was liberated. Of this less than 30 per cent came from the lungs and the remainder from the skin. Vaporization of water from the skin independent of the sweat glands was thereby demonstrated. The quantity of water so eliminated was sufficient in combination with heat lost in other ways to keep the body temperature within safe limits, even with exercise which increased the metabolism, for a period of 35 minutes to two and a half times the resting value. During this exercise the elimination of water did not increase as in a normal individual and the body temperature rose somewhat higher. With exposure to external heat there was no increase in the quantity of water vaporized, and the body temperature rose sharply. The study of this patient confirms the theory that the sweat glands constitute an emergency apparatus which is called upon only under exceptional conditions.

In a paper published by Mitchell (116) upon the effects of damp heat (90° to 100° F. dry bulb, and wet bulb within 5° F. of this) observed by him in the Persian Gulf and elsewhere, the statement was made that "damp heat" of itself frequently produced an alteration of the blood, visible only as anemia, and that this alteration was primarily responsible for the difficulties encountered in the treatment of other conditions. He thought that if this alteration in the blood could be thoroughly investigated by elaborate chemical and bacteriological methods, a remedy, probably preventive in nature, might be found for the large amount of disease which proves so intractable in such climates. Wickline (117), who made a study of the blood cells in American troops incidental to the complete physical examination made at intervals during residence in the Philippines, found that there was a marked increase in the relative and absolute number of mononuclear blood units, the increase being at the expense of the polymorphonuclear leucocytes. There was no marked changed in the total white cell count. Chamberlain (118) later confirmed and extended the findings of Wickline. Murphy and Sturm (119) pointed out the large number of lymphocytes found in the circulation apparently in the process of an amitotic division. They said that after heating there is a large increase in what appears to be normal circulating lymphocytes of both the large and small type, but that it was impossible to say where they had arisen, although probably from stimulation of the lymphoid centers. According to Nakahara (120) a striking number of mitotic figures have been observed in the germinal center of the spleen and lymph glands during the regeneration of the cellular elements of these organs after the destructive effect of heat. This enhanced cell proliferation is interpreted as more than compensating for the degenerated cells, because of the subsequent enlargement of the organs. It has also been pointed out that the characteristic decrease in the number of lymphocytes immediately after the heat treatment is always accompanied by an extensive cell degeneration in spleen and lymph glands at the corresponding period. On this basis it seems evident that the pronounced lymphocytosis induced by means of heat treatment of the animal is due, at least in part, to the enhanced proliferative activity of germinal centers in the spleen and lymph glands, reacting to the destructive effect of heat upon lymphoid cells.

Respiration.—With increasing humidity it is noted that at high temperatures the respiration frequency increases so much that care must be taken not to expose oneself for a long time to a very high temperature. The connection of the increased decomposition of foodstuffs with the increased work in breathing is sufficiently expressed in the increase of total heat production which from 69.3 cal. at 9.0 per cent relative humidity reaches 70.9 cal. at 16 per cent and 75.5 at 30 per cent relative humidity (44). Haldane (48) found that hyperpnea was not noticeable until the rectal temperature exceeded 102° F.; at 103° it was marked during muscular work, and distinctly noticeable during rest. According to Sihler (121) respirations grow more shallow instead of deeper in warm moist air. In the case of lower animals, rates of 300 per minute and over have been observed (122) with the thermometer 100° to 104° in the shade. Lee and Eastman (77) observed that when a young man was confined for a period of 2.43 hours in an atmosphere which reached an average temperature of 100.5° F. and an average relative humidity of 86 per cent, the rate of respiration per minute increased from an average of 23 to an average of 31.2, a percentage increase of 35. The average of the maxima of the several experiments was 42. McConnell, Houghton, and Yagloglou (69) report that, in experiments conducted by them with subjects at rest, the respiratory rate did not noticeably increase during the test, except in extreme conditions. In the moderately warm experiments the respiratory rate frequently diminishes. In the extreme conditions the air is too hot to inhale through the nostrils and necessitates oral breathing. The subject apparently seeks relief through respiration, but on inhalation he finds no relief and immediately exhales, so that the result is a series of short, irregular respirations. It is doubtful whether the ventilation of the lungs is increased under these conditions. In tests where the air is not too hot, and permits of nasal breathing, all subjects were able to hold their breath longer than in cooler atmospheres. In the extreme conditions, if the subject's attention is called to his rapid breathing, and he is asked to breathe slower, he invariably does so. On the other hand, on leaving the test chamber, the respirations increased in depth and number. A certain amount of relief is experienced in so doing, and the subject continues to breathe rapidly and deeply until he is relieved of the symptoms of discomfort he has just experienced.

Loss of weight.—According to McConnell and Sayers (95), the loss of weight varied with the individual, the heavier and stouter man losing more than the lighter and thinner one. Notwithstanding this, the lighter man, as a rule, could not endure the temperature conditions as long, and complained more of the exhaustion which followed. The conclusion, however, that all stout men can stand heat better than thinner ones is unwarranted, because only a few men, neither very thin nor very stout, were subjects of the experiments. The loss in weight gradually increased with an increase in atmospheric temperature. Whenever the subject drank ice water he immediately gained in weight. In any case the subject usually regained the entire weight lost within 24 hours. Benedict and coworkers (97) observed the following effect on body weight of exposure of the nude human body to a current of hot air having a temperature of approximately 176° to 185° F.: There was a loss in body weight of from 220 to 660 grams per hour, this loss in general being greater the larger the individual. The length of exposure to the hot air also undoubtedly played some rôle. The normal loss of a nude human being in room air would be about 40 to 50 grams per hour. Hence the loss due to exposure to hot air would be five to thirteen times greater. This increased loss is due almost exclusively to the increase in visible perspiration. Measurements of the oxygen consumption show that it probably represents only a minor increase in the oxidation of body tissue.

Body metabolism.—The increased body metabolism of inhabitants living in cold climates as compared with that for persons living in warmer climates is frequently referred to in the literature. Contrary to what might be expected, metabolism also increases with exposure to high temperatures. Both the carbon dioxide output and the oxygen consumed increase with exposure to either higher or lower temperature than the normal atmospheric condition. The investigations by the Bureau of Mines in cooperation with the Public Health Service and the American Society of Heating and Ventilating Engineers (123) indicate that there is a temperature zone of minimum metabolism, between 75° and 83° effective temperature, within which a lowest value of 36 calories per square meter per hour is reached. These investigators believe that basal metabolism should be measured within this zone. This is substantiated from results of various other investigators who recorded values well below the DuBois standard, depending upon the temperature in which the observations were made. The rate of gaseous exchange is practically constant within a temperature zone between 70° and 85° effective temperature. Above and below this zone both quantities increase at an accelerated rate. At the normal temperature of 65° effective temperature the figures show an average of 7.3 liters of carbon dioxide expired and 7.7 liters of oxygen (O_2) consumed per square meter of body surface per hour. This corresponds to a respiratory quotient of 0.948. A tendency for an increase in heat production is also shown below 65° effective temperature, which is necessary to keep the body warm in cold weather.

Experiments carried on, with the subject naked, to determine the secretion of carbon dioxide by the skin and its dependence on temperature, according to Schierbeck (124), indicated that at a temperature of 30° to 33° C., with complete rest, the amount of carbon dioxide excreted was about 35 to 40 mg. per hour; but if the temperature went higher than 33° C. the excretion of carbon dioxide suddenly began to increase so that at 34°, which seemed to be a critical point, the carbon dioxide secretion through the skin suddenly increased very greatly. At a temperature of 33° C. the subject felt pleasantly warm, as he would have felt normally when clothed, and showed no perspiration. At higher temperatures the skin was always covered with sweat and the subject felt unpleasantly warm. The increase in carbon dioxide secretion began suddenly at the same temperature at which sweat broke out on the surface of the skin. Of course this point would probably vary with different individuals. The amount of carbon dioxide excreted from the skin in 24 hours must certainly not be less than about 8 grams. It was found that clothing *per se* had no influence on the secretion of carbon dioxide, except that the secretion took place sooner with increased temperature with clothing than without clothing.

Von Willebrand (125) carried out some experiments, with the object of studying more closely the physiological processes mentioned by Schierbeck and others, from which he concluded that the secretion of water through the skin, when the body is at complete rest, increases slowly in proportion to the temperature of the surrounding air while the same goes up from 12° C. to the point at which sweat breaks forth. The secretion of carbon dioxide through the skin remains unchanged during complete rest at a temperature from 20° to 33° C., being about 7 or 8 grams in 24 hours. However, when the temperature reaches the point at which sweat appears (about 33° C.) the carbon dioxide excretion suddenly increases to three or four times this amount. From his experiments von Willebrand favored the hypothesis that the invisible secretion of water takes place mostly through "evaporation" from the surface of the skin, but in the literature at his disposal he found no explanation of the manner in which the secretion of carbon dioxide occurs through the skin. However, he assumed that the carbon dioxide present in the blood is diffused through the fine capillary vessels and then through the epithelium. At low temperatures this takes place uniformly and slowly. But when the sweat glands are activated by higher temperatures, they may be considered as producing carbon dioxide in greater quantity.

As the greater number of observations of reaction of animal body to varying temperatures has been carried on under artificial conditions, Osborne (122) made experiments under more normal conditions, out of doors at an altitude of about 150 feet above sea level, from which he concluded that if the air is dry and in motion it will tend to desiccate the skin, but that there must be a limit to the extent of desiccation, as the skin can be injured easily owing to the fact that many of its physical properties depend on the water of imbibition which it contains. If, however, the normal state of imbibition of the skin be maintained by vaso-dilation of the peripheral vessels and by perspiration, the heat loss will become excessive if the air temperature is well below that of the body. In such conditions if the body is to preserve its constant temperature with constant metabolism, the skin will be injured. If body temperature and skin imbibition are to be maintained constant, then the metabolism must be augmented. What apparently occurs is a compromise between the two extremes; the skin loses some of its water of imbibition and the metabolism undergoes a moderate rise. This increased demand on the metabolism of the body when the wind is cold, dry, and in motion, may be one of the causes of the proverbial unpopularity of the east wind in northwest Europe.

Mayer (126) found by experiments with reef corals from Tortugas, Fla., that if the rate of consumption of oxygen be taken as a measure of the metabolism of the corals, it appears that the metabolic activity bears an inverse ratio to the corals' ability to withstand the effects of carbonic acid, and their ability to resist high temperature follows nearly the same law. It seems possible, therefore, that, under the influence of high temperature, carbonic acid may accumulate in the tissues faster than it can be eliminated, and, acids being toxic, would soon cause death. He recalled that Blackman (127) and Harvey (128) advanced the theory that some enzyme might be destroyed by the excessive heat, and, being essential to nerve conduction, its loss caused the rate to decline. Mayer (126), however, thought it possible that some toxic-acid substance might be formed under the influence of excessive heat, its rate of formation being commensurate with the metabolism of the tissues, and that acid of this sort might be eliminated and the rate gradually restored when the animal was replaced in normal sea water, whereas if an enzyme were destroyed it might not so readily be replaced. He felt that one or other of these hypotheses was more in accord with the facts than Winterstein's (129) asphyxiation theory, or the theory that death occurs at too low a temperature for coagulation in most if not all proteids, and when killed, the animals are fully relaxed, as shown by Harvey. Also, coagulated proteins could not be eliminated readily when the animal was restored to water at normal temperature, coagulation being a practically nonreversible process.

Bernard thought that the cause of death from exposure to high temperature was due to the action of heat on the muscular element (46), heat very evidently being a stimulus for the muscular system of the organic life. However, according to him, there is a limit which can not be passed, and excess of heat ends by stopping the muscles of the heart as the other muscles, and, here as always, that which is a vital physiological agent becomes a toxic agent when its action is pushed to the extreme. Thus, if the temperature is raised too much, the heart beats, after becoming more and more rapid, suddenly cease. In the same way the peristaltic movements of the intestine completely cease if subjected to heat beyond a certain limit. In these cases it is death complete, absolute, inevitable, that seizes the muscular tissue; and, in fact, in case of animals killed by heat, the heart is absolutely insensible to all excitation, and finally cadaveric rigidity takes place with extreme rapidity. Bernard's first thought was to search for the cause of these phenomena as being of purely chemical nature. It appeared to him very possible, or at least probable that a real coagulation of the myeline takes place and that this is the cause of the death of the muscular element and of the heart in particular. It is, then, the loss of the vital properties of this element that, by producing rigidity, arrests the circulation and respiration and causes death. Bernard believed that this destruction of the contractile element takes place at about 37°–39° C. with cold-blooded animals, at about 43°–44° C. with mammals, and at about 48°–50° C. with birds, that is to say, in general, at some degrees above the normal temperature of the animal.

In a study to determine the influence of the local bath upon fatigue of voluntary and involuntary muscle, Patrizi (74) found that below 46° C. no modification from normal was produced by heat and that it was not possible to raise the heat much above this as the pain was intolerable, but there was an essential change at 46° to 47° C. The modification of the type of curve traced by the ergograph was more marked in those with heat traced without the interference of the will; that is, with the direct electric irritation of the muscles. He considered that this peculiarity confirmed anew the fact found by Mosso (130) that the muscle, independent of the nerves and brain, has a manner entirely its own of exhausting its energy and that certain phenomena of fatigue, which were believed to be of central origin, must be imputed to the periphery. The margin of adaptation of the muscle to a temperature lower than that of the body, according to Patrizi, is even more extensive than that for heat.

Fletcher and Hopkins (131) called attention to the large increase in the yield of lactic acid as the result of heating and also as a result of contractions of excised muscles, but the amount of acid attainable by severe direct stimulation is not more than about one-half that reached in the production of full heat rigor (at 40°–45° C.).

According to Lee and Scott (132) the results of their studies seemed to indicate that the disinclination to perform muscular work rests upon a greater physiological basis than a cerebral condition only, whether this be merely a relative cerebral anemia or an additional depression of cerebral activity through toxic metabolic products. Besides an effect on the nervous system, the capacities of the muscles themselves are diminished. Hence, excessive muscular work, a whipping-up of the muscles, would tend toward early muscular exhaustion, and thus we have additional physiological justification for maintaining that with human beings who are obliged to labor in an atmosphere of extreme heat and humidity excessive and continuous muscular labor should be avoided.

The effect of cold on body temperature up to the point of death from freezing is described in Lefèvre's "law of refrigeration" as follows (39):

1. *The law of peripheral homothermism.*—With a subject exposed to refrigeration below 25°, the cutaneous covering, after an initial rapid decrease of temperature, speedily adapts itself and remains sensibly homothermic by becoming stable between 18° and 27°, according to the refrigerating temperature.

2. *Law of the central poikilothermism.*—In these same refrigerations, when they are prolonged, the sub-aponeurotic regions, for a time homothermes (initial hyperthermism), quickly give up their heat to the peripheral regions to aid them against the attack of the cold (cutaneous hyperemia) and tend to become lower during the rest of the refrigeration.

3. *Law of internal poikilothermic uniformity.*—During this time, the thermic oscillations of the different sub-aponeurotic regions are parallel. There does not seem to be any privileged region, for the fat itself, the warmest of the viscera, submits to the common law, and has reached in this second phase a sensible poikilothermic depression equal to that of the rectum and the muscular coat.

4. *Law of thermogenetic excitation "in extremis."*—When the temperature of the body has descended to the vicinity of 30° or 32°, the decrease is considerably retarded by a supreme effort of thermogenetic resistance.

5. *Law of the final generalized poikilothermism.*—But when the refrigeration has been severe enough and of long enough duration to lower the temperature of the body to the level of the temperature of its peripheral covering, that is to say about 25°, the poikilothermic depression becomes general, all the temperature peripheral or internal, fall simultaneously.

6. *Law of progressive thermic equalization.*—Finally, the initial topographic inequality of the peripheral and internal regions disappears then little by little; all the curves tend toward the horizontal of 25° by progressive but general fall of subaponeurotic temperatures.

7. *General law of the thermic depression in four periods.*—The refrigeration then goes through four phases, as follows:

a. Peripheral poikilothermism with internal homothermism (first phase of thermogenetic excitation);

b. Peripheral homothermism between 18° and 27°, with rapid internal poikilothermism, up to the vicinity of 30° or 32°;

c. Slowing of the internal poikilothermism with tendency toward a new central homothermism (second phase of thermogenetic excitation) to 25°;

d. Final generalized poikilothermism, rapidly carrying the organism from 25° to the fatal temperature.

Thus, up to the end, even in these intense and prolonged refrigerations, the warm blooded animal has been able to escape the common laws of refrigeration; it preserves its discipline and its own reactions, even though it is going to succumb to the cold.

Measures for the Prevention of Ill Effects of Exposure to High Temperatures

PERSONAL HYGIENE

In his "Manual of the Diseases of Warm Climates," Manson (26), in calling attention to the part played by hygienic living in enabling people to adjust themselves to excessive temperatures without untoward effects, stated that the healthy human body, when untrammeled by unsuitable clothing, when not exhausted by fatigue or excesses, when not clogged by surfeit of food, by alcoholic drinks, or by drugs, can support with impunity very high temperatures. In many parts of the world men live and work out of doors in temperatures of 100° or even 120° F. Many industries are carried on at temperatures far above this—glass blowing, sugar boiling, for example. The stokers of steamers, especially in the tropics, discharge for hours their arduous duties in a temperature often above 150° F. When, however, the physiological activities have become impaired by disease, especially by heart disease, kidney, liver, or brain disease, by malaria, by alcoholic or other excesses, by fatigue, by living in overcrowded rooms, or when the body is oppressed by unsuitable clothing, or a combination of some of these, then high atmospheric temperatures are badly supported, the enervation of the heart may fail, and syncope may ensue. However, according to Kober (89), while the human organism endeavors to adapt itself to extremes of heat and cold, the facility of the body to maintain the equilibrium is by no means unlimited, and the heat-regulating center is liable to fail, or become paralyzed if imposed upon too long or too frequently. Kober's statement agrees with that made by Harrington and Richardson (133) that, if people can take reasonable care of themselves, and do not give way to excesses in any form, as in drinking, eating, or working, they will live as healthily in Manila as in New Orleans or St. Louis or New York; but they can not withstand the effects of any tropical climate for long without an occasional visit to the temperate zone, for prolonged residence brings about an undoubted deterioration of the system in spite of all possible care.

The wearing of proper clothing is of importance in the prevention of the ill effects of subjection to extremes of temperature, either climatic or industrial. Clothing aids the human body in maintaining its constant temperature (134). Air is entangled and rendered stationary within its cellular structure and between its layers, thus insulating the body against heat loss. The loss of heat by radiation and convection is reduced considerably through a decrease in the surface temperature, but the heat loss by evaporation may, under certain conditions, increase because of the greater surface afforded by the clothing. The rate at which clothing transfers heat through it depends upon the material, condition of the same with respect to moisture, thickness, and size of its meshes. When dry, cotton or woolen clothes of the same thickness and size of mesh are equally good; but when wet, woolen clothes prevent heat loss much better than cotton. In general, it can be stated that other things being equal, the rate at which clothing transfers heat depends upon the amount of air within its meshes and between its layers. In general, normal clothing at ordinary humidity halves the cooling effect of wind as compared with that obtained when only light work trousers, socks, and shoes are worn. The importance of stripping to the waist is therefore apparent when high cooling power of the air is desired, provided that the temperature conditions do not exceed certain prescribed limits. On the other hand, clothing in a number of instances is advantageous in increasing loss of heat by evaporation and decreasing heat gain by radiation and convection. This is particularly true when very high dry-bulb temperatures are accompanied by humidities below 20 per cent, and when the wet-bulb temperature is well below 99°. In fact, man is capable in such cases of increasing evaporation materially by suitable clothing. An elastic cotton union suit which will cover tightly as much of the body's surface as possible constitutes an ideal outfit for exposure to hot atmospheres. The excessive perspiration, most of which runs down and off the body in the case of a man stripped to the waist, and thus rendered unavailable for evaporation, is absorbed by the cotton garment and distributed uniformly over the entire surface by capillary action. This method of exposure eliminates the burning effect upon the areas of the body which become dry, while other parts of the body's surface are cooled adequately by the evaporation of abundant perspiration. Clothing should never be removed when the wet-bulb temperature exceeds the temperature of the body. The air in such cases should be kept as still as possible, and the more the clothing the greater the insulation against transfer of heat from the air to the body.

Leonard Hill (135) blames custom and fashion for imposing on people clothing which is either unsuitable in character or too much. According to him the great error is lack of ventilation. Too heavy clothing is less of an evil than badly ventilated clothing, because the latter provokes excessive sweating and leaves the skin needlessly long in active state. Clothing should allow great adaptability of the body to change in temperature. It should not provoke sweating in the resting subject in still air at too low a temperature, e. g., at 27° instead of 30°. For extreme cold, such as experienced by Arctic travelers, a light waterproof and wind-proof flexible outer cover should be worn with a thick layer of air-holding, fluffy material beneath. For tropical heat Hill recommends an open-meshed, cellular, cotton or linen garment, if the skin is tanned. To prevent sunburn in the untanned, a garment should be worn of close enough mesh to prevent penetration of the sun's rays—a single flapping sunproof white robe, loose enough to be well ventilated.

VENTILATION

Hygienic living and the wearing of proper clothing are of more importance in the prevention of the ill effects of heat due to climatic conditions than in the case of exposure to heat in industrial work. One reason for this is that in industry the temperature usually may be regulated by proper ventilation or by refrigeration. Of course, some time in the future, homes and business establishments may have a cooling system for the summer as they now have a heating system for the winter. At present, ventilation is the most feasible method, although there are a few instances in which refrigeration is being used, as in the St. John del Rey mine in Brazil. To secure good working conditions in a deep mine, action should be taken to keep the effective temperature below 80° F. Read and Houghton (136) have indicated the difficulty of doing this, as the temperature and humidity of the incoming air of a mine will depend upon the climate of the region in which it is situated; in some cases it will vary widely from day to day and month to month, in others it will vary but little. As air descends the shaft of a deep mine two things usually happen. The first is that the temperature of the air increases continuously with depth, and the second is that the moisture content of the air also increases. The temperature of the air increases with depth for two reasons, and one, perhaps the more important, is seldom recognized, the observed effects being usually ascribed to the other. It is an accepted fact that air currents on the earth's surface become cooler when they rise, and warmer when they sink. The increase in temperature due to sinking arises from the fact that the compression of the air by reason of the greater pressure to which it is subjected with depth, produces heat, just as heat is produced in the cylinders of an air compressor. The air is not a good conductor of heat and also usually has little opportunity to give off this heat to its surroundings, so that on being subjected to increased pressures its temperature increases (adiabatic compression).

The temperature rise due to adiabatic compression is important, because it is independent of the quantity of the air circulation, being only a function of depth. It makes no difference whether 10,000 cubic feet per minute or 100,000 cubic feet per minute are being circulated, it will rise 5½° F. for every 1,000 feet in depth unless the heat due to compression is disposed of otherwise than by raising the sensible heat of the air. The heat release by the rock walls is dependent on the area exposed and the conductivity of the rock; when these two factors are known, the quantity of air to be passed can be regulated so as to give any desired rise in the sensible heat of the air. If the moisture content of the air current will permit and if enough moisture is available for evaporation, the whole heat release may be taken care of as latent heat, without any increase in sensible heat. It is interesting to note in this connection that in many coal mines it is necessary to guard against the drying out of the dust, and the downcast air is therefore sometimes humidified, which greatly decreases its cooling power. Where the effective temperature of the ventilating current is so high that its cooling power for man approaches zero, no practicable increase in velocity will suffice to raise the cooling power to a satisfactory figure, and the only practicable method is to lower the effective temperature. It has been shown that this can best be done by decreasing the moisture content of the air, a refrigerating plant being used for this purpose in the one instance in which it has been attempted.

The one instance, referred to by Read and Houghten, is that of the cooling plant installed in the Morro Velho mine of the John del Rey Mining Co. of Brazil. In this plant, as described by Davies (137), the downcast air is passed through two large Heenan air-coolers, and from these it enters the mine at a temperature of about 43° F. It was decided that it would not be safe to put any of these installations down the mine. Since the mine is an almost absolutely dry one, there was no fear of a great quantity of moisture being picked up; the scheme would not work in a wet mine. The average dry-bulb temperature at the surface now is approximately 68° F., and it is being reduced to 43°, a drop of 25° on the surface; and as the strata around the airways become cooler, that temperature drop should be reached approximately throughout the mine.

In a paper devoted to industrial applications of the experimental facts developed in the cooperative studies conducted by the Bureau of Mines, the Public Health Service, and the American Society of Heating and Ventilating Engineers, Yagloglou and Miller (70) expressed the opinion that, in cases where air motion produces considerable cooling, it is the simplest and most inexpensive method available, but that at high temperatures the benefit derived from movement of the air is small, and steps should be taken to reduce the effective temperature by other means prior to setting the air in motion. One of the most important principles of air conditioning is manifested in the cooling produced by the evaporation of water. When air partly saturated comes in contact with water, as, for instance, by passing it through a humidifier, a certain amount of heat is absorbed from the air in the process of evaporation, effecting an appreciable lowering in the temperature of the air. The wet-bulb temperature remains the same if no heat is added to or subtracted from the system, the sensible heat of the air being transformed to latent heat. Ultimately the dry-bulb temperature of the air is reduced to that of the wet bulb when the air becomes completely saturated. In addition to the cooling obtained from the evaporation of water, the effect of air movement reaches a maximum value at saturation, and an enormous amount of cooling results from the combination of the two. This method of artificial cooling is very promising to many hot operations in industries where the humidity of the air is not very high. The air is simply saturated and blown upon the workers. The process involves the use of simple and inexpensive equipment as compared with refrigeration, such as humidifiers and fans.

The benefits of increased efficiency on the part of the workers, which, in turn, means increased output, and therefore greater financial return, to be derived from proper ventilation of working places have been described by various authors. According to Collis and Greenwood (138), energy which should be devoted to muscular work is wasted when it is diverted to cooling the body by sweating; and the aim of industrial ventilation should be to stimulate the desire for physical work, the desire for healthy activity. The employer by having regard to this physiological fact in arranging ventilation will secure greater efficiency and output; the worker, by working in a healthy atmosphere, will have increased comfort, enjoy better health, and do more work with less fatigue.

In his bulletin on Underground Ventilation at Butte (139), Harrington discussed the financial aspects of effective ventilation in mines, the summary of which is given below:

Continuance of unfavorable working conditions underground results in impaired health for mine workers and in immense financial loss to operators. In a section of a mine having unusually poor ventilation and high temperature and humidity a bonus of 25 cents a day over the regular wage was paid, the working shift was reduced from eight to seven hours, and while one man worked his partner sat under a compressed air hose to cool and to recuperate. The maximum efficiency of the worker, who had to be a man of exceptional endurance, was much less than 50 per cent, probably not over 30 per cent, yet he received a bonus of 12½ per cent in reduced length of shift and an increase of 25 cents per shift in pay.

A 30 per cent loss of efficiency, due to defective mine ventilation, among men working underground at Butte is probably a conservative estimate, but, figured for each of the 13,000 underground workers in 1917 and 1918, with a wage of $5.75 per shift, this loss amounts daily to $22,425.

The excessive use of compressed air by workers in poorly ventilated places in an attempt to secure relief constitutes a heavy economic loss. In most of the mines investigated workers were utilizing compressed air in over half the places visited, and it was estimated that in some mines the compressed-air blowers consumed at least 5,000 cubic feet of air per minute. It is a conservative estimate that in the 30 or more large mines of Butte at least 50,000 cubic feet of compressed air per minute was used for blowers, all of which could be eliminated by efficient ventilation. The cost per month in compressing 50,000 cubic feet of air per minute during two eight-hour shifts daily runs well over $30,000. A far greater financial loss, however, is sustained in the decreased efficiency of compressed-air drilling machines through using air at 30 to 40 pounds pressure per square inch. If the drills were the only consumers of compressed air, the working pressure would be 60 to 80 pounds.

The cost of providing adequate ventilation in the mines of Butte can be only roughly estimated. Coal mines are ventilated generally at a cost less than 2 cents per ton of coal produced; on that basis to ventilate the mines of Butte, which produced approximately 6,000,000 tons of ore in 1917 and 1918, would cost $120,000 annually. For a few years at least, however, the cost might run as high as 5 cents per ton, as so little has been done in the past toward providing air currents at working faces; this rate would involve about $300,000 annually, based on the 1917 and 1918 tonnages. Approximately 4,000 horsepower probably would be needed to drive the necessary fans and blowers, at a power cost of $2.50 per horsepower per month, or $120,000 per year; in each of the 30 representative mines there should be at least one man whose entire attention should be devoted to ventilation; their salaries would amount to about $75,000 per year. Repairs, interest, and depreciation on electrical installations would amount to about $100,000 per year.

Summary

1. Temperature and humidity, according to the literature, are the two most important atmospheric conditions that affect the health and efficiency of people in their living and working places.

2. The belief that the ill effects experienced from exposure to crowded conditions in inclosed spaces were generally due to gaseous constituents of the air has been proved false by experiments conducted by numerous investigators. It then was thought that perhaps there were organic poisonous substances exhaled by people; this also has been proved by experimentation to be erroneous and the part played by high temperature and humidity was finally recognized.

3. Abnormal temperatures and humidities are encountered through seasonal changes in the Temperate Zones and with changing elevations in tropical climates. The large degree of conformity in the mortality curve of the cities and States throughout the world during different periods of time seem clearly to prove that there is some definite relation of weather to disease. The effects of high temperatures encountered in seasonal variation in the Temperate Zones are considered acute, many sudden deaths occurring during certain periods of excessively hot weather, while the effects of exposure to a tropical climate are more chronic.

4. The literature in regard to the action of cold on animals is very meager. Extreme cold seems to be borne better by the human organism than extreme heat; this is partly due to the fact that the effects of cold can be mitigated by artificial control. Explorers in Antarctic regions found that in still weather no temperature was low enough to prevent outdoor work but that it was impossible to exist outside for any length of time at very low temperatures when the wind was blowing.

5. In regard to the relation of sex and age to susceptibility to abnormal atmospheric conditions, women appear to react more readily than men, and children and old persons are more easily affected. Men between 30 and 40 are said to be best adapted to endure the rigors of Arctic exploration.

6. A few of the large number of occupations which require exposure to extreme heat, humidity, and variations in temperature are listed.

7. The source or cause of animal heat was an unsolved mystery to the ancients. They had no thermometers and their knowledge of the constant heat of the human body was imperfect. A scientific attitude toward the subject was developed through contributions from time to time of knowledge obtained by various investigators, who finally determined that animal heat is the result of processes of combustion within the body.

8. It has been determined by observation that there is a limit to the heat-regulating power of the body and that an animal can not live indefinitely in a temperature higher than that of its body; according to Bernard, the larger the mass of the animal the quicker the death. Remaining at rest in saturated air at 91½° F. for one hour with no air movement caused an increase in body temperature.

9. The effects on the human body of abnormal air temperatures are modified by humidity, air motion, exercise, physical condition of persons exposed, food eaten, clothing worn, and individual idiosyncrasy.

(*a*) Humidity increases the discomfort and ill effects of both high and low temperature. Comfort, as determined by both sense and physiological reactions, depends solely upon effective temperature.

At 32° the effective-temperature line coincides with the dry-bulb temperature line; hence, in this particular case, dry-bulb temperature is the only factor in determining comfort. In the comfort zone, comfort depends equally upon wet-bulb and dry-bulb temperatures. At about 132° the effective temperature coincides with the wet-bulb temperature, and for this case the wet-bulb temperature is the only factor. Below 32° the effect of humidity is reversed—that is, the lower the humidity the greater the feeling of warmth.

(*b*) The limiting physiological reaction caused by high temperatures, as determined by comfort, is not body temperature but the pulse rate. When this is above 135 the first symptoms of discomfort arise; when above 160 the effects are severe to distressing.

(*c*) Air movement decreases the discomfort of high temperatures below 98° F.; moving saturated air above 98° F. was found to be of no benefit and, apparently, is even disadvantageous. A thermometric chart is given showing effective temperatures for different air velocities at different temperatures and humidities, as well as for still air conditions.

(*d*) The upper limit in atmospheric conditions at which work can be performed efficiently corresponds to a dry-bulb temperature of 100° and a relative humidity of 30 per cent, or 90° or 95° F. in still saturated air, even when stripped to the waist. The optimum temperature at rest is around 66° F.; and with hard work the optimum temperature is 59.5°; 43° F. was pronounced as too cold with or without air movement, regardless of humidity. In still air no temperature is too low to prevent outdoor work.

(*e*) Normal clothing at ordinary humidity was found to halve the cooling effect of wind as compared with that obtained with the subject stripped to the waist. On the other hand, clothing under certain conditions is advantageous in increasing loss of heat by evaporation and decreasing heat gain by radiation and convection; in fact, man is capable of increasing evaporation materially by suitable clothing. At rest in still air with a temperature of 65° to 70° and with 100 per cent relative humidity, subjects stripped to the waist felt from "slightly cool" to "comfortable"; under these same conditions with moderately hard work, they felt "comfortable." At rest in still air with temperatures from 55° to 60°, 100 per cent relative humidity, clothing was required for comfort, while at moderatly hard work under these conditions the subjects were "comfortable" to "cool" stripped to the waist, and at 45° to 50° subjects working moderately hard felt "cool" stripped to the waist.

10. Death generally takes place when the body temperature is raised to between 109° and 113° F., although no direct statement was found in the literature as to the air conditions and the length of exposure required to raise the body temperature to the fatal point.

The lowest body temperature compatible with life is said to be 78.8° F., although Lefèvre found that a rabbit died when the temperature of the rectum had fallen to between 60° and 65° F.

11. According to one observer, the minimum accident frequency in factory work in both men and women was at 65° and 69° F. At lower air temperatures it gradually increased to a similar extent in men and women till at 50° to 54° it was 35 per cent greater than at 65° to 69°. At temperatures below 49° the frequency fell off slightly. This fall may have been due to the workers being too cold to keep up their usual rate of production. In such a case they would expose themselves to less risk of accident. At temperatures above 65° to 69° the accident frequency showed only a slight rise in the women, but in the men it increased rapidly, and at temperatures above 75° it was 39 per cent greater than at 65° to 69°. Probably this difference was due to the fact that the work of the men was often of a heavier character than that of the women, and the greater the exertion required, the more trying must be the effect of exposure to high temperatures. During the 16 months preceding the installation of the cooling plant in the Morro Velho mine there were 20 fatal accidents, while during the 16 months' period following the installation there were only 6 fatal accidents.

12. It has been found that a moderate increase of temperature—within physiological limits—augments the action of drugs and toxic substances such as carbon monoxide, mustard gas, and lead.

13. A list of the symptoms—subjective and objective—observed by different investigators is given. The most commonly observed subjective symptoms were cramp, headache, pain in the back, dizziness, great thirst, chilliness although the body temperature might be high, diarrhea, restlessness, and insomnia. Chronic exposure to excessive heat results in lowered physical efficiency and diminished resistance to fatigue and disease. The principal objective symptoms noted were changes in body temperature, pulse rate, and blood pressure, increased respiration and body metabolism, and loss of weight. The statement is made by one group of investigators that the pulse rate is probably the best single physiological measure of discomfort due to high temperature.

14. The action of high temperatures on muscular tissue is discussed, especially as a cause of fatigue.

15. The effect of cold on the body temperature up to the point of freezing is given as described in Lefèvre's "law of refrigeration."

16. Measures for the prevention of ill effects of exposure to high temperatures are given under personal hygiene and ventilation and refrigeration of working and living places. The economic value of the proper ventilation and cooling of working places is discussed.

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DEATHS DURING WEEK ENDED MARCH 26, 1927

Summary of information received by telegraph from industrial insurance companies for week ended March 26, 1927, and corresponding week of 1926. (From the Weekly Health Index, March 31, 1927, issued by the Bureau of the Census, Department of Commerce)

	Week ended Mar. 26, 1927	Corresponding week 1926
Policies in force	67, 112, 016	63, 798, 457
Number of death claims	13, 742	16, 239
Death claims per 1,000 policies in force, annual rate	10. 7	13. 3

Deaths from all causes in certain large cities of the United States during the week ended March 26, 1927, infant mortality, annual death rate, and comparison with corresponding week of 1926. (From the Weekly Health Index, March 31, 1927, issued by the Bureau of the Census, Department of Commerce)

City	Week ended Mar. 26, 1927		Annual death rate per 1,000 corresponding week 1926	Deaths under 1 year		Infant mortality rate, week ended Mar. 26, 1927 [2]
	Total deaths	Death rate [1]		Week ended Mar. 26, 1927	Corresponding week 1926	
Total (68 cities)	7, 535	13. 2	[3] 19. 1	765	[3] 1, 219	[4] 64
Akron	31			5	14	54
Albany [5]	35	15. 2	32. 4	4	11	83
Atlanta	79			10	9	
White	38			4	5	
Colored	41	(6)		6	4	
Baltimore [5]	246	15. 7	19. 2	19	30	59
White	197		17. 6	14	25	54
Colored	49	(6)	28. 5	5	5	78
Birmingham	70	17. 0	20. 0	9	12	
White	33		16. 7	5	4	
Colored	37	(6)	25. 1	4	8	
Boston	221	14. 5	24. 2	22	49	61
Bridgeport	42			2	6	37
Buffalo	128	12. 1	23. 5	16	24	67
Cambridge	32	13. 5	18. 4	2	8	36
Camden	33	12. 9	18. 3	5	5	86
Canton	23	10. 6	11. 4	3	6	71
Chicago [5]	747	12. 6	19. 1	76	144	66
Cincinnati	133	16. 8	24. 9	8	15	50
Cleveland	190	10. 1	17. 8	22	49	58
Columbus	93	16. 7	14. 6	10	10	93
Dallas	42	10. 5	12. 6	5	6	
White	30		10. 1	4	3	
Colored	12	(6)	29. 0	1	3	
Dayton	35	10. 1	13. 0	5	8	82
Denver	81	14. 6	13. 7	3	4	
Des Moines	45	15. 7	20. 0	3	2	50
Detroit	309	12. 1	19. 2	55	88	87
Duluth	23	10. 4	10. 2	2	1	43
El Paso	20	9. 1	16. 3	3	9	
Erie	26			2	10	39
Fall River [5]	38	14. 9	15. 1	9	4	159
Flint	26	9. 5	15. 3	4	5	65
Fort Worth	36	11. 4	11. 5	2	3	
White	29		11. 2	2	2	
Colored	7	(6)	13. 7	0	1	
Grand Rapids	29	9. 5	18. 4	5	10	73
Houston	60			3	2	
White	47			2	1	
Colored	13	(6)		1	1	
Indianapolis	80	11. 2	15. 8	8	5	63
White	67		15. 3	5	5	45
Colored	13	(6)	19. 0	3	0	183
Jersey City	74	12. 0	18. 7	4	11	30
Kansas City, Kans	32	14. 3	19. 6	2	5	39
White	21		16. 8	2	2	45
Colored	11	(6)	33. 1	0	3	0
Kansas City, Mo	90	12. 3	16. 8	2	12	
Knoxville	36	18. 4		2		
White	25			1		
Colored	11	(6)		1		
Los Angeles	259			15	21	43

Footnotes at end of table.

Deaths from all causes in certain large cities of the United States during the week ended March 26, 1927, infant mortality, annual death rate, and comparison with corresponding week of 1926. (From the Weekly Health Index, March 31, 1927, issued by the Bureau of the Census, Department of Commerce)—Continued

City	Week ended Mar. 26, 1927		Annual death rate per 1,000 corresponding week 1926	Deaths under 1 year		Infant mortality rate week ended Mar. 26, 1927 [2]
	Total deaths	Death rate [1]		Week ended Mar. 26, 1927	Corresponding week 1926	
Louisville	82	13.4	22.8	7	15	60
White	56		21.1	2	11	19
Colored	26	(6)	32.2	5	4	350
Lowell	24	11.3	14.2	4	2	77
Lynn	22	10.9	22.1	4	3	106
Memphis	78	22.7	19.7	10	6	
White	34		14.2	5	2	
Colored	44	(6)	29.8	5	4	
Milwaukee	119	11.8	13.1	19	23	89
Minneapolis	93	11.0	12.5	6	12	34
Nashville [5]	54	20.4	32.7	3	13	
White	40		29.3	2	8	
Colored	14	(6)	41.4	1	5	
New Bedford	24	10.5	22.7	5	10	87
New Haven	41	11.6	17.8	4	6	56
New Orleans	166	20.4	20.3	16	10	
White	100		15.0	10	3	
Colored	66	(6)	35.4	6	7	
New York	1,480	12.9	21.7	150	275	62
Bronx Borough	195	11.0	15.6	18	31	57
Brooklyn Borough	475	10.9	20.7	61	99	63
Manhattan Borough	643	18.5	28.7	57	121	67
Queens Borough	132	8.5	14.0	13	19	56
Richmond Borough	35	12.4	23.0	1	5	19
Newark, N. J.	116	13.0	16.7	10	13	50
Norfolk	37	10.8	14.1	4	3	81
White	26		8.0	2	2	65
Colored	11	(6)	24.8	2	1	106
Oakland	64	12.5	11.4	5	9	59
Okalhoma City	30			3	0	
Omaha	58	13.8	14.7	7	6	78
Paterson	39	14.1	23.3	1	3	18
Philadelphia	557	14.3	19.6	49	76	65
Pittsburgh	165	13.4	21.8	17	32	59
Portland, Oreg.	80			0	2	0
Providence	65	12.1	24.1	8	9	68
Richmond	66	17.9	19.6	7	9	92
White	36		15.2	2	7	40
Colored	30	(6)	30.3	5	2	190
Rochester	77	12.4	19.2	8	8	67
St. Louis	219	13.6	17.2	14	30	
St. Paul	74	15.4	13.5	12	4	109
Salt Lake City [5]	32	12.3	15.3	4	6	61
San Antonio	59	14.6	14.0	7	10	
San Diego	44	20.0	19.4	3	2	64
San Francisco	158	14.3	13.8	6	4	37
Schenectady	19	10.7	21.3	2	3	60
Seattle	76			5	3	52
Somerville	19	9.7	16.7	4	1	144
Spokane	33	15.8	16.3	0	3	0
Springfield, Mass	28	9.9	19.4	5	6	77
Syracuse	51	13.5	27.3	8	9	103
Tacoma	28	13.6	10.3	3	2	71
Toledo	74	12.7	16.1	9	14	87
Trenton	34	12.9	21.4	3	4	52
Washington, D. C	132	12.7	16.6	8	25	46
White	78		12.7	3	17	25
Colored	54	(6)	28.1	5	8	92
Waterbury	23			3	5	71
Wilmington, Del	23	9.5	13.5	0	4	0
Worcester	63	16.8	22.7	14	4	168
Yonkers	32	14.0	14.8	6	5	136
Youngstown	39	12.0	11.1	3	4	42

[1] Annual rate per 1,000 population.
[2] Deaths under 1 year per 1,000 births. Cities left blank are not in the registration area for births.
[3] Data for 67 cities.
[4] Data for 63 cities.
[5] Deaths for week ended Friday, Mar. 25, 1927.
[6] In the cities for which deaths are shown by color, the colored population in 1920 constituted the following percentages of the total population: Atlanta 31, Baltimore 15, Birmingham 39, Dallas 15, Fort Worth 14, Houston 25, Indianapolis 11, Kansas City, Kans., 14, Knoxville 15, Louisville 17, Memphis 38, Nashville 30, New Orleans 26, Norfolk 38, Richmond 32, and Washington, D. C., 25.

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary and the figures are subject to change when later returns are received by the State health officers

Reports for Week Ended April 2, 1927

ALABAMA

	Cases
Cerebrospinal meningitis	1
Chicken pox	61
Diphtheria	19
Influenza	230
Lethargic encephalitis	1
Malaria	8
Measles	253
Mumps	51
Pellagra	3
Pneumonia	62
Scarlet fever	19
Smallpox	85
Tuberculosis	46
Typhoid fever	14
Whooping cough	61

ARIZONA

Diphtheria	1
Influenza	1
Measles	15
Scarlet fever	9
Trachoma	1
Tuberculosis	51
Whooping cough	1

ARKANSAS

Chicken pox	52
Diphtheria	9
Influenza	87
Malaria	31
Measles	230
Mumps	45
Pellagra	10
Scarlet fever	6
Smallpox	3
Trachoma	2
Tuberculosis	14
Typhoid fever	3
Whooping cough	35

CALIFORNIA

	Cases
Cerebrospinal meningitis:	
Berkeley	1
Los Angeles County	1
Oakland	1
Sacramento	1
San Francisco	1
San Rafael	1
Scattering	3
Chicken pox	574
Diphtheria	147
Influenza	107
Leprosy—Los Angeles	1
Lethargic encephalitis	2
Measles	3,010
Mumps	351
Poliomyelitis:	
Los Angeles County	1
San Diego County	1
San Francisco	1
Scarlet fever	220
Smallpox	26
Tuberculosis	204
Typhoid fever	10
Whooping cough	198

COLORADO

Cerebrospinal meningitis	1
Chicken pox	55
Diphtheria	6
German measles	13
Impetigo contagiosa	1
Measles	426
Mumps	16
Pneumonia	3
Scarlet fever	208
Smallpox	10
Tuberculosis	47
Typhoid fever	2
Whooping cough	10

CONNECTICUT

	Cases
Chicken pox	85
Diphtheria	20
German measles	14
Influenza	11
Lethargic encephalitis	1
Measles	102
Mumps	46
Pneumonia (broncho)	31
Pneumonia (lobar)	50
Poliomyelitis	1
Scarlet fever	94
Septic sore throat	2
Tuberculosis (all forms)	34
Whooping cough	38

DELAWARE

Chicken pox	2
Diphtheria	1
Influenza	3
Measles	5
Pneumonia	2
Scarlet fever	19
Tuberculosis	4
Whooping cough	2

FLORIDA

Chicken pox	64
Diphtheria	20
Influenza	8
Malaria	6
Measles	228
Mumps	22
Pneumonia	3
Scarlet fever	8
Smallpox	84
Tetanus	2
Typhoid fever	12
Whooping cough	35

GEORGIA

Chicken pox	71
Conjunctivitis (infectious)	1
Diphtheria	7
Dysentery	6
Hookworm disease	2
Influenza	299
Malaria	19
Measles	333
Mumps	118
Pellagra	6
Pneumonia	53
Scarlet fever	13
Septic sore throat	4
Smallpox	84
Tetanus	1
Tuberculosis	19
Typhoid fever	8
Whooping cough	39

IDAHO

Chicken pox	7
Diphtheria	2
Measles	91
Mumps	1
Ophthalmia neonatorum	1
Rocky Mountain spotted fever	1
Scarlet fever	26
Smallpox	5
Tuberculosis	2

ILLINOIS

	Cases
Cerebrospinal meningitis:	
Cook County	1
Lake County	1
Lee County	1
Chicken pox	309
Diphtheria	123
Influenza	33
Lethargic encephalitis:	
Champaign County	1
Cook County	1
Measles	2,031
Mumps	609
Pneumonia	298
Scarlet fever	331
Smallpox	32
Tuberculosis	248
Typhoid fever	4
Whooping cough	192

INDIANA

Chicken pox	252
Diphtheria	40
Influenza	58
Measles	275
Mumps	4
Pneumonia	9
Scarlet fever	250
Smallpox	213
Tuberculosis	46
Typhoid fever	6
Whooping cough	96

IOWA

Chicken pox	65
Diphtheria	13
Measles	584
Mumps	50
Pneumonia	2
Scarlet fever	72
Smallpox	20
Tuberculosis	7
Whooping cough	21

KANSAS

Cerebrospinal meningitis—Bazine	1
Chicken pox	135
Diphtheria	12
German measles	13
Influenza	11
Measles	1,230
Mumps	64
Pneumonia	47
Ptomaine poisoning	1
Scarlet fever	194
Smallpox	47
Tuberculosis	36
Typhoid fever	2
Whooping cough	69

LOUISIANA

Diphtheria	27
Influenza	19
Malaria	9
Measles	90
Pneumonia	25
Scarlet fever	6
Smallpox	4
Tuberculosis	17
Typhoid fever	19
Whooping cough	17

MAINE

	Cases
Chicken pox	32
Diphtheria	4
German measles	53
Influenza	18
Measles	211
Mumps	14
Pneumonia	15
Scarlet fever	22
Smallpox	[1] 1
Tuberculosis	4
Vincent's angina	7
Whooping cough	46

MARYLAND [2]

	Cases
Chicken pox	137
Diphtheria	56
Dysentery	2
German measles	3
Influenza	136
Measles	58
Mumps	17
Pellagra	1
Pneumonia (broncho)	64
Pneumonia (lobar)	71
Scarlet fever	71
Septic sore throat	1
Tetanus	1
Tuberculosis	62
Typhoid fever	8
Vincent's angina	1
Whooping cough	71

MASSACHUSETTS

	Cases
Chicken pox	226
Conjunctivitis (suppurative)	9
Diphtheria	94
German measles	10
Influenza	17
Lethargic encephalitis	4
Measles	324
Mumps	491
Ophthalmia neonatorum	33
Pneumonia (lobar)	115
Scarlet fever	505
Septic sore throat	2
Tetanus	1
Trachoma	2
Tuberculosis (pulmonary)	86
Tuberculosis (other forms)	26
Typhoid fever	13
Whooping cough	151

MICHIGAN

	Cases
Diphtheria	105
Measles	220
Pneumonia	108
Scarlet fever	318
Smallpox	34
Tuberculosis	70
Typhoid fever	5
Whooping cough	111

MINNESOTA

	Cases
Cerebrospinal meningitis	6
Chicken pox	134
Diphtheria	35

[1] Delayed report.

MINNESOTA—continued

	Cases
Measles	281
Pneumonia	4
Scarlet fever	305
Smallpox	4
Tuberculosis	62
Typhoid fever	1
Whooping cough	13

MISSISSIPPI

	Cases
Diphtheria	9
Scarlet fever	18
Smallpox	3
Typhoid fever	10

MISSOURI

	Cases
Cerebrospinal meningitis	4
Chicken pox	83
Diphtheria	58
Epidemic sore throat	4
Influenza	4
Malaria	6
Measles	216
Mumps	67
Ophthalmia neonatorum	1
Pneumonia	5
Rabies (in animals)	6
Scarlet fever	146
Smallpox	19
Trachoma	12
Tuberculosis	47
Typhoid fever	1
Whooping cough	57

MONTANA

	Cases
Cerebrospinal meningitis	1
Chicken pox	35
Diphtheria	4
Measles	49
Mumps	15
Scarlet fever	66
Smallpox	21
Typhoid fever	1

NEBRASKA

	Cases
Chicken pox	47
Diphtheria	6
German measles	149
Measles	327
Mumps	65
Scarlet fever	71
Smallpox	12
Tuberculosis	5
Whooping cough	12

NEW JERSEY

	Cases
Cerebrospinal meningitis	1
Chicken pox	339
Diphtheria	115
Influenza	21
Measles	45
Pneumonia	149
Scarlet fever	365
Typhoid fever	3
Whooping cough	234

[2] Week ended Friday.

NEW MEXICO

	Cases
Chicken pox	71
Diphtheria	4
German measles	98
Lethargic encephalitis	1
Malaria	2
Measles	63
Mumps	46
Pneumonia	8
Rabies	2
Scarlet fever	23
Smallpox	2
Tuberculosis	26
Whooping cough	9

NEW YORK

(Exclusive of New York City)

	Cases
Cerebrospinal meningitis	1
Chicken pox	397
Diphtheria	67
German measles	229
Lethargic encephalitis	1
Measles	687
Mumps	609
Ophthalmia neonatorum	1
Pneumonia	319
Poliomyelitis	2
Scarlet fever	355
Septic sore throat	6
Smallpox	9
Typhoid fever	8
Vincent's angina	24
Whooping cough	203

NORTH CAROLINA

	Cases
Chicken pox	157
Diphtheria	16
German measles	7
Measles	782
Scarlet fever	29
Small pox	74
Typhoid fever	2
Whooping cough	733

OKLAHOMA

(Exclusive of Oklahoma City and Tulsa)

	Cases
Chicken pox	26
Diphtheria	11
Influenza	120
Malaria	15
Measles	230
Mumps	12
Pneumonia	71
Smallpox:	
Delaware County	[1] 50
Scattering	37
Typhoid fever	9

OREGON

	Cases
Cerebrospinal meningitis	2
Chicken pox	17
Diphtheria	12
Influenza	93
Measles	238
Mumps	18
Pneumonia	[2] 3

[1] Delayed report.

OREGON—continued

	Cases
Scarlet fever	45
Smallpox	18
Tuberculosis	9
Typhoid fever	6
Whooping cough	14

PENNSYLVANIA

	Cases
Anthrax—Philadelphia	1
Cerebrospinal meningitis:	
Carlisle	1
Clarion County	1
Philadelphia	1
Pittsburgh	2
Chicken pox	738
Diphtheria	196
German measles	180
Impetigo contagiosa	8
Lethargic encephalitis	2
Measles	962
Mumps	747
Ophthalmia neonatorum	2
Pneumonia	281
Poliomyelitis—Arnold	1
Puerperal fever	1
Scabies	9
Scarlet fever	702
Smallpox	1
Tetanus—Philadelphia	1
Trachoma	1
Tuberculosis	134
Typhoid fever	23
Whooping cough	263

RHODE ISLAND

	Cases
Diphtheria	10
Measles	2
Mumps	3
Ophthalmia neonatorum	1
Pneumonia	2
Scarlet fever	24
Tuberculosis	8
Whooping cough	15

SOUTH CAROLINA

	Cases
Chicken pox	119
Dengue	1
Diphtheria	23
Hookworm disease	25
Influenza	1,978
Malaria	99
Measles	258
Pellagra	67
Poliomyelitis	3
Scarlet fever	3
Smallpox	21
Tuberculosis	53
Typhoid fever	10
Whooping cough	171

SOUTH DAKOTA

	Cases
Actinomycosis	1
Chicken pox	9
Diphtheria	3
Influenza	11
Measles	285

[2] Deaths.

SOUTH DAKOTA—continued

	Cases
Mumps	13
Pneumonia	7
Scarlet fever	110
Smallpox	15
Tuberculosis	3
Typhoid fever	1
Whooping cough	4

TENNESSEE

	Cases
Cerebrospinal meningitis:	
Franklin County	1
Rhea County	1
Chicken pox	37
Diphtheria	15
Influenza	229
Malaria	4
Measles	96
Mumps	25
Pellagra	7
Pneumonia	61
Scarlet fever	20
Smallpox	8
Tetanus	1
Tuberculosis	42
Typhoid fever	12
Whooping cough	22

TEXAS

	Cases
Chicken pox	52
Diphtheria	23
Dysentery	1
Influenza	38
Measles	241
Mumps	49
Pellagra	1
Pneumonia	23
Scarlet fever	19
Smallpox	62
Trachoma	4
Tuberculosis	14
Typhoid fever	1
Whooping cough	42

UTAH

	Cases
Chicken pox	39
Diphtheria	6
Influenza	7
Measles	67
Mumps	9
Pneumonia	7
Scarlet fever	29
Whooping cough	51

VERMONT

	Cases
Chicken pox	3
Diphtheria	2
Measles	144
Mumps	53
Scarlet fever	12
Typhoid fever	1
Whooping cough	10

VIRGINIA

	Cases
Smallpox	2

WASHINGTON

	Cases
Cerebrospinal meningitis:	
Asotin County	1
Thurston County	2

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WASHINGTON—continued

	Cases
Chicken pox	127
Diphtheria	13
German measles	417
Measles	401
Mumps	119
Pneumonia	2
Poliomyelitis	1
Scarlet fever	106
Smallpox	60
Tuberculosis	5
Typhoid fever	7
Whooping cough	54

WEST VIRGINIA

	Cases
Cerebrospinal meningitis—Nicholas County	1
Chicken pox	73
Diphtheria	21
Influenza	99
Measles	194
Scarlet fever	34
Smallpox	32
Tuberculosis	47
Typhoid fever	4
Whooping cough	180

WISCONSIN

	Cases
Milwaukee:	
Cerebrospinal meningitis	8
Chicken pox	105
Diphtheria	12
German measles	4
Measles	129
Mumps	105
Ophthalmia neonatorum	1
Pneumonia	25
Scarlet fever	44
Tuberculosis	14
Whooping cough	38
Scattering:	
Cerebrospinal meningitis	4
Chicken pox	128
Diphtheria	17
German measles	36
Influenza	50
Measles	614
Mumps	120
Pneumonia	29
Poliomyelitis	2
Scarlet fever	154
Smallpox	9
Tuberculosis	36
Typhoid fever	5
Whooping cough	116

WYOMING

	Cases
Chicken pox	17
Diphtheria	1
German measles	20
Influenza	1
Measles	81
Mumps	5
Ophthalmia neonatorum	1
Pneumonia	5
Poliomyelitis	1
Scarlet fever	24
Smallpox	1

Reports for Week Ended March 26, 1927

DISTRICT OF COLUMBIA

	Cases
Cerebrospinal meningitis	1
Chicken pox	73
Diphtheria	25
Influenza	5
Measles	9
Pneumonia	34
Scarlet fever	26
Tuberculosis	25
Typhoid fever	1
Whooping cough	17

NORTH DAKOTA

	Cases
Chicken pox	8
Diphtheria	8
Measles	189
Mumps	5
Pneumonia	9
Poliomyelitis	1
Scarlet fever	44
Smallpox	1
Tuberculosis	4

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of monthly State reports is published weekly and covers only those States from which reports are received during the current week:

State	Cerebrospinal meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
February, 1927										
Alabama	3	161	344	52	718	19	1	70	224	67
Arkansas	0	24	428	95	80	27	0	49	22	23
Idaho	4	6	1		1,312		1	163	40	6
Kansas	6	79	37		2,458		0	763	197	8
Mississippi	0	56	4,672	2,108	2,323	257	0	101	35	63
Montana	34	28	20		308		1	444	37	1
New York	16	1,583		9	3,343		6	4,135	31	82
North Carolina	2	123			1,427		3	176	259	21
Oregon	5	63	1,817		354		0	214	120	20
Pennsylvania	8	806		2	3,721		0	2,742	1	87
South Dakota	1	14	25		1,103		1	418	23	7
Washington	26	103	107		974		1	492	211	8

February, 1927

	Cases
Anthrax:	
New York	2
Pennsylvania	1
Botulism:	
New York	1
Chicken pox:	
Alabama	222
Arkansas	209
Idaho	57
Kansas	694
Mississippi	842
Montana	122
New York	3,153
North Carolina	865
Oregon	174
Pennsylvania	3,390
South Dakota	107
Washington	443
Conjunctivitis (epidemic):	
Idaho	1
Dengue:	
Alabama	1
Mississippi	7
Dysentery:	
Kansas	2
Mississippi (amœbic)	65
Mississippi (bacillary)	174
Washington	2

February, 1927—Continued

	Cases
German measles:	
Kansas	25
Montana	1
New York	816
North Carolina	85
Pennsylvania	397
Washington	558
Hookworm disease:	
Arkansas	3
Mississippi	242
Impetigo contagiosa:	
Oregon	10
Pennsylvania	61
Washington	1
Lethargic encephalitis:	
Kansas	2
New York	29
Oregon	1
Pennsylvania	4
Washington	1
Mumps:	
Alabama	101
Arkansas	210
Idaho	52
Kansas	242
Mississippi	639
Montana	73
New York	3,303

February, 1927—Continued

	Cases
Mumps—Continued.	
Oregon	101
Pennsylvania	1,449
South Dakota	24
Washington	369
Ophthalmia neonatorum:	
Arkansas	4
Mississippi	7
New York	7
Pennsylvania	16
Paratyphoid fever:	
New York	1
Oregon	1
Pink eye:	
Kansas	7
Puerperal septicemia:	
Mississippi	34
New York	11
Pennsylvania	1
Rabies in animals:	
Idaho	1
Mississippi	15
New York	16
Oregon	2
Rabies in man:	
Pennsylvania	1
Rocky Mountain spotted or tick fever:	
Idaho	1
Septic sore throat:	
Kansas	2
New York	21
North Carolina	15
Oregon	4
Washington	1

February, 1927—Continued

	Cases
Scabies:	
Idaho	2
Oregon	20
Pennsylvania	34
Tetanus:	
Kansas	1
New York	3
Pennsylvania	1
Trachoma:	
Arkansas	2
Mississippi	17
New York	3
Pennsylvania	2
Washington	2
Trichinosis:	
Pennsylvania	4
Typhus fever:	
Alabama	1
New York	1
Vincent's angina:	
Idaho	1
New York	70
Whooping cough:	
Alabama	205
Arkansas	198
Idaho	34
Kansas	296
Mississippi	1,595
Montana	6
New York	1,618
North Carolina	2,612
Oregon	58
Pennsylvania	1,231
South Dakota	38
Washington	73

GENERAL CURRENT SUMMARY AND WEEKLY REPORTS FROM CITIES

The 95 cities reporting cases used in the following table are situated in all parts of the country, and have an estimated aggregate population of more than 29,900,000. The estimated population of the 90 cities reporting deaths is more than 29,340,000. The estimated expectancy is based on the experience of the last nine years, excluding epidemics.

Weeks ended March 19, 1927, and March 20, 1926

	1926	1927	Estimated expectancy
Cases reported			
Diphtheria:			
41 States	1,339	1,710	
95 cities	690	994	907
Measles:			
39 States	19,648	14,503	
95 cities	10,367	5,239	
Poliomyelitis:			
41 States	18	14	
Scarlet fever:			
41 States	4,523	6,081	
95 cities	1,714	2,543	1,288
Smallpox:			
41 States	959	1,032	
95 cities	210	176	143
Typhoid fever:			
41 States	144	221	
95 cities	33	41	42
Deaths reported			
Influenza and pneumonia:			
90 cities	2,496	1,203	
Smallpox:			
90 cities	11	1	
Atlanta	0	1	
Los Angeles	8	0	
Sacramento	1	0	
San Francisco	2	0	

City reports for week ended March 19, 1927

The "estimated expectancy" given for diphtheria, poliomyelitis, scarlet fever, smallpox, and typhoid fever is the result of an attempt to ascertain from previous occurrence how many cases of the disease under consideration may be expected to occur during a certain week in the absence of epidemics. It is based on reports to the Public Health Service during the past nine years. It is in most instances the median number of cases reported in the corresponding week of the preceding years. When the reports include several epidemics or when for other reasons the median is unsatisfactory, the epidemic periods are excluded and the estimated expectancy is the mean number of cases reported for the week during nonepidemic years.

If reports have not been received for the full nine years, data are used for as many years as possiblo, but no year earlier than 1918 is included. In obtaining the estimated expectancy, the figures are smoothed when necessary to avoid abrupt deviations from the usual trend. For some of the diseases given in the table the available data were not sufficient to make it practicable to compute the estimated expectancy.

Division, State, and city	Population July 1, 1925, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
NEW ENGLAND									
Maine:									
Portland	75,333	11	1	0	0	0	1	0	1
New Hampshire:									
Concord	22,546	0	0	0	0	0	20	0	0
Manchester	83,097	0	2	0	0	1	0	0	4
Vermont:									
Barre	10,008	0	0	0	0	0	0	8	0
Burlington	24,089	1	0	0	0	0	9	1	0
Massachusetts:									
Boston	779,620	67	58	35	4	2	58	111	33
Fall River	128,993	3	4	3	1	0	1	3	7
Springfield	142,065	7	3	3	1	1	1	2	3
Worcester	190,757	13	4	2	0	0	0	3	4
Rhode Island:									
Pawtucket	69,760	4	1	1	0	0	0	1	6
Providence	267,918	0	9	7	0	4	0	0	8
Connecticut:									
Bridgeport	(1)	2	7	7	0	0	10	3	3
Hartford	160,197	1	8	0	0	1	0	4	4
New Haven	178,927	31	3	1	0	0	0	5	5
MIDDLE ATLANTIC									
New York:									
Buffalo	538,016	27	11	47		1	5	17	29
New York	5,873,356	363	203	313	82	33	46	456	242
Rochester	316,786	3	10	7		0	17	4	6
Syracuse	182,003	29	7	2		0	12	10	2
New Jersey:									
Camden	128,642	10	4	18	1	1	2	1	13
Newark	452,513	81	17	4	16	3	5	85	19
Trenton	132,020	2	4	2	3	1	1	0	4
Pennsylvania:									
Philadelphia	1,979,364	113	74	63		18	28	152	104
Pittsburgh	631,563	105	19	30		7	71	7	37
Reading	112,707	13	3	2		0	2	45	3
EAST NORTH CENTRAL									
Ohio:									
Cincinnati	409,333	12	9	8	0	2	1	18	10
Cleveland	936,485	106	25	35	3	4	9	61	24
Columbus	279,836	15	3	10	0	3	9	1	8
Toledo	287,380	14	5	4	1	0	28	5	3
Indiana:									
Fort Wayne	97,846		3						
Indianapolis	358,819	77	7	2	0	2	22	26	18
South Bend	80,091	5	1	0	0	0	29	0	0
Terre Haute	71,071	5	1	0	0	0	23	0	1
Illinois:									
Chicago	2,995,239	116	86	92	35	10	1,384	180	79
Peoria	81,564	2	0	0	0	0	30	3	4
Springfield	63,923	6	1	1	0	0	74	3	0
Michigan:									
Detroit	1,245,824	139	55	51	10	5	22	195	41
Flint	130,316	38	4	3	0	0	7	1	7
Grand Rapids	153,698	3	3	1	0	0	1	0	0

[1] No estimate made.

City reports for week ended March 19, 1927—Continued

Division, State, and city	Population July 1, 1925, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
EAST NORTH CENTRAL—continued									
Wisconsin:									
Kenosha	50,891	6	2	0	0	0	128	31	2
Madison	46,385	19	1	0	0	0	15	1	1
Milwaukee	509,192	107	16	28	1	1	78	79	20
Racine	67,707	8	2	0	0	0	22	31	1
Superior	39,671	1	0	3	0	0	3	0	1
WEST NORTH CENTRAL									
Minnesota:									
Duluth	110,502	5	1	0	0	1	52	0	2
Minneapolis	425,435	94	15	11	0	3	1	2	9
St. Paul	246,001	34	14	0	0	0	24	2	12
Iowa:									
Davenport	52,469	1	1	2	0	--------	7	0	--------
Sioux City	76,411	9	1	1	0	--------	38	20	--------
Waterloo	36,771	0	0	0	0	--------	145	0	--------
Missouri:									
Kansas City	367,481	41	7	6	0	3	83	7	11
St. Joseph	78,342	4	1	0	0	0	20	0	3
St. Louis	821,543	35	41	40	0	0	42	55	--------
North Dakota:									
Fargo	26,403	11	1	1	0	1	204	5	2
Grand Forks	14,811	0	0	0	0	--------	0	0	--------
South Dakota:									
Aberdeen	15,036	4	0	0	0	--------	120	0	--------
Sioux Falls	30,127	0	1	0	0	--------	2	0	--------
Nebraska:									
Lincoln	60,941	14	1	3	0	0	48	3	0
Omaha	211,768	14	4	3	1	1	111	61	10
Kansas:									
Topeka	55,411	15	1	0	1	1	59	0	2
Wichita	88,367	26	2	2	0	0	9	0	4
SOUTH ATLANTIC									
Delaware:									
Wilmington	122,049	1	2	0	0	0	0	0	2
Maryland:									
Baltimore	796,296	94	26	29	156	14	3	5	67
Cumberland	33,741	0	1	1	20	1	0	0	1
Frederick	12,035	1	0	0	2	0	0	3	0
District of Columbia:									
Washington	497,906	65	12	28	10	6	2	0	13
Virginia:									
Lynchburg	30,395	30	0	3	0	1	23	0	3
Norfolk	(1)	--------	1	--------	--------	--------	--------	--------	--------
Richmond	186,403	1	3	1	0	0	246	0	8
Roanoke	58,208	7	1	1	0	5	2	0	5
West Virginia:									
Charleston	49,019	8	0	1	1	2	1	0	2
Wheeling	56,208	3	1	0	0	0	18	0	2
North Carolina:									
Raleigh	30,371	19	0	0	0	0	0	0	1
Wilmington	37,061	3	0	0	0	0	1	10	0
Winston-Salem	69,031	4	1	1	0	5	2	18	5
South Carolina:									
Charleston	73,125	2	0	1	61	0	23	0	1
Columbia	41,225	--------	1	--------	--------	--------	--------	--------	--------
Greenville	27,311	1	0	0	2	0	0	0	1
Georgia:									
Atlanta	(1)	5	2	4	123	8	42	4	17
Brunswick	16,809	0	0	0	0	0	2	5	1
Savannah	93,134	5	1	5	46	0	0	0	1
Florida:									
Miami	69,754	26	4	3	0	0	0	7	3
St. Petersburg	26,847	--------	0	--------	--------	0	--------	--------	3
Tampa	94,743	6	1	1	2	0	115	0	4

[1] No estimate made.

City reports for week ended March 19, 1927—Continued

Division, State, and city	Population July 1, 1925, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
EAST SOUTH CENTRAL									
Kentucky:									
Covington	58,309		0						
Louisville	305,935	4	5	1	5	0	0	3	12
Tennessee:									
Memphis	174,533	18	5	1	0	8	2	4	15
Nashville	136,220	5	1	0	0	1	1	3	2
Alabama:									
Birmingham	205,670	6	2	2	8	6	17	3	5
Mobile	65,955	2	1	0	0	2	40	1	1
Montgomery	46,481	6	0	0	3	0	27	1	0
WEST SOUTH CENTRAL									
Arkansas:									
Fort Smith	31,643	7	1	0	0		44	3	2
Little Rock	74,216	2	1	1	0	1	8	0	2
Louisiana:									
New Orleans	414,493	1	8	9	6	4	100	0	19
Shreveport	57,857	4	1	0	0	0	0	14	0
Oklahoma:									
Oklahoma City	[1]	12	1	0	0	0	4	0	3
Texas:									
Dallas	194,450	22	4	8	0	0	92	0	6
Galveston	48,375	0	0	2	0	0	0	0	0
Houston	164,954	4	2	10	0	0	1	1	10
San Antonio	198,069	1	2	9	0	0	3	0	7
MOUNTAIN									
Montana:									
Billings	17,971	6	0	0	0	0	2	0	0
Great Falls	29,883	11	1	1	0	0	9	0	1
Helena	12,037	1	0	0	0	0	0	0	2
Missoula	12,668	0	0	0	0	0	1	22	0
Idaho:									
Boise	23,042	0	0	0	0	0	0	0	0
Colorado:									
Denver	280,911	20	8	2		2	527	0	7
Pueblo	43,787	3	1	3	0	0	24	0	4
New Mexico:									
Albuquerque	21,000	3	1	0	2	0	29	30	0
Arizona:									
Phoenix	38,669	1	0	3	0	0	4	0	1
Utah:									
Salt Lake City	130,948	10	3	6	1	0	39	1	4
Nevada:									
Reno	12,665	0	0	2	0	0	0	0	0
PACIFIC									
Washington:									
Seattle	[1]	49	5	4	0		42	75	
Spokane	108,897	4	2	2	0		20	0	
Tacoma	104,455	0	1	1	0	0	47	1	5
Oregon:									
Portland	282,383	18	6	7	3	0	43	1	5
California:									
Los Angeles	[1]	54	40	44	45	2	823	16	15
Sacramento	72,260	2	1	1	1	1	24	4	2
San Francisco	557,530	40	21	11	4	1	163	106	5

[1] No estimate made.

City reports for week ended March 19, 1927—Continued

Division, State, and city	Scarlet fever: Cases, estimated expectancy	Scarlet fever: Cases reported	Smallpox: Cases, estimated expectancy	Smallpox: Cases reported	Smallpox: Deaths reported	Tuberculosis, deaths reported	Typhoid fever: Cases, estimated expectancy	Typhoid fever: Cases reported	Typhoid fever: Deaths reported	Whooping cough, cases reported	Deaths, all causes
NEW ENGLAND											
Maine:											
Portland	4	1	0	0	0	0	0	0	0	6	15
New Hampshire:											
Concord	0	0	0	0	0	0	0	0	0	1	2
Manchester	3	0	0	0	0	1	0	0	0	0	14
Vermont:											
Barre	1	0	0	0	0	0	0	0	0	0	5
Burlington	1	1	0	0	0	1	0	0	0	2	8
Massachusetts:											
Boston	73	157	0	0	0	14	1	2	0	26	262
Fall River	4	4	0	0	0	1	0	0	0	1	40
Springfield	7	5	0	0	0	4	0	0	0	2	29
Worcester	9	12	0	0	0	7	1	0	0	23	53
Rhode Island:											
Pawtucket	2	3	0	0	0	0	1	0	0	2	21
Providence	9	14	0	0	0	2	1	0	0	2	70
Connecticut:											
Bridgeport	12	17	0	0	0	1	0	0	0	0	23
Hartford	6	13	0	0	0	6	0	0	0	3	43
New Haven	11	9	0	0	0	1	0	0	0	0	36
MIDDLE ATLANTIC											
New York:											
Buffalo	22	20	0	0	0	10	0	0	0	17	184
New York	278	871	1	0	0	[1] 121	7	7	1	106	1,621
Rochester	16	22	0	0	0	3	0	2	0	2	72
Syracuse	14	6	0	1	0	2	0	0	0	8	36
New Jersey:											
Camden	5	5	0	0	0	2	1	0	0	2	44
Newark	26	65	0	0	0	17	0	0	0	34	125
Trenton	5	2	0	0	0	3	1	0	0	3	33
Pennsylvania:											
Philadelphia	79	144	1	0	0	54	3	1	0	22	658
Pittsburgh	31	26	0	0	0	12	0	1	0	12	184
Reading	4	1	0	0	0	1	1	1	0	0	29
EAST NORTH CENTRAL											
Ohio:											
Cincinnati	16	40	2	0	0	14	1	2	0	6	134
Cleveland	44	54	0	0	0	7	1	0	0	22	190
Columbus	12	16	3	0	0	3	1	0	0	11	72
Toledo	15	17	5	0	0	7	0	0	0	51	76
Indiana:											
Ft. Wayne	5		2				1				
Indianapolis	10	23	12	33	0	3	0	0	0	18	102
South Bend	3	1	1	0	0	0	0	0	0	1	15
Terre Haute	3	1	1	4	0	0	0	0	0	0	15
Illinois:											
Chicago	124	139	4	4	0	50	3	0	0	70	734
Peoria	4	0	1	0	0	0	0	0	0	2	17
Springfield	2	1	0	0	0	0	0	0	0	1	19
Michigan:											
Detroit	92	137	2	1	0	26	1	3	1	81	336
Flint	6	33	1	7	0	0	0	1	0	0	33
Grand Rapids	10	13	1	0	0	0	1	0	0	2	20
Wisconsin:											
Kenosha	3	2	1	0	0	0	0	0	0	3	8
Madison	3	10	0	0	0	1	0	0	0	23	7
Milwaukee	29	58	3	0	0	6	0	0	0	30	125
Racine	4	2	0	0	0	0	1	0	0	15	8
Superior	3	5	5	0	0	0	0	0	0	0	9

[1] Pulmonary tuberculosis only.

City reports for week ended March 19, 1927—Continued

Division, State, and city	Scarlet fever: Cases, estimated expectancy	Scarlet fever: Cases reported	Smallpox: Cases, estimated expectancy	Smallpox: Cases reported	Smallpox: Deaths reported	Tuberculosis, deaths reported	Typhoid fever: Cases, estimated expectancy	Typhoid fever: Cases reported	Typhoid fever: Deaths reported	Whooping cough, cases reported	Deaths, all causes
WEST NORTH CENTRAL											
Minnesota:											
Duluth	9	6	1	0	0	2	0	0	0	2	26
Minneapolis	45	56	8	0	0	2	0	0	0	3	89
St. Paul	33	49	6	0	0	2	0	0	0	12	67
Iowa:											
Davenport	2	4	2	0			0	0		0	
Sioux City	2	9	1	0			0	0		4	
Waterloo	2	0	0	0			0	0		1	
Missouri:											
Kansas City	11	22	2	13	0	7	0	0	0	9	117
St. Joseph	2	9	0	3	0	1	0	0	0	2	26
St. Louis	31	38	5	2	0	6	1	0	0	32	232
North Dakota:											
Fargo	2	10	0	0	0	0	1	0	0	0	15
Grand Forks	1	5	0	0			0	0		0	
South Dakota:											
Aberdeen	4	4	0	0			0	0		0	
Sioux Falls	2	3	0	0			0	0		0	
Nebraska:											
Lincoln	3	3	0	0	0	0	0	0	0	5	12
Omaha	4	12	9	2	0	4	0	0	0	0	51
Kansas:											
Topeka	3	1	1	5	0	2	0	0	0	13	23
Wichita	2	3	2	0	0	0	0	0	0	2	35
SOUTH ATLANTIC											
Delaware:											
Wilmington	3	26	0	0	0	2	0	0	1	5	28
Maryland:											
Baltimore	37	41	0	0	0	19	2	1	0	79	302
Cumberland	1	0	0	0	0	0	1	0	0	0	11
Frederick	0	2	0	0	0	0	0	0	0	0	3
District of Columbia:											
Washington	26	29	1	0	0	8	1	1	0	31	167
Virginia:											
Lynchburg	1	0	0	0	0	0	0	0	0	3	12
Norfolk	2		1				0				
Richmond	3	3	1	0	0	4	0	0	0	3	61
Roanoke	1	3	1	1	0	1	0	0	1	1	20
West Virginia:											
Charleston	0	1	1	2	0	2	0	1	0	0	19
Wheeling	2	3	0	0	0	2	1	0	0	1	17
North Carolina:											
Raleigh	0	2	0	0	0	1	0	0	1	50	15
Wilmington	0	1	0	0	0	0	0	0	0	28	11
Winston-Salem	0	3	5	0	0	2	0	1	0	38	30
South Carolina:											
Charleston	1	0	0	0	0	1	0	0	0	4	23
Columbia	1		1				0				
Greenville	0	0	0	0	0	0	0	0	0	1	5
Georgia:											
Atlanta	4	5	3	18	1	7	0	0	0	7	
Brunswick	0	0	0	0	0	1	0	0	0	0	3
Savannah	1	0	0	6	0	2	0	0	0	1	31
Florida:											
Miami	3	4		0	0	0	1	0	0	8	39
St. Petersburg	1		0		0	0	0		0		23
Tampa	0	0	0	0	0	2	1	2	1	0	30
EAST SOUTH CENTRAL											
Kentucky:											
Covington	2		1				0				
Louisville	5	15	1	3	0	2	0	2	0	82	82
Tennessee:											
Memphis	4	19	3	9	0	5	1	0	0	18	88
Nashville	3	1	2	0	0	1	0	1	0	6	28
Alabama:											
Birmingham	2	4	9	7	0	3	1	0	0	3	73
Mobile	1	0	2	0	0	2	0	1	0	0	16
Montgomery	0	0	1	7	0	0	0	0	0	15	27

City reports for week ended March 19, 1927—Continued

Division, State, and city	Scarlet fever		Smallpox			Tuberculosis, deaths reported	Typhoid fever			Whooping cough, cases reported	Deaths, all causes
	Cases, estimated expectancy	Cases reported	Cases, estimated expectancy	Cases reported	Deaths reported		Cases, estimated expectancy	Cases reported	Deaths reported		
WEST SOUTH CENTRAL											
Arkansas:											
Fort Smith	1	0	1	0	-------	-------	0	0	-------	10	15
Little Rock	1	0	1	0	0	4	1	0	0	4	-------
Louisiana:											
New Orleans	6	1	3	0	0	15	2	2	1	6	188
Shreveport	1	1	1	1	0	3	0	0	0	0	23
Oklahoma:											
Oklahoma City	2	0	4	5	0	0	1	0	0	0	21
Texas:											
Dallas	2	6	6	7	0	3	1	0	0	8	40
Galveston	0	0	0	0	0	2	0	0	0	0	18
Houston	1	4	1	3	0	3	0	0	0	1	55
San Antonio	1	3	0	0	0	13	0	1	0	1	56
MOUNTAIN											
Montana:											
Billings	0	2	0	0	0	0	0	0	0	0	6
Great Falls	1	8	1	0	0	1	0	0	0	0	9
Helena	0	0	0	0	0	0	0	0	0	0	4
Missoula	0	13	0	0	0	0	0	0	0	0	8
Idaho:											
Boise	1	2	1	0	0	0	0	0	0	0	3
Colorado:											
Denver	15	106	2	1	0	8	0	0	0	1	86
Pueblo	1	7	0	0	0	0	0	0	1	0	14
New Mexico:											
Albuquerque	1	2	0	0	0	4	0	0	0	0	16
Arizona:											
Phoenix	0	1	0	0	0	14	0	0	0	0	33
Utah:											
Salt Lake City	3	11	1	9	0	4	0	1	0	10	44
Nevada:											
Reno	0	0	0	0	0	0	0	0	0	0	2
PACIFIC											
Washington:											
Seattle	11	14	4	2	-------	-------	0	1	-------	28	-------
Spokane	5	29	4	13	-------	-------	0	0	-------	2	-------
Tacoma	3	2	3	15	0	0	0	0	0	0	31
Oregon:											
Portland	6	10	9	5	0	0	1	0	0	1	54
California:											
Los Angeles	24	28	6	0	0	31	1	4	0	20	270
Sacramento	2	0	1	1	0	3	0	2	0	0	20
San Francisco	14	24	6	1	0	7	1	0	2	22	139

City reports for week ended March 19, 1927—Continued

Division, State, and city	Cerebrospinal meningitis		Lethargic encephalitis		Pellagra		Poliomyelitis (infantile paralysis)		
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases, estimated expectancy	Cases	Deaths
NEW ENGLAND									
Massachusetts:									
Boston	1	3	0	0	0	0	0	0	0
Rhode Island:									
Providence	1	0	0	0	0	0	0	0	0
MIDDLE ATLANTIC									
New York:									
New York	4	3	2	4	0	0	1	0	0
Syracuse	1	0	0	0	0	0	0	0	0
New Jersey:									
Trenton	0	0	0	0	0	0	0	1	1
Pennsylvania:									
Philadelphia	1	0	0	0	0	0	0	2	0
Pittsburgh	0	1	0	0	0	0	0	0	0
EAST NORTH CENTRAL									
Ohio:									
Cleveland	3	1	0	0	0	0	0	0	0
Illinois:									
Chicago	1	0	1	0	0	0	0	0	0
Michigan:									
Detroit	0	0	1	0	0	0	0	0	0
Wisconsin:									
Milwaukee	5	2	0	0	0	0	0	0	0
Racine	1	0	0	0	0	0	0	0	0
WEST NORTH CENTRAL									
Minnesota:									
St. Paul	0	0	0	1	0	0	0	0	0
Missouri:									
St. Louis	4	0	0	0	0	0	0	0	0
SOUTH ATLANTIC									
North Carolina:									
Raleigh	0	0	0	0	0	1	0	0	0
South Carolina:									
Charleston	0	0	0	1	2	0	0	0	0
Georgia:[1]									
Atlanta	0	0	0	0	0	1	0	0	0
Florida:									
Miami	0	0	0	0	1	0	0	0	0
EAST SOUTH CENTRAL									
Tennessee:									
Memphis	0	0	0	1	0	0	0	0	0
WEST SOUTH CENTRAL									
Arkansas:									
Little Rock	0	0	0	0	0	1	0	0	0
Louisiana:									
New Orleans	0	1	0	0	0	0	0	0	0
MOUNTAIN									
Colorado:									
Denver	0	0	0	1	0	0	0	0	0
New Mexico:									
Albuquerque	1	1	0	0	0	0	0	0	0
PACIFIC									
Washington:									
Spokane	1	0	0	0	0	0	0	0	0
California:									
Los Angeles	3	1	0	1	0	0	0	0	0
Sacramento	1	1	0	0	0	0	0	0	0
San Francisco	0	1	0	0	0	0	0	0	0

[1] Typhus fever: 1 death at Savannah, Ga.

The following table gives the rates per 100,000 population for 101 cities for the five-week period ended March 19, 1927, compared with those for a like period ended March 20, 1926. The population figures used in computing the rates are approximate estimates as of July 1, 1926 and 1927, respectively, authoritative figures for many of the cities not being available. The 101 cities reporting cases had estimated aggregate populations of approximately 30,440,000 in 1926 and 30,960,000 in 1927. The 95 cities reporting deaths had nearly 29,780,000 estimated population in 1926 and nearly 30,290,000 in 1927. The number of cities included in each group and the estimated aggregate populations are shown in a separate table below.

Summary of weekly reports from cities, February 13 to March 19, 1927—Annual rates per 100,000 population, compared with rates for the corresponding period of 1926 [1]

DIPHTHERIA CASE RATES

	Week ended—									
	Feb. 20, 1926	Feb. 19, 1927	Feb. 27, 1926	Feb. 26, 1927	Mar. 6, 1926	Mar. 5, 1927	Mar. 13, 1926	Mar. 12, 1927	Mar. 20, 1926	Mar. 19, 1927
101 cities	137	204	134	179	[2] 124	182	[3] 114	[4] 186	120	[5] 173
New England	116	132	101	149	94	163	78	128	127	137
Middle Atlantic	132	277	119	200	111	224	113	231	126	[6] 230
East North Central	134	169	141	198	123	177	[3] 107	[3] 166	98	[7] 158
West North Central	206	165	246	109	[2] 241	115	216	[8] 148	147	[9] 130
South Atlantic	104	192	73	192	108	196	86	156	69	[10] 149
East South Central	57	87	52	117	47	82	26	[11] 116	26	[12] 22
West South Central	90	172	116	197	103	151	103	193	103	164
Mountain	219	162	210	72	73	234	109	[13] 215	73	126
Pacific	204	188	214	152	188	134	147	199	281	165

MEASLES CASE RATES

	Feb. 20, 1926	Feb. 19, 1927	Feb. 27, 1926	Feb. 26, 1927	Mar. 6, 1926	Mar. 5, 1927	Mar. 13, 1926	Mar. 12, 1927	Mar. 20, 1926	Mar. 19, 1927
101 cities	1,995	784	2,066	843	[2] 1,884	858	[3] 1,686	[4] 784	1,783	[5] 911
New England	2,703	181	2,184	228	2,441	172	1,964	197	1,722	211
Middle Atlantic	1,917	69	2,044	75	1,843	68	1,716	80	1,858	[6] 96
East North Central	2,933	899	3,084	930	2,695	1,078	[3] 2,135	[3] 1,104	1,994	[7] 1,150
West North Central	676	566	901	963	[2] 842	955	1,603	[8] 1,193	1,892	[9] 1,480
South Atlantic	3,248	795	3,269	654	2,675	797	2,248	786	2,772	[10] 942
East South Central	957	469	1,231	464	1,319	540	1,407	[11] 360	2,260	[12] 470
West South Central	9	570	9	600	17	730	39	1,204	43	1,040
Mountain	137	9,691	82	10,653	210	8,154	337	[13] 1,828	328	5,412
Pacific	201	2,780	161	2,872	276	3,037	324	3,259	319	2,930

[1] The figures given in this table are rates per 100,000 population, annual basis, and not the number of cases reported. Populations used are estimated as of July 1, 1926 and 1927, respectively.
[2] Kansas City, Mo., not included.
[3] Madison, Wis., not included.
[4] Madison, Wis., Kansas City, Mo., Fargo., N. Dak., Covington, Ky., Mobile, Ala., and Denver, Colo., not included.
[5] Buffalo, N. Y., Fort Wayne, Ind., Topeka, Kans., Norfolk, Va., Columbia, S. C., and Covington, Ky., not included.
[6] Buffalo, N. Y., not included.
[7] Fort Wayne, Ind., not included.
[8] Kansas City, Mo., and Fargo, N. Dak., not included.
[9] Topeka, Kans., not included.
[10] Norfolk, Va., and Columbia, S. C., not included.
[11] Covington, Ky., and Mobile, Ala., not included.
[12] Covington, Ky., not included.
[13] Denver, Colo., not included.

Summary of weekly reports from cities, February 13 to March 19, 1927—Annual rates per 100,000 population, compared with rates for the corresponding period of 1926—Continued

SCARLET FEVER CASE RATES

	Week ended—									
	Feb. 20, 1926	Feb. 19, 1927	Feb. 27, 1926	Feb. 26, 1927	Mar. 6, 1926	Mar. 5, 1927	Mar. 13, 1926	Mar. 12, 1927	Mar. 20, 1926	Mar. 19, 1927
101 cities	309	439	285	424	[2] 289	419	[3] 303	[4] 436	300	[5] 442
New England	361	469	354	541	347	423	333	590	403	546
Middle Atlantic	208	582	187	532	185	533	192	585	202	[6] 594
East North Central	372	323	340	365	346	398	[3] 371	[3] 364	340	[7] 361
West North Central	782	542	706	447	[2] 807	445	903	[8] 482	815	[9] 434
South Atlantic	149	250	199	219	162	181	149	194	156	[10] 234
East South Central	243	245	171	183	186	219	140	[11] 293	145	[12] 211
West South Central	107	67	112	117	90	67	112	122	137	63
Mountain	237	1,250	100	1,196	337	1,079	219	[13] 573	246	1,340
Pacific	330	340	311	314	311	330	249	285	279	254

SMALLPOX CASE RATES

101 cities	41	33	41	25	[2] 50	22	[3] 40	[4] 28	36	[5] 31
New England	0	0	0	0	0	0	0	0	0	0
Middle Atlantic	0	0	0	0	0	0	0	0	0	[6] 1
East North Central	33	28	18	15	23	21	[3] 19	[3] 34	26	[7] 33
West North Central	65	81	79	64	[2] 61	54	67	[8] 31	50	[9] 41
South Atlantic	50	60	65	45	99	53	48	54	60	[10] 53
East South Central	103	132	52	71	67	122	67	[11] 93	83	[12] 141
West South Central	142	63	133	50	193	50	142	71	137	46
Mountain	36	27	46	0	36	0	18	[13] 0	64	90
Pacific	193	94	244	105	300	13	260	94	163	84

TYPHOID FEVER CASE RATES

101 cities	7	9	5	8	[2] 10	9	[3] 8	[4] 8	6	[5] 7
New England	7	2	5	9	12	2	5	12	0	5
Middle Atlantic	4	10	2	1	4	5	7	8	4	[6] 6
East North Central	5	4	1	6	5	6	[3] 4	[3] 1	3	[7] 4
West North Central	6	10	2	8	[2] 0	10	4	[8] 5	2	[9] 0
South Atlantic	4	24	11	29	6	24	7	11	20	[10] 12
East South Central	5	31	10	25	10	41	5	[11] 35	21	[12] 22
West South Central	21	8	30	4	39	8	4	17	9	13
Mountain	18	0	18	18	146	9	146	[13] 0	9	9
Pacific	16	3	8	8	16	8	0	10	5	18

[2] Kansas City, Mo., not included.
[3] Madison, Wis., not included.
[4] Madison, Wis., Kansas City, Mo., Fargo, N. Dak., Covington, Ky., Mobile, Ala., and Denver, Colo., not included.
[5] Buffalo, N. Y., Fort Wayne, Ind., Topeka, Kans., Norfolk, Va., Columbia, S. C., and Covington, Ky., not included.
[6] Buffalo, N. Y., not included.
[7] Fort Wayne, Ind., not included.
[8] Kansas City, Mo., and Fargo, N. Dak., not included.
[9] Topeka, Kans., not included.
[10] Norfolk, Va., and Columbia, S. C., not included
[11] Covington, Ky., and Mobile, Ala., not included
[12] Covington, Ky., not included.
[13] Denver, Colo., not included.

Summary of weekly reports from cities, February 13 to March 19, 1927—Annual rates per 100,000 population, compared with rates for the corresponding period of 1926—Continued

INFLUENZA DEATH RATES

	Week ended—									
	Feb. 20, 1926	Feb. 19, 1927	Feb. 27, 1926	Feb. 26, 1927	Mar. 6, 1926	Mar. 5, 1927	Mar. 13, 1926	Mar. 12, 1927	Mar. 20, 1926	Mar. 19, 1927
95 cities	50	23	46	22	[2] 51	25	[3] 71	[14] 27	76	[15] 31
New England	2	9	19	12	12	9	24	12	45	19
Middle Atlantic	27	25	39	22	68	24	105	25	95	[6] 33
East North Central	11	19	14	17	14	23	[3] 32	[3] 16	65	[7] 18
West North Central	19	23	23	10	[2] 5	17	36	[8] 12	32	[9] 19
South Atlantic	138	31	96	42	47	48	78	72	51	[16] 82
East South Central	160	41	134	41	259	20	197	[11] 81	222	[12] 92
West South Central	278	39	212	26	124	39	97	47	146	22
Mountain	109	27	100	54	109	54	146	54	46	18
Pacific	95	17	35	17	32	17	21	7	18	14

PNEUMONIA DEATH RATES

95 cities	259	146	259	164	[2] 269	172	[3] 326	[14] 189	372	[15] 182
New England	175	102	165	183	186	202	217	188	356	172
Middle Atlantic	290	149	317	177	358	193	461	223	504	[6] 224
East North Central	181	120	179	146	206	134	[3] 289	[3] 159	355	[7] 143
West North Central	127	91	108	91	[2] 97	104	148	[8] 70	146	[9] 113
South Atlantic	490	239	454	257	342	234	303	278	352	[16] 263
East South Central	295	168	300	117	310	260	388	[11] 186	398	[12] 189
West South Central	516	207	353	164	362	185	238	159	260	190
Mountain	173	189	410	135	237	126	301	171	201	162
Pacific	173	176	141	131	117	121	92	148	99	93

[2] Kansas City, Mo., not included.
[3] Madison, Wis., not included.
[6] Buffalo, N. Y., not included.
[7] Fort Wayne, Ind., not included.
[8] Kansas City, Mo., and Fargo, N. Dak., not included.
[9] Topeka, Kans., not included.
[11] Covington, Ky., and Mobile, Ala., not included.
[12] Covington, Ky., not included.
[14] Madison, Wis., Kansas City, Mo., Fargo, N. Dak., Covington, Ky., and Mobile, Ala., not included.
[15] Buffalo, N. Y., Fort Wayne, Ind., Topeka, Kans., Norfolk, Va., and Covington, Ky., not included
[16] Norfolk, Va., not included.

Number of cities included in summary of weekly reports, and aggregate population of cities in each group, approximated as of July 1, 1926 and 1927, respectively

Group of cities	Number of cities reporting cases	Number of cities reporting deaths	Aggregate population of cities reporting cases		Aggregate population of cities reporting deaths	
			1926	1927	1926	1927
Total	101	95	30,438,500	30,960,600	29,778,400	30,289,800
New England	12	12	2,211,000	2,245,900	2,211,000	2,245,900
Middle Atlantic	10	10	10,457,000	10,567,000	10,457,000	10,567,000
East North Central	16	16	7,644,900	7,804,500	7,644,900	7,804,500
West North Central	12	10	2,585,500	2,626,600	2,470,600	2,510,000
South Atlantic	21	20	2,799,500	2,878,100	2,757,700	2,835,700
East South Central	7	7	1,008,300	1,023,500	1,008,300	1,023,500
West South Central	8	7	1,213,800	1,243,300	1,181,500	1,210,400
Mountain	9	9	572,100	580,000	572,100	580,000
Pacific	6	4	1,946,400	1,991,700	1,475,300	1,512,800

FOREIGN AND INSULAR

THE FAR EAST

Report for week ended March 12, 1927.—The following report for the week ended March 12, 1927, was transmitted by the eastern bureau of the health section of the secretariat of the League of Nations, located at Singapore, to the headquarters at Geneva:

Maritime towns	Plague		Cholera		Smallpox	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Arabia: Kamaran	0	0	0	0	1	0
Ceylon: Colombo	3	2	0	0	0	0
British India:						
Karachi	----	0	----	0	1	0
Bombay	----	2	----	0	52	31
Calcutta	----	0	----	41	238	179
Rangoon	----	0	----	1	30	6
Madras	----	0	----	1	20	----
Negapatam	----	0	----	0	3	2
Tuticorin	----	0	----	0	3	0
Siam: Bangkok	0	0	19	9	6	3
French Indo-China:						
Saigon	0	0	0	0	1	0
Hongkong	0	0	0	0	4	1
U. S. S. R.: Vladivostok	0	0	0	0	2	0
Manchuria:						
Mukden	0	0	0	0	1	0
Changchun	0	0	0	0	1	0
Kwantung: Dairen	0	0	0	0	2	1
Kenya: Mombasa	0	0	0	0	0	0

Telegraphic reports from the following maritime towns indicated that no case of plague, cholera, or smallpox was reported during the week:

ASIA

Arabia.—Aden, Jeddah, Perim.

Iraq.—Basrah.

Persia.—Mohammerah, Bender-Abbas, Bushire, Lingah.

British India.—Chittagong, Cochin, Vizagapatam.

Portuguese India.—Nova Goa.

Federated Malay States.—Port Swettenham.

Straits Settlements.—Penang.

Dutch East Indies.—Batavia, Sabang, Belawan-Deli, Pontianak, Semarang, Menado, Banjermasin, Cheribon, Pandang, Palembang, Balikpapan, Surabaya, Makassar, Samarinda.

Sarawak.—Kuching.

British North Borneo.—Sandakan, Jesselton, Kudat, Tawao.

Portuguese Timor.—Dilly.

French Indo-China.—Haiphong, Tourane.

Philippine Islands.—Manila, Iloilo, Jolo, Cebu, Zamboanga.

China.—Amoy, Shanghai.

Macao.

Formosa.—Keelung.

Chosen.—Chemulpo, Fusan.

Manchuria.—Harbin, Antung, Yingkow.

Kwantung.—Port Arthur.

Japan.—Yokohama, Nagasaki, Niigata, Hakodate, Shimonoseki, Moji, Tsuruga, Osaka, Kobe.

AUSTRALASIA AND OCEANIA

Australia.—Adelaide, Melbourne, Sydney, Brisbane, Rockhampton, Townsville, Port Darwin, Broome, Fremantle, Carnarvon, Thursday Island, Cairns.

New Guinea.—Port Moresby.

New Britain Mandated Territory.—Rabaul and Kokopo.

New Zealand.—Auckland, Wellington, Christchurch, Invercargill, Dunedin.

New Caledonia.—Noumea.

Fiji.—Suva.

Hawaii.—Honolulu.

Society Islands.—Papeete.

AFRICA

Egypt.—Port Said, Suez, Alexandria.

Anglo-Egyptian Sudan.—Port Sudan, Suakin.

Eritrea.—Massaua.

French Somaliland.—Djibouti.

British Somaliland.—Berbera.

Italian Somaliland.—Mogadiscio.

Zanzibar.—Zanzibar.

Tanganyika.—Dar-es-Salaam.

Seychelles.—Victoria.

Portuguese East Africa.—Mozambique, Beira, Lourenço Marques.

Union of South Africa.—East London, Port Elizabeth, Cape Town, Durban.

Reunion.—Saint Denis.

Mauritius.—Port Louis.

Madagascar.—Majunga, Tamatave.

Reports had not been received in time for publication from:

Dutch East Indies.—Tarakan.

Movement of infected ships:

Penang.—The S. S. *Ekma* arrived from Rangoon on March 6 infected with cholera.

Sandakan.—The S. S. *Tanda* arrived on March 13 from the Philippine Islands infected with smallpox.

The S. S. *Mausang* arrived on the same date from Hongkong also infected with smallpox.

Belated information:

Week ending March 5. Pondicherry and Karikal were free from plague, cholera, and smallpox.

CANADA

Communicable diseases—Week ended March 19, 1927.—The Canadian ministry of health reports cases of certain communicable diseases from seven Provinces of Canada for the week ended March 19, 1927, as follows:

Disease	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	Total
Cerebrospinal fever						2		2
Influenza	27			6				33
Poliomyelitis				1				1
Smallpox				20			27	47
Typhoid fever		1	471	10	1			483

Vital statistics—Quebec—January, 1927.—Births and deaths in the Province of Quebec for the month of January, 1927, were reported as follows:

Estimated population	2,604,000
Births	5,641
Birth rate per 1,000 population	25.99
Deaths (all causes)	3,006
Death rate per 1,000 population	13.85
Deaths under 1 year	920
Infant mortality rate	163.09
Deaths from—	
Accidents (all)	132
Cancer	125
Cerebrospinal meningitis	12
Diabetes	24
Deaths from—Continued.	
Diphtheria	52
Heart disease	374
Influenza	107
Measles	58
Pneumonia	378
Scarlet fever	15
Syphilis	9
Tuberculosis (pulmonary)	191
Tuberculosis (other forms)	46
Typhoid fever	26
Whooping cough	62

Typhoid fever—Montreal.—Information from the Canadian health authorities dated April 2 shows that from March 1 to April 1, 1927, inclusive, 1,750 cases of typhoid fever were reported in Montreal, Quebec, Canada. The number of cases was stated to be diminishing. An investigation to determine the source of the infection is being carried on. Pasteurization of milk in plants is carefully controlled by the health authorities.

GREAT BRITAIN (SCOTLAND)

Smallpox—Dundee—March 31, 1927.—Under date of March 31, 1927, 42 cases of smallpox were reported at Dundee, Scotland.

HAWAII TERRITORY

Rodent operations—Island of Hawaii—February, 1927.—During the month of February, 1927, rodent operations in the island of Hawaii were reported as follows:

Rodents exterminated	11, 859
Rodents examined	10, 868
Rodents found plague infected	0
Human plague	0

Last case of rodent plague, July 24, 1926; last case of human plague, October 6, 1926.

JAMAICA

Smallpox (Alastrim)—February 6–March 12, 1927.—During the period February 6 to March 12, 1927, 50 cases of smallpox, reported as alastrim, were notified in the Island of Jamaica, exclusive of Kingston.

Other communicable diseases.—During the same period other communicable diseases were reported in the Island of Jamaica as follows:

Disease	Cases		Disease	Cases	
	Kingston	Other localities		Kingston	Other localities
Cerebrospinal meningitis		1	Septicemia	1	
Chicken pox	1	34	Tuberculosis	10	48
Dysentery	2	13	Typhoid fever	13	77
Puerperal fever		1			

Population: Island—estimated—916, 620; Kingston—census—62,707.

MALTA

Communicable diseases—February 1–28, 1927.—During the month of February, 1927, communicable diseases were reported in the Island of Malta as follows:

Disease	Cases	Disease	Cases
Bronchopneumonia	12	Pneumonia	6
Chicken pox	3	Scarlet fever	2
Diphtheria	6	Trachoma	60
Erysipelas	3	Tuberculosis	20
Influenza	12	Typhoid fever	61
Lethargic encephalitis	1	Whooping cough	84
Malta fever	38		

Population—civil—estimated: 225,242.

MAURITIUS

Plague—December, 1926.—During the month of December, 1926, 22 cases of plague with 20 deaths were reported in the Island of Mauritius, occurring in the district of Pamplemousses, with three cases and three deaths, and in the town of Port Louis, with 19 cases and 17 deaths.

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UNION OF SOUTH AFRICA

Plague—Cape Province—Orange Free State—January 31–February 12, 1927—Cape Province.—A suspected outbreak at Vaalbank, Glen Grey district, reported for the week ended February 5, 1927, was confirmed for plague with a total to February 12, from date of outbreak, of eight fatal cases, in natives. *Orange Free State.*—In the Vredefort district, one case in a European and one fatal case in native, occurring on two farms; in Hoopstad district, one fatal case, native, on farm in Bultfontein area.

Smallpox—Typhus fever.—Fresh outbreaks of smallpox were reported in the Cape Province, in Wodehouse district, during the two weeks ended February 12, 1927. In the Orange Free State, in Frankfort district, typhus fever was reported present during the week ended February 12, 1927.

YUGOSLAVIA

Communicable diseases—February, 1927.—During the month of February, 1927, communicable diseases were reported in Yugoslavia as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Anthrax	12		Rabies	3	3
Cerebrospinal meningitis	7	5	Scarlet fever	377	70
Diphtheria	121	32	Tetanus	6	5
Dysentery	9	1	Typhoid fever	183	15
Influenza	146, 784	633	Typhus fever	22	1
Lethargic encephalitis	1	1	Whooping cough	248	6
Measles	1, 308	22			

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

The reports contained in the following tables must not be considered as complete or final as regards either the lists of countries included or the figures for the particular countries for which reports are given.

Reports Received During Week Ended April 8, 1927 [1]

CHOLERA

Place	Date	Cases	Deaths	Remarks
India:				
Calcutta	Feb. 6–12	37	27	
Rangoon	do	8	8	
Siam	do			Feb. 6–12, 1927: Cases, 58; deaths, 43. Apr. 1, 1926–Feb. 12, 1927: Cases, 8,040; deaths, 5,306.
Bangkok	do	7	3	

[1] From medical officers of the Public Health Service, American consuls, and other sources.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received During Week Ended April 8, 1927—Continued

PLAGUE

Place	Date	Cases	Deaths	Remarks
Ceylon:				
Colombo	Feb. 13-19	3		1 plague rodent.
India:				
Madras Presidency	Jan. 30-Feb. 5	72	49	
Rangoon	Feb. 6-12	4	4	
Java:				
Batavia	do	34	32	Province.
East Java and Madura	Jan. 21-27	1	1	
Madagascar				Jan. 1-15, 1927: Cases, 160; deaths, 153. Bubonic, cases 108; pneumonic, 25; septicemic, 27.
Ambositra Province	Jan. 1-15	9	9	
Antisirabe town	do	5	5	
Diego-Suarez Province	do	4	4	
Itasy Province	do	8	8	
Moramanga Province	do	29	27	
Tananarive Town	do	1	1	
Tananarive Province	do	104	99	
Mauritius				December, 1926: Cases, 22; deaths, 20.
Pamplemousses district	Dec. 1-31	3	3	
Port Louis	do	19	17	
Siam				Feb. 6-12, 1927: Cases, 2; deaths, 1. Apr. 1, 1926-Feb. 12, 1927: Cases, 37; deaths, 27.
Syria:				
Beirut	Feb. 1-10	1		
Union of South Africa:				
Cape Province—				
Glen Grey district—Vaalbank	Jan. 31-Feb. 12	8	8	Natives.
Orange Free State—				
Hoopstad district	Feb. 6-12	1	1	Native; on farm in Bultfontein Area.
Vredefort district	do	2	1	1 case in European; fatal case in native. On 2 farms.

SMALLPOX

Place	Date	Cases	Deaths	Remarks
Canada	Mar. 13-19	47		
Alberta	do	27		
Calgary	Feb. 27-Mar. 19	21		
Ontario	Mar. 13-19	20		
Ottawa	Mar. 20-26	1		
China:				
Canton	Dec. 1-31	5		Variola.
Chefoo	Jan. 23-Feb. 19			Present.
Chungking	Jan. 23-Feb. 5			Do.
Hongkong	Feb. 6-19	15	10	
Manchuria—				
Harbin	Feb. 7-13	1		
Shanghai	Feb. 20-26		1	Chinese. In foreign settlement.
Tientsin	Feb. 6-19	9		Reported by 1 mission hospital.
Great Britain:				
England and Wales	Feb. 20-Mar. 5	967		
Dundee	Mar. 31	42		
Newcastle-on-Tyne	Mar. 6-12	1		
India:				
Calcutta	Feb. 6-12	153	102	
Madras	Feb. 19-26	32		
Rangoon	Feb. 6-12	46	2	
Jamaica	Feb. 6-Mar. 12			Cases, 50; reported as alastrim.
Java:				
Surabaya	Jan. 21-27	2		
Mexico:				
San Luis Potosi	Mar. 6-12		5	
Persia:				
Teheran	Nov. 22-Dec. 23		5	
Portugal:				
Lisbon	Feb. 27-Mar. 5	3		
Senegal:				
Dakar	Feb. 28-Mar. 6	2		One case chicken pox reported.
Siam	Feb. 6-12	8	1	Apr. 1, 1926-Feb. 12, 1927: Cases, 739; deaths, 281.
Union of South Africa:				
Cape Province—				
Wodehouse district	Jan. 30-Feb. 12			Outbreaks.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received During Week Ended April 8, 1927—Continued

TYPHUS FEVER

Place	Date	Cases	Deaths	Remarks
Union of South Africa:				
Orange Free State—				
Frankfort district	Jan. 30-Feb. 5			Outbreaks.
Yugoslavia				February, 1927: cases 22; deaths, 1.

Reports Received from January 1 to April 1, 1927 [1]

CHOLERA

Place	Date	Cases	Deaths	Remarks
China:				
Canton	Nov. 1-30	10	3	
Chungking	Nov. 14-20			Present.
Do	Jan. 2-8			Do.
Tsingtao	Nov. 14-Dec. 11			Do.
Chosen	Sept. 1-Oct. 31	252	159	
French Settlements in India	Aug. 29-Dec. 18	131	97	
India	Oct. 10-Jan. 1			Cases, 20,298; deaths, 3,507.
Do	Jan. 2-22			Cases, 9,029; deaths, 5,063.
Bombay	Jan. 9-29	2	1	
Calcutta	Oct. 31-Jan. 1	385	313	
Do	Jan. 2-Feb. 5	315	244	
Madras	Dec. 26-Jan. 1	2	2	
Do	Jan. 2-8	8	6	
Rangoon	Nov. 21-Jan. 1	11	7	
Do	Jan. 2-Feb. 5	4	4	
Indo-China	July 1-31			Cases, 2,204; deaths, 1,350. European, 1.
Saigon	Oct. 31-Nov. 13	2	2	
Province—				
Annam	July, 1926	215	178	July, 1925: Cases, none.
Cambodia	do	571	352	1 European, fatal. July, 1925: Cases, 3.
Cochin-China	do	390	317	July, 1925: Cases, 6; deaths, 2.
Kwang-Chow-Wan	do	220		July, 1925: Cases, 22; deaths, 15.
Laos	do	24	21	July, 1925: Case, 1.
Tonkin	do	784	482	July, 1925: Cases, 3; death, 1.
Japan:				
Hiogo	Nov. 14-20	3		
Philippine Islands:				
Manila	Oct. 31-Nov. 6	1		
Russia	Aug. 1-Sept. 30	8		
Siam	Apr. 1-Jan. 1			Cases, 7,847; deaths, 5,164.
Do	Jan. 2-Feb. 5			Cases, 135; deaths, 99.
Bangkok	Oct. 31-Jan. 1	16	5	
Do	Jan. 9-Feb. 5	7	2	
Straits Settlements	July 25-Oct. 16		60	
Singapore	Nov. 21-Jan. 1	14	8	

PLAGUE

Place	Date	Cases	Deaths	Remarks
Algeria:				
Algiers	Reported Nov. 16	1		
Bona	Jan. 11-19	3	2	
Oran	Nov. 21-Dec. 10	32	22	
Tarafaraoul	Nov. 1-Dec. 9	10	9	Near Oran.
Angola:				
Benguela district	Oct. 1-Dec. 31	17	10	
Cuanza Norte district	Dec. 1-31	18	10	
Mossamedes district	Dec. 16-31	10		
Argentina	Jan. 9-15	5		
Azores:				
St. Michael's Island—				
Furnas	Nov. 3-17	4	1	27 miles distant from port.

[1] From medical officers of the Public Health Service, American consuls, and other sources.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received from January 1 to April 1, 1927—Continued

PLAGUE—Continued

Place	Date	Cases	Deaths	Remarks
Brazil:				
Porto Alegre	Jan. 23	2	2	
Rio de Janeiro	Nov. 28–Dec. 4	2	2	
Do	Dec. 26–Jan. 1	1	1	On vessel in harbor.
Do	Jan. 2–8	1		
Sao Paulo	Nov. 1–14	1	1	
British East Africa:				
Kenya—				
Kisumu	Jan. 16–22	1	1	
Tanganyika Territory	Nov. 21–Dec. 18		12	
Uganda	Sept. 1–Oct. 31	162	152	
Canary Islands:				
Atarfe	Dec. 20	1	1	Vicinity of Las Palmas.
Las Palmas	Jan. 8–Feb. 12	2		
San Miguel	do	1		Vicinity of Santa Cruz de Teneriffe.
Celebes:				
Makassar	Dec. 22			Outbreak.
Ceylon:				
Colombo	Nov. 14–Dec. 11	3	1	2 plague rodents.
Do	Jan. 2–Feb. 12	21	10	8 plague rodents.
China:				
Mongolia	Reported Dec. 21	500		
Nanking	Oct. 31–Dec. 18			Prevalent.
Ecuador:				
Guayaquil	Nov. 1–Dec. 31	26	8	Rats taken, 50,615; found infected, 184.
Do	Jan. 1–Feb. 15	43	10	Rats taken, 36,124; found infected, 129.
Egypt	Jan. 1–Dec. 9			Cases, 149.
Do	Jan. 1–28			Cases, 13.
Alexandria	Nov. 19–Dec. 2	2		
Charkia Provine	Jan. 5	1	1	At Zagazig (Tel el Kebir).
Gharbia Province	Jan. 4	1	1	
Kafr el Sheikh	Dec. 3–9	2		
Marsa Matrah	Dec. 23–29	10		
Do	Jan. 27	1		
Tanta district	Nov. 19–Dec. 20	3		
Greece	Nov. 1–30	10	1	Athens and Piræus.
Athens	Nov. 1–Dec. 31	9	4	
Patras	Nov. 28–Dec. 4		1	
Pravi	Nov. 27	1	1	Province of Drama-Kevalla.
India	Oct. 10–Jan. 1			Cases, 16,162; deaths, 9,905.
Do	Jan. 2–22			Cases, 4,535; deaths, 3,047.
Bombay	Nov. 21–27	1	1	
Do	Jan. 16–Feb. 12	4	4	
Madras	Oct. 31–Jan. 1	581	324	
Do	Jan. 2–29	435	276	
Rangoon	Nov. 14–Dec. 25	11	9	
Do	Jan. 2–Feb. 5	22	21	
Indo-China	July 1–31			Cases, 24; deaths, 10.
Province—				
Cambodia	July, 1926	6	6	July, 1925: Cases, 16; deaths, 13.
Cochin-China	do	8	4	July, 1925: No cases.
Kwang-Chow-Wan	do	10		July, 1925: Cases, 22; deaths, 15.
Iraq:				
Baghdad	Jan. 23–Feb. 5	2	1	
Java:				
Batavia	Nov. 7–Jan. 1	91	90	Province.
Do	Jan. 2–Feb. 5	123	118	
East Java and Madura	Dec. 19–Jan. 1	3	3	
Do	Jan. 2–22	4	4	
Surabaya	Oct. 24–Dec. 18	14	14	
Madagascar:				
Province—				
Ambositra	Dec. 16–31	10	10	
Analalava	Oct. 16–31	1	1	
Antisirabé	Dec. 16–31	2	2	
Itasy	Oct. 16–Dec. 31	39	39	
Maevatanana	Oct. 16–31	10	10	
Majunga	do	3	1	
Moramanga	Oct. 16–Dec. 31	92	67	
Tamatave	do	15	2	
Tananarive	do			Cases, 533; deaths, 497.
Town—				
Tamatave	Nov. 16–30	2		
Tananarive	Oct. 16–Dec. 31	48	34	

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received from January 1 to April 1, 1927—Continued

PLAGUE—Continued

Place	Date	Cases	Deaths	Remarks
Mauritius:				
Plaines Wilhems	Oct. 1-Nov. 30	3	3	
Port Louis	do	20	18	
Nigeria	Aug. 1-Nov. 30	999	902	
Peru	Nov. 1-Dec. 31			Cases, 90; deaths, 26.
Do	Jan. 1-31	47	10	
Departments—				
Ancash	Dec. 1-31	6	6	
Do	Jan. 1-31			Present.
Cajamarca	do	36	6	
Ica—				
Chincha	Nov. 1-30	1		
Lambayeque	do			Present in Province.
Chiclayo	do	3		
Do	Jan. 1-31	2		
Libertad	Dec. 1-31	2		
Do	Jan. 1-31	1		
Lima	Nov. 1-Dec. 31	42	14	
Do	Jan. 1-31	46	10	
Portugal:				
Lisbon	Nov. 23-26	3	2	In suburb of Balem.
Russia	May 1-June 30	44		
Do	July 1-Sept. 30	64		
Senegal	July 1-31	178	162	
Diourbel	Nov. 20-30	12	1	
Tivaouane	Dec. 19-25	6	2	In interior.
Siam	Apr. 1-Jan. 1			Cases, 30; deaths, 22.
Do	Jan. 16-Feb. 5			Cases, 5; deaths, 4.
Syria:				
Beirut	Nov. 11-Dec. 20	4		
Tunisia	Dec. 1-31			Cases, 43.
Do	Jan. 12-26			Cases, 34.
Acheche district	Feb. 11-14	14	14	Pneumonic.
Bousse	Jan. 12-26	8		
Djeneniana	Feb. 11-14	8		
Kairouan	do	3		
Mahares	do	15		
Sfax	Oct. 1-Dec. 31	304	128	
Turkey:				
Constantinople	Dec. 15-25	1		
Union of South Africa:				
Cape Province—				
Craddock district	Jan. 2-8	2	1	
De Aar district	Nov. 21-27	1		Native.
Hanover district	Nov. 14-Jan. 1	3	2	
Do	Jan. 2-8	1	1	
Middleburg district	Dec. 5-11	1	1	Do.
Orange Free State	do			Cases, 12; deaths, 2.
Bothaville district	Dec. 5-18	2	1	
Hoopstad district	Nov. 7-13	1	1	Native.
Do	Dec. 5-25	2	1	Do.
Do	Jan. 2-22	3		
Vredefort district	Dec. 19-25	10	5	First case occurred Dec. 1, 1926. Reported Dec. 17.

SMALLPOX

Algeria	Sept. 21-Dec. 31			Cases, 797.
Do	Jan. 1-20	86		
Algiers	Dec. 11-31	4		
Do	Jan. 1-Feb. 10	3		
Angola	Oct. 1-15			Present in Congo district.
Cuanza Norte	Nov. 1-15			Present.
Arabia:				
Aden	Dec. 12-18	1		Imported.
Belgium	Oct. 1-10	1		
Brazil:				
Bahia	Oct. 30-Dec. 18	12	8	
Para	Oct. 31-Nov. 6		1	
Do	Feb. 5-12		1	
Pernambuco	Oct. 17-Dec. 25	58	4	
Rio de Janeiro	Year 1926			Cases, 4,083; deaths, 2,180.
Do	Jan. 2-Feb. 12	51	25	
Sao Paulo	Aug. 23-Dec. 5	34	18	

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received from January 1 to April 1, 1927—Continued

SMALLPOX—Continued

Place	Date	Cases	Deaths	Remarks
British East Africa:				
Tanganyika Territory	Oct. 31-Nov. 20	2		
Do	Jan. 2-15	34	7	
Zanzibar	Oct. 1-31	23	12	
British South Africa:				
Northern Rhodesia	Nov. 27-Dec. 3			Cases, 200. In natives.
Bulgaria	Nov. 1-30	1		
Canada	Dec. 5-Jan. 1			Cases, 155.
Do	Jan. 2-Mar. 12			Cases, 416.
Alberta	Dec. 5-Jan. 1	132		
Do	Jan. 2-Mar. 12	120		
Calgary	Nov. 28-Dec. 25	12		
Do	Jan. 2-29	12		
Edmonton	Dec. 1-31	4		
Do	Jan. 1-31	5		
British Columbia—				
Vancouver	Jan. 31-Mar. 6	6		
Manitoba	Dec. 5-Jan. 1	9		
Do	Jan. 2-Mar. 12	20		
Winnipeg	Dec. 19-25	1		
Do	Jan. 2-Mar. 5	7		
New Brunswick	Feb. 13-26	2		
Ontario	Dec. 5-Jan. 1	96		
Do	Jan. 2-Mar. 12	229		
Kingston	Jan. 1-Feb. 19	3		
Ottawa	Dec. 12-31	5		
Do	Jan. 9-Mar. 19	5		
Toronto	Dec. 14-25	14		
Do	Jan. 1-Mar. 12	62	1	
Saskatchewan	Dec. 5-Jan. 1	18		
Do	Jan. 2-Mar. 12	45		
Regina	Jan. 16-22	1		
Chile:				
Concepcion	Dec. 26-Jan. 1		5	
China:				
Amoy	Jan. 1-15	1		
Canton	Nov. 1-30	1		
Chungking	Nov. 7-Dec. 25			Present.
Do	Jan. 2-31			Do.
Foochow	Nov. 7-Dec. 25			Do.
Hankow	Nov. 6-30			Do.
Hongkong	Jan. 23-Mar. 8	33	22	
Manchuria—				
Harbin	Dec. 16-31	3		
Mukden	Dec. 5-11	1		
Nanking	Dec. 12-25			Do.
Do	Jan. 2-15			Do.
Shanghai	Dec. 12-18		1	
Do	Jan. 30-Feb. 5		1	
Swatow	Nov. 21-27			Do.
Tientsin	Jan. 16-22	2		
Chosen	Aug. 1-Nov. 30	53	19	
Seoul	Nov. 1-30	2		
Egypt:				
Alexandria	Jan. 8-14	1		
Cairo	June 11-Aug. 26	27	4	
Estonia	Oct. 1-30	2		
France	Sept. 1-Dec. 31	293		
Paris	Dec. 1-31	10	3	
Do	Jan. 1-Feb. 20	17	3	
French Settlements in India	Aug. 29-Dec. 18	118	118	
Germany:				
Stuttgart	Nov. 28-Dec. 4	7		
Gold Coast	Aug 1-Nov. 30	59	14	
Great Britain:				
England and Wales	Nov. 14-Jan. 4			Cases, 2,262.
Do	Jan. 2-Feb. 19			Cases, 3,524.
Bradford	Jan. 9-22	2		
Cardiff	Feb. 13-19	1		
Monmouthshire	Feb. 25	22		
Newcastle-on-Tyne	Dec. 5-13	2		
Do	Jan. 2-Feb. 19	15		
Normanton	Dec. 30	1		9 miles from Leeds
Sheffield	Nov. 28-Jan. 1	60		
Do	Jan. 2-Mar. 5	484		
Wakefield	Jan. 30-Feb. 2	2		

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received from January 1 to April 1, 1927—Continued

SMALLPOX—Continued

Place	Date	Cases	Deaths	Remarks
Greece	Nov. 1-Dec. 31	25		
Athens	Dec. 1-31	14	2	
Guatemala:				
Guatemala City	Nov. 1-Dec. 31		15	
Do	Jan. 1-31		23	
India	Oct. 10-Jan. 1			Cases, 22,946; deaths, 6,000.
Do	Jan. 2-22			Cases, 14,228; deaths, 3,495.
Bombay	Nov. 7-Jan. 1	37	26	
Do	Jan. 2-Feb. 12	140	74	
Calcutta	Oct. 31-Jan. 1	449	311	
Do	Jan. 2-Feb. 5	561	422	
Karachi	Dec. 19-25	1	1	
Do	Jan. 2-Feb. 12	26	24	
Madras	Nov. 21-Jan. 1	32	2	
Do	Jan. 2-Feb. 19	131	6	
Rangoon	Nov. 28-Jan. 1	2	2	
Do	Jan. 2-Feb. 19	12	7	
Indo-China	July 1-31			Cases, 29; deaths, 10.
Province—				
Annam	July, 1926	6	3	July, 1925: Cases, 39; deaths, 7.
Cambodia	do	11	4	July, 1925: Cases, 62; deaths, 18.
Cochin-China	do	6	1	July, 1925: Cases, 12; deaths, 7.
Laos	do	3	1	July, 1925: Cases, none.
Tonkin	do	3	1	July, 1925: Cases, 31; deaths, 3.
Saigon	Dec. 26-Jan. 1	3		
Iraq:				
Baghdad	Oct. 31-Dec. 4	7	4	
Do	Jan. 23-29	1		
Basra	Nov. 7-13	1	1	
Italy	Aug. 29-Jan. 1	28		
Genoa	Dec. 30-31	1		
Do	Jan. 1-10	2		
Jamaica	Nov. 26-Jan. 1	37		Reported as alastrim.
Do	Jan. 2-Feb. 5	45		
Japan	Oct. 24-Dec. 25	25		
Kobe	Nov. 14-20	1		
Do	Jan. 23-Feb. 5	2		
Yokohama	Nov. 27-Dec. 3	2		
Java:				
Batavia	do	2		Province.
East Java and Madura	Dec. 17-25	1		
Do	Jan. 2-22	2	3	
Surabaya	Oct. 24-Nov. 27	10	1	
Lithuania	Nov. 1-30	2		
Luxemburg	Nov. 1-Dec. 31	2		
Mexico	July 1-Oct. 31		534	
Chihuahua	Dec. 31			Several cases; mild.
Do	Jan. 31-Feb. 6			Present.
Ciudad Juarez	Dec. 14-27		2	
Manzanillo	Mar. 5	6		
Mazatlan	Feb. 14-20		2	
Mexico City	Nov. 23-Dec. 25	6		Including municipalities in Federal District.
Do	Dec. 26-Feb. 26	5		Do.
Nuevo Leon State:				
Cerralvo	Mar. 11			Epidemic.
Montemorelos	Feb. 24			Reported present.
Monterey	do			About 60 cases reported in one hospital; other cases stated to exist.
Parral	Jan. 31-Feb. 6			Cases, 25. Unofficially reported.
Piedras Negras district	Feb. 25	68		At Nueva Rosita.
Saltillo	Feb. 6-12		1	
San Luis Potosi	Nov. 12-Dec. 18		3	
Do	Jan. 9-Mar. 5		17	
Tampico	Jan. 21-31	1		
Torreon	Nov. 28-Jan. 1		12	
Do	Jan. 2-Mar. 5		12	
Victoria	Feb. 24			Present.
Netherlands East Indies	Dec. 14			Island of Borneo; epidemic in two villages.
Nigeria	Aug. 1-Nov. 30	78	4	

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received from January 1 to April 1, 1927—Continued

SMALLPOX—Continued

Place	Date	Cases	Deaths	Remarks
Peru:				
Arequipa	Dec. 1-31		1	
Do	Jan. 1-31		1	
Laredo	Dec. 1			Severe outbreak; vicinity of Trujillo.
Poland	Oct. 11-Dec. 31			Cases, 32; deaths, 3.
Do	Jan. 1-8			Deaths, 1.
Portugal:				
Lisbon	Nov. 22-Jan. 1	43	4	
Do	Jan. 2-Feb. 26	22		
Rumania	Jan. 1-Sept. 30	7	1	
Russia	May 1-June 30	705		
Do	July 1-Sept. 30	884		
Senegal:				
Dakar	Jan. 9-15	1		
Siam	Apr. 1926-Jan. 1			Cases, 711; deaths, 268.
Do	Jan. 2-Feb. 5, 1927			Cases, 20; deaths, 12.
Bangkok	Oct. 31-Jan. 1	28	10	
Do	Jan. 2-Feb. 5	18	12	
Sierra Leone:				
Nanowa	Dec. 1-15	1		Pendembu district.
Spain	July 1-Sept. 30		9	
Valencia	Feb. 8-Mar. 5	4		
Straits Settlements:				
Singapore	Oct. 31-Jan. 1	12	2	
Do	Jan. 2-15	3	3	
Tunisia	Oct. 1-Dec. 31	9		
Do	Jan. 1-20	8		
Tunis	Jan. 1-10	1		
Turkey:				
Constantinople	Feb. 1-7		1	
Union of South Africa:				
Cape Province—				
Albany district	Jan. 23-29			Outbreaks.
Caledon district	Dec. 5-11			Do.
Steynsburg district	do			Do.
Stutterheim district	Nov. 21-27			Do.
Natal—				
Durban district	Nov. 7-27	9		Including Durban municipality. Total from date of outbreak: Cases, 62; deaths, 16.
Orange Free State	Nov. 14-27			Outbreaks.
Bothaville district	Nov. 21-27			Do.
Transvaal	Nov. 7-20	2		Europeans.
Bethal district	Jan. 23-29			Outbreaks.
Johannesburg	Nov. 14-20	1		
West Africa:				
French Guinea—				
Kissidougou	Feb. 19			Present.
French Sudan—				
Kayes	do			Do.
Yugoslavia	Nov. 1-Dec. 31	4	1	
Do	Jan. 1-31	3		

TYPHUS FEVER

Place	Date	Cases	Deaths	Remarks
Algeria	Sept. 21-Dec. 20	59	2	
Do	Jan. 1-20			Cases, 21.
Algiers	Feb. 1-20	12		
Argentina:				
Rosario	Dec. 1-31		1	
Do	Jan. 25-31		3	
Bulgaria	July 1-Dec. 31	39	5	
Chile:				
Concepcion	Jan. 23-29		1	
Valparaiso	Nov. 21-Dec. 25	6		
Do	Jan. 2-22	4	1	
China:				
Antung	Nov. 22-Dec. 5	4		
Chefoo	Oct. 24-Nov. 6			Present.
Chungking	Dec. 25-31			Do.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received from January 1 to April 1, 1927—Continued

TYPHUS FEVER—Continued

Place	Date	Cases	Deaths	Remarks
Chosen	Aug. 1-Nov. 30	43	2	
Seoul	Nov. 1-30	1		
Do	Jan. 1-31	2	1	
Czechoslovakia	Oct. 1-Dec. 31	10		
Egypt:				
Alexandria	Dec. 3-9		1	
Do	Jan. 22-28	1		
Cairo	Oct. 29-Nov. 4	1	1	
Estonia	Dec. 1-31	1		
France	Nov. 1-30	1		
Gold Coast	Sept. 1-30	1	1	
Greece	Nov. 1-30			Cases, 12.
Athens	Nov. 1-Dec. 31	19	2	
Do	Feb. 1-28	4		For all Greece: Cases, 5; deaths, 1.
Drama	Dec. 1-31	2		
Kavalla	do	2		
Patras	Jan. 23-29		1	
Ravokan	do	1		
Saloniki	Jan. 25-31	1		
Ireland:				
Clare County—				
Tulla district	Jan. 9-15	1		Suspect.
Italy	Aug. 29-Sept. 23	3		
Japan:				
Tokyo Prefecture	Dec. 5-25	9		
Tokyo city	do	5	1	
Lithuania	Sept. 1-Dec. 31	41	4	
Mexico	July 1-Oct. 31			Deaths, 534.
Aguascalientes	Jan. 9-Feb. 5	2		
Durango	Jan. 1-31		1	
Guadalajara	Jan. 25-31		1	
Mexico City	Dec. 5-11	3		Including municipalities in Federal district.
Do	Jan. 2-Mar. 5	58		Do.
Parral	Jan. 30-Feb. 5	1		
Nigeria	Sept. 1-30	1		
Palestine:				
Acre	Dec. 29-Jan. 3	1		
Beisan	Dec. 21-27	1		
Haifa	Nov. 23-Dec. 13	5		
Do	Dec. 28-Feb. 7	7		
Jaffa	Nov. 23-Dec. 27	7		
Do	Jan. 11-Feb. 21	3		
Majdal	Dec. 28-Jan. 3	1		
Nazareth	Nov. 16-Jan. 3	12		
Ramleh	Jan. 31-Feb. 7	1		
Safad	Dec. 21-Jan. 3	2		
Peru:				
Arequipa	Dec. 1-31		2	
Poland	Oct. 11-Dec. 25			Cases, 341; deaths, 27.
Do	Jan. 1-15			Cases, 115; deaths, 4.
Rumania	Aug. 1-Nov. 30	255	11	
Russia	May 1-June 30	6,043		
Do	July 1-Aug. 31	3,060		
Spain	July 1-Sept. 30		4	
Tunisia	Oct. 1-Dec. 27	30		
Do	Jan. 1-20	21		
Tunis	Jan. 21-31	1		
Turkey:				
Constantinople	Dec. 12-25	3		
Do	Jan. 16-22			1 death reported by press.
Union of South Africa	Oct. 1-Dec. 31			Cases, 233; deaths, 30.
Cape Province	do	47	7	
Do	Jan. 16-22			Outbreaks.
East London	Nov. 21-27	1		Native. Imported.
Port St. Johns district	Dec. 5-11			Outbreaks. On farm.
Natal	Oct. 1-31	1		
Orange Free State	Oct. 1-Dec. 31	31	2	
Do	Jan. 16-22			Outbreaks.
Transvaal	Oct. 1-31	1		
Yugoslavia	Nov. 1-Dec. 31	30	2	
Do	Jan. 1-31	43	3	

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued

Reports Received from January 1 to April 1, 1927—Continued

YELLOW FEVER

Place	Date	Cases	Deaths	Remarks
French Sudan	Dec. 19-25	1	1	
Gold Coast	Aug. 1-Nov. 30	10	5	
Nigeria	Sept. 1-Nov. 30	4	3	
Senegal	Dec. 19-25	3	3	
Diourbel	Dec. 6	1	1	
Do	Jan. 1-20	1	1	At N'Bake.
Guinguineo	Dec. 7	1	1	
Rufisque	Nov. 27-Dec. 29	2	1	In European.
Do	Jan. 2-8	3	3	
Upper Volta:				
Gaoua district	Oct. 25	2		

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